PROJECT MANUAL

FOR

PE COMPLEX REPLACEMENT BUILDING

1111 EAST ARTESIA BIVD.
COMPTON, CA 90221-5393

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COMPTON COLLEGE
COMPTON COMMUNITY COLLEGE DISTRICT

DSA SUBMITTAL V4

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END OF SECTION

SECTION 00 01 10 - TABLE OF CONTENTS

ROJECT TITLE PAGE

DIVISION 00 – PROCURMENT AND CONTRATTING REQUIREMENTS

DIVISION 01 - GENERAL REQUIREMENTS (By College)

DIVISION 32 - EXTERIOR IMPROVEMENTS

DIVISION 33 - UTILITIES

APPENDICES

END OF TABLE OF CONTENTS

DIVISION 01
GENERAL REQUIREMENTS

SECTION 01 45 25 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 – GENERAL

1.01 SUMMARY

A. SECTION INCLUDES

1. This Section specifies the requirements for test and balance of HVAC and related systems.

B. RELATED REQUIREMENTS

1. Section 01 11 00: Summary of Work.
2. Section 01 31 13: Project Coordination.
3. Section 01 32 13: Construction Schedule.
4. Section 01 33 00: Submittal Procedures.
5. Section 01 77 00: Contract Closeout.
6. Section 23 05 00: Common Work Results for HVAC.
7. Section 23 05 13: Basic HVAC Materials and Methods.
8. Section 23 05 48: HVAC Sound, Vibration and Seismic Control.
9. Section 23 09 00: HVAC Instrumentation and Controls.
10. Section 23 09 23: Environmental Control and Energy Management Systems (Only include when DDC Energy Management and Control Systems are provided).
11. Section 23 30 00: Air Distribution.
12. Section 23 50 00: Central Heating Equipment
13. Section 23 80 00: Heating, Ventilating and Air Conditioning Equipment.

PART 2 – PRODUCTS (Not used)

PART 3 – EXECUTION

3.01 DEFINITIONS AND APPLICABLE PUBLICATIONS

A. For the purposes of this Section definitions are as indicated in applicable publications of AABC, NEBB, TABB, ASHRAE, ANSI and SMACNA.

1. TAB: Testing, Adjusting and Balancing.

2. TABB: Testing, Adjusting and Balancing Bureau.

3. AABC: Associated Air Balance Council.

4. NEBB: National Environmental Balancing Bureau.

5. ASHRAE: American Society of Heating, Refrigerating and Air-Conditioning Engineers.

6. ANSI: American National Standards Institute.

7. SMACNA: Sheet Metal and Air Conditioning Contractors' National Association.

8. OAR: OWNER'S Authorized Representative

3.02 QUALITY ASSURANCE

A. The General Contractor shall contract directly with the test and balance agency. Tests performed by testing agencies contracted with the system's subcontractor will not be accepted. The qualifications of the agency shall comply with Article 3.02, Quality Assurance. The agency shall be responsible for furnishing labor, instruments, and tools required to test, adjust, and balance the heating, ventilating, and air conditioning (HVAC) systems and related plumbing systems, as described and/or as indicated in the Contract Documents.

B. CONTRACTOR shall obtain services of an independent, qualified testing agency acceptable to Architect to perform testing and balancing Work as specified and as follows:

1. Agency shall be currently certified by either the Associated Air Balance Council (AABC), the National Environmental Balancing Bureau (NEBB), or the Testing, Adjusting and Balancing Bureau (TABB). NEBB or TABB certification shall be for Air and Hydronic Testing, Adjusting and Balancing and Sound and Vibration Measurement.

2. Work shall be in accordance with the latest edition of the AABC, NEBB, or TABB National Standards. Where the requirements of the two standards are different, the more stringent requirements shall prevail. Also, if the Contract Documents impose a more stringent standard, then the Contract Documents shall prevail.

C. Performance Criteria: Work of this Section shall be performed in accordance with approved Testing, Adjusting, and Balancing agenda.

D. Test Equipment Criteria: Basic instrumentation requirements and accuracy/calibration required by Section Two of the AABC, Section II of the NEBB, or TABB Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems.

E. Verification: The Test and Balance Agency shall recheck 10 percent (minimum 10) of the measurements listed in the report. The locations shall be selected by PROJECT INSPECTOR or OAR. The recheck will be witnessed by PROJECT INSPECTOR or OAR. If 20 percent of the measurements that are retested differ from the report and are also out of the specified range, an additional 10 percent will be tested. If 20 percent fall outside the specified range, the report will be considered invalid and all test and balance work shall be repeated.

F. Due to more stringent acoustical requirements in the educational environment, the Test and Balance Agency shall recheck the air systems where the sound level is higher than the specified requirements and demonstrate compliance with the methodology specified in this document with emphasis on fan speed adjustment and balancing for optimum acoustical performance. The recheck will be witnessed by PROJECT INSPECTOR or OAR. When there are multiple air systems, a system selected by PROJECT INSPECTOR or OAR shall be rechecked. If this system is found to be not in compliance, a second system shall be checked. If the second system if also found to be not in compliance, the report will be considered invalid, and all test and balance work shall be repeated.

3.03 SUBMITTALS

A. Submit name of agency to perform the Work. Include in the submittal the certified qualifications of all persons responsible for supervising and performing actual Work of this Section. Agency shall submit a minimum of five commercial or industrial HVAC system TAB projects of similar type, size, and degree of difficulty completed within the last two years. Agency shall provide name and telephone number of contact person for each listed project.

B. Submit, for approval, 6 copies of the Agenda as indicated in Article 3.06 to test and balance all mechanical and relevant plumbing systems.

C. Preliminary Report: Review the Contract Documents, examine Work installations and submit a written report to ARCHITECT, PROJECT INSPECTOR and OAR indicating deficiencies in Work precluding proper testing and balancing of the Work.

D. Final TAB Report: Submit the final TAB report for review by ARCHITECT, PROJECT INSPECTOR, and OAR outlining the conditions and Work completed on each HVAC system. All outlets, devices, HVAC equipment, etc. shall be identified, along with a numbering system corresponding to report unit identification.

E. Submit an AABC “National Project Performance Guaranty” or “NEBB Quality Assurance Certification”, assuring the Project systems were tested, adjusted, and balanced in accordance with the Specifications and AABC, NEBB, or TABB National Standards.

F. CAD drawings: Submit single line, multi-color CAD drawings indicating outside return and supply air, volume control boxes, each outlet and inlet, room numbers, duct sizes at traverse locations, temperatures and pressures, systems balanced, components changed, and CONTRACTOR installed access points. In addition, drawings shall identify controls, equipment settings, including manual damper quadrant positions, manual valve indicators, fan speed control levers, and similar controls, and devices shall be marked on the drawings to show final settings. CAD files shall be submitted on CD-ROM upon final submittal of TAB report. Reports shall identify discrepancies between completed Work and the Contract Documents affecting the performance and longevity of the system.

3.04 GENERAL SCOPE OF WORK

A. The general scope of Work shall include but not be limited to the following:

1. Measure airflow rates of HVAC systems and make adjustments to achieve design airflow rates, tabulate results, and submit reports.

2. Measure water-flow rates of HVAC systems and make adjustments to achieve design water flow rates, tabulate results, and submit reports.

3. Measure flow velocities, temperatures, static pressures or head, rotational speed, and electrical power demand of fans, pumps, and other related HVAC system components, tabulate results, and submit reports.

4. Measure sound levels in each conditioned space, tabulate results, and submit reports.

5. Measure ambient sound levels of outdoor HVAC units and system components, tabulate results, and submit reports.

6. Reports shall contain sufficient data for the system designer to evaluate system performance and solve installation problems such as system pressure profiles and pressure drops across system components

3.05 SPECIFIC SCOPE OF WORK

A. The specific scope of Work shall include the following HVAC system components as indicated on the Drawings:

1. Air Handling Units.

2. Air Conditioning Units.

3. Heating and Ventilating Units.

4. Heating and Cooling Coils.

5. Supply, Return, Relief and Exhaust Fans.

6. Outside Air and Return Air Plenums.

7. Outside Air Intakes.

8. All Supply and Return Ductwork.

9. All associated Air Terminal Devices, i.e. Supply Diffusers, Return Registers, etc.

10. Mixing Boxes and Variable Air Volume (VAV) boxes.

11. Reheat Coils

12. Exhaust Duct Systems.

13. Fire and Fire/Smoke Dampers.

16. Heat Exchangers.

19. Boilers.

20. Chilled Water and Heating Hot Water pumps.

3.06 TESTING, ADJUSTING, AND BALANCING AGENDA

A. Provide proposed materials, methods, procedures, forms, diagrams, and reports for test and balance Work.

B. Agenda to be completed by the test and balance agency and submitted to ARCHITECT, PROJECT INSPECTOR, and OAR for review and approval.

C. Agenda shall include one complete set of AABC, NEBB, or TABB publications listed in Sub-paragraph 3.02.B.2, applicable publications, or, in case of other test and balance agencies and or organizations, comparable publications to establish an approved, systematic, and uniform set of procedures.

D. Agenda shall also include the following detailed narrative procedures, system diagrams, and forms for test results:

1. Specific standard procedures required and proposed for each system of the Work.

2. Specified test forms for recording each procedure and for recording sound and vibration measurements.

3. Systems diagrams for each air, water, and steam system. Diagrams may be single line.

E. In addition to information recorded for standard AABC, NEBB, or TABB procedures, the following information is required:

1. Fan data.

2. System number, location, manufacturer, model, and serial number.

3. Fan wheel type and size.

4. Motor horse power, type, and rpm.

5. Sheave size, type, number of grooves, and open turns on Variable Pitch Sheave.

6. Number and size of belts, motor and fan shaft sizes, center-to-center of shafts in inches, and adjustment available motor data, including nameplate data, actual amps, rated, and actual motor rpm, volts, phase, hp, kW, starter heater size, and capacity.

7. Fan design airflow and service (supply, return, outdoor air or exhaust).

8. Fan static pressure, suction/discharge, static profile, and static control point.

F. The following traverse data is required:

1. Traverse location, size of duct (inside dimensions), and area of duct in square feet.

2. Column for each hole traversed/lines for each reading.

3. Barometric pressure.

4. Temperature/Static pressure in the duct.

5. Actual CFM corrected to SCFM.

6. Notes.

G. The following air distribution data is required:

1. Room identification.

2. Outlet or intake balance sequence number.

3. Size of outlet or inlet.

4. AK Factor.

5. Design and Actual FPM and CFM.

6. Notes.

H. The following hydronic coil data is required:

1. Air flow through the coil in CFM.

2. Dry bulb and wet bulb temperatures entering/leaving coil.

3. Enthalpy or total heat differences in BTU/pound.

4. Capacity in BTU/hour at time of test.

5. Water temperature and pressure entering/leaving coil.

6. Flow (in GPM) through coil.

7. Air pressure drop across coil.

8. Water head drop across coil.

9. Notes.

I. The following DX coil data is required:

1. Air flow through the coil in CFM.

2. Dry and wet bulb temperatures entering/leaving coil.

3. Enthalpy or total heat difference across coil in BTU/ pound.

4. Capacity in BTU/hour at time of test.

5. Air pressure drop across coil.

6. Notes.

J. The following data is required for steam to water heat exchangers for heat and/or domestic generation:

1. Exchanger identification number.
2. Nameplate data; manufacturer, model, and serial number.
3. Temperature entering/leaving unit.
4. Flow through unit in GPM.
5. Pressure drop through unit.
6. Entering steam pressure.
7. Notes.

K. The following electric heating coil data is required:

1. Heating coil identification number.
2. Nameplate data; manufacturer, model and serial number.
3. Amperage/Voltage on each phase.
4. Phase, kW, and Stages.
5. Safety device installed.
6. Air pressure drop across coil.
7. Notes.

L. The following boiler and domestic water heater data is required:

1. Performance test results for rated capacity.
2. Boiler identification number.
3. Nameplate data; manufacturer, model, and serial number.
4. Water temperature entering/leaving the boiler.
5. Outside conditions: temperature, humidity, general cloud cover.
6. Barometric pressure.

M. The following air-cooled split system condensing unit data is required:

1. Performance test results for rated capacity.
2. Unit identification number.
3. Nameplate data, manufacturer, model, and serial number.
4. Compressor nameplate and actual amps, volts, phase, and hertz.

5. RPM of motors, where applicable.

6. Refrigerant type.

7. Suction/Discharge pressure when gage installed.

8. Number of stages.

9. Low-pressure/High-pressure control setting.

10. Condenser fan sequence stages.

11. Crankcase heater watts (nameplate).

12. Hot gas bypass installed - yes/no.

13. SCFM Air Flow Measurement vs. Design CFM.

N. The following air-cooled split system heat pump data is required:

1. Performance test results for rated heating and cooling capacities.

2. Unit identification number.

3. Nameplate data, manufacturer, model, and serial number.

4. Compressor nameplate and actual amps, volts, phase, and hertz.

5. RPM of motors, where applicable.

6. Refrigerant type.

7. Suction/Discharge pressure for both heating and cooling modes when gage installed.

8. Number of stages.

9. Low-pressure/High-pressure control setting.

10. Condenser fan sequence stages.

11. Crankcase heater watts (nameplate).

12. Hot gas bypass installed - yes/no.

13. SCFM Air Flow Measurement vs. Design CFM.

O. The following sound test data is required:

1. Area or location.

2. Sound level in dB(A) as specified in Article 3.19.

3. Sound level at the center band frequencies of eight non-weighted octaves with equipment on and off for 5 rooms selected by the OAR/PROJECT INSPECTOR.

4. Plot of corrected sound-level reading on Noise Criteria (NC) curve for the measurements in Q 3 above.

P. The following vibration test data is required:

1. Equipment identification number.

2. Vibration levels at all accessible bearings, motors, fans, pumps, casings, and isolators.

3. Measurements in mils deflection and velocity in inches per second.

4. Each measurement taken in horizontal, vertical, and axial planes as accessible.

Q. The following mixing damper leakage test data is required:

1. Equipment identification number (unit, box, zone, etc.).

2. Dry bulb temperature in the cold/hot (or bypass) deck.

3. Dry bulb temperature in the mixed air stream.

4. Calculated percent leakage.

5. Data above taken in the full cool and full heat (or bypass) mode.

6. Notes.

R. The following airflow station data is required:

1. Station identification number.

2. Nameplate data including effective area.

3. Differential test pressure or velocity.

4. Calculated CFM.

5. Actual CFM (from Pitot-tube traverse form).

6. Read out CFM.

7. Notes

S. The following unit heater data is required:

1. Equipment identification number.

2. Nameplate data; manufacturer, model, and serial number.

3. Test CFM (use manufacturer rated CFM if not ducted).

4. Heat test data per applicable procedure (hot water, electric, etc.).

5. Notes.

T. The following fan coil and unit ventilator data is required:

1. Equipment identification number.

2. Nameplate data; manufacturer, model, and serial number.

3. Tested supply CFM or manufacturer rated CFM if not ducted.

4. Tested outside air in CFM.

5. Motor data and actual amps and volts.

6. Cooling/Heating test data.

7. Static pressure.

8. Notes.

U. The following data for water-to-water heat exchangers for domestic and/or heating is required:

1. Exchanger identification number.

2. Nameplate data; manufacturer, model, and serial number.

3. GPM and Pressure drop through each side.

4. Capacity of each side.

5. Notes.

V. The following pump data, including but not limited to, chilled water, heating hot water, boiler feed, domestic hot water booster, domestic hot water circulation, sewage ejectors, sump pumps and domestic hot water booster is required:

1. Pump number.

2. Nameplate data; manufacturer, model, and serial number.

3. Motor data including nameplate data, actual amps, volts, RPM, horsepower, starter heater size, and capacity.

4. Pump discharge and suction pressure along with total dynamic head in the following modes.

5. Shut-off head FT, Wide open Head FT, and Final operating Head FT.

6. Final GPM Test plotted on a pump curve.

7. Notes.

W. The following water flow station data is required:

1. Station identification number.
2. Nameplate data; manufacturer, model, and serial number.
3. Design and actual GPM.
4. Differential test pressure.
5. Setting (open turns, degree, etc.) if required GPM.
6. Notes.

X. The following terminal box data is required:

1. Box identification number.
2. Node, address, or designation on system.
3. Box size.
4. Cooling CFM.
5. Minimum CFM (if applicable).
6. Heating CFM (if applicable).
7. Box fan amps and volts (if applicable).
8. For DDC controlled boxes, record computer readout maximum, minimum, and heat, along with box correction factor for calibrating to true CFM.
9. Notes.

3.07 PROCEDURES

A. Schedule the Work of this Section in order for test and balance activities to be completed prior to the date of Substantial Completion. CONTRACTOR shall place all heating, ventilating, and air conditioning equipment into operation during each day and until all HVAC adjusting, balancing, testing, demonstrations, and instructions on systems are completed. Agency shall prepare and submit reports within ten (10) days from completion of the Work of this Section to allow sufficient time for corrective measures to be completed before Substantial Completion of the Work. When an individual building or portion thereof is ready for occupancy, all equipment relative to such portion of Work shall be put into service, tested, and balanced.

B. Prior to the date of Substantial Completion, and upon completion of test and balance Work, place all exhaust fans in operation, force all air handling units, and air conditioning units into a 100 percent outdoor air economizer mode with heating and cooling locked out and flush the building continuously for a period of fourteen (14) days.

C. Coordinate test and balance procedures with any phased Project requirements so test and balance procedures on each phased portion of the Work will be completed prior to completion of said designated phase.

3.08 FIELD EXAMINATION

A. Before the commencement of test and balance Work, CONTRACTOR shall ascertain that following conditions are fulfilled:

1. Ensure that all water heating and water cooling systems have been flushed, cleaned, and filled and high points vented.

2. Boilers (hot water) are filled.

3. Refrigerant systems are fully charged with specified refrigerant.

4. Over-voltage and current protection have been provided for motors.

5. Equipment has been labeled as required.

6. Curves and descriptive data on each piece of equipment to be tested and adjusted are available as required.

7. Operations and maintenance manuals have been supplied.

8. Controls manufacturer and boiler-burner representatives shall be available for consultation and supervision of adjustments during tests.

9. Verify that heating and cooling coil fins are cleaned, combed and air filters clean, and installed.

10. Verify that duct systems are clean of debris and leakage is minimized, access doors are closed and duct end caps are in place, and fire and volume dampers are in place and open.

11. Automatic control systems are completed and operating.

12. Start up and initial commissioning of all HVAC equipment except fans shall be by the manufacturer.

B. In addition to the above, CONTRACTOR shall establish a specific, coordinated plan which details how each area of existing building will be balanced during the various phases of the Work. The evaluation shall address, at a minimum, the following concerns:

1. OWNER operations.

2. Building safety and security policies. Prior to any fire safety or security systems shutdown at any time during the Work, CONTRACTOR shall first advise and coordinate with OWNER to ensure all concerned parties are notified.

3. Protecting furniture, computers, photocopiers, and other office equipment.

4. Protecting classroom fixtures and equipment.

5. Concerns specific and unique to building related issues.

6. Downtime required for each Air Handling Unit including projected time to return each portion of the building back to its normal occupancy temperature and humidity.

7. Shutdown and reactivation of the fire alarm system to avoid accidental alarms during test and balance and related Work.

3.09 TEST AND BALANCE

A. For each heating, ventilating, or air conditioning system the following shall be performed, recorded, and submitted in an approved format for review. Make, type, and model of unit, and location of each piece of equipment shall be included in the report. Readings shall include but not be limited to following:

1. Air Systems**:**

a. General

1) Verify all ductwork, dampers, grilles, registers, and diffusers have been installed per design and set in the full open position. Agency shall perform the following TAB procedures in accordance with AABC or NEBB National Standards. Where the requirements of the two standards are different, the more stringent requirements shall prevail. Also, if the Contract Documents impose a more stringent standard then the Contract Documents shall prevail.

b. Zone, Branch, and Main Ducts:

1) Adjust ducts to within design CFM requirements by means of Pitot-tube duct traverse.

c. Supply Fans:

1) Fan Speeds: Test and adjust fan RPM to achieve maximum or design CFM. CONTRACTOR shall provide new belt pulleys when required.

2) Current and Voltage: Test and record motor voltage and amperage, and compare data with the nameplate limits. Ensure fan motor is not in or above the service factor as published by the motor manufacturer.

3) Pitot-Tube Traverse: Perform a Pitot-tube traverse of main supply and return ducts, record total CFM.

4) Outside Air: Test and adjust the outside air using Pitot-tube traverse.

5) Static Pressure: Test and record system static profile of each supply fan.

6) Current and Voltage: Test and record motor voltage and amperage, and compare data with the nameplate limits. Ensure fan motor is not in or above the service factor as published by the motor manufacturer.

d. Return, Relief, and Exhaust Fans:

1) Fan Speeds: Test and adjust fan RPM to achieve maximum or design CFM. CONTRACTOR shall provide new belt pulleys where required.

2) Pitot-Tube Traverse: Perform a Pitot-tube traverse of the main return ducts to obtain total CFM.

3. Static Pressure: Test and record system static profile of each fan.

e. VAV Systems:

1) Set volume regulators on all terminal boxes to meet design maximum and minimum CFM requirements.

2) Identification: Identify the type, location, and size of each terminal box. This information shall be recorded on terminal box data sheets.

f. Diffusers, Registers and Grilles:

1) Tolerances: Test and balance each diffuser, grille, and register to within 5 percent of design requirements.

2) Identification: Identify the type, location, and size of each grille, diffuser, and register. This information shall be recorded on air outlet data sheets.

g. Coils: Air Temperature: Once airflow is set to acceptable limits, agency shall take wet bulb and dry bulb air temperatures on the entering and leaving side of each cooling coil. Dry-bulb temperature shall be taken on the entering and leaving side of each heating coil.

h. Duct Leakage Testing:

1) On existing ductwork, agency shall calculate duct leakage by traversing the unit and reading associated diffusers.

2) On new installations each and every section of the entire air distribution system (all supply, return, exhaust, and relief ductwork) shall be tested at 1.5 times design static pressure. All ducts shall demonstrate 5 percent leakage maximum (per CBC).

i. Air Handling Units:

1) Prepare pressure profile and show design and actual CFM (outside air, return air, and supply air).

2) Measure and record each mode (minimum OA and 100 percent OA) where economizer cycle is specified.

3) Record pressure drops of all components (coils, filters, sound attenuators, louvers, dampers, and fans) and compare with design values.

4) Pressure profile and component pressure drops are performance indicators and are not to be used for flow measurements.

j. System Pressure Profiles:

1) Prepare pressure profiles from fan (supply, return, and exhaust) or air handling unit to extremities of system.

2) As a minimum, show pressure at each floor, main branch, and airflow measuring device.

3) Make pitot-tube traverses of all trunk lines and major branch lines where required for analysis of distribution system. Airflow measuring devices installed in ductwork, if available, may be utilized.

4) Record residual pressures at inlets of volume controlled terminals at ends of system.

5) Show actual pressures at all static pressure control points utilized for constant or variable flow systems.

k. Fan speed adjustments and balancing for optimum acoustical performance:

1) As the very first step, the speed of all fans (supply, return, and exhaust inside packaged equipment or air handling units) shall be adjusted to deliver the required fan total air quantity with all volume dampers and other flow rate control devices fully open. Adjustments shall be made with the outdoor air intake dampers, return air dampers, and relief air dampers in the minimum outdoor air position. The adjustments shall be made again in the 100 percent outdoor air position in systems with 100 percent outdoor air economizers.

2) The above adjustment shall be done with wet cooling coils, where cooling coils are provided.

3) The airflow rates at each branch duct shall be adjusted as the second step with air with all volume dampers and other flow rate control devices fully open.

4) The airflow rates at each air inlet and outlet shall be adjusted as the final step. The volume damper in the branch duct shall be used for balancing. Opposed blade dampers at air inlets and outlets where provided shall only be used for fine adjustments and shall not be closed beyond 60 percent open or when the dampers start to generate audible noise.

5) CONTRACTOR shall provide the labor and materials for all dampers, pulleys, and belt changes required for balancing. The design documents indicate the worst-case scenario with safety factors in fan static pressures for contingency. Properly coordinated and installed air systems may require a lower static pressure and a reduction in fan speed.

2. Water Systems: CONTRACTOR shall confirm all equipment, piping, and coils have been filled and purged, strainers are clean, and all balancing valves (except bypass valves) are set full open. Agency shall perform the following TAB procedures in accordance with the AABC, TABB, or NEBB National Standards:

B. Pumps:

1. Test and adjust chilled water, hot water, and condenser water pumps to achieve maximum or design GPM.

2. Measure and record suction and discharge pressures.

3. Check pumps for proper operation. Pumps shall be free of vibration and cavitation.

4. Current and Voltage: Agency shall test and record motor voltage and amperage and compare data with the nameplate limits. Ensure pump motor is not in or above the service factor as published by the motor manufacturer.

5. Adjust pump flow by adjusting and setting balancing valves to obtain amperage reading on a clamp-on ammeter that corresponds to amperage indicated on pump's curves for required flow.

6. Verify that the motor is not drawing more current than indicated on motor plate rating. When actual flows of primary pumps are found by test to vary more than 5 percent from specified amount, system shall be re-balanced to regulate flow within this tolerance. When a flow indicating device(s) is in circuit, it shall be used to verify pump flows.

7. When testing is completed, a pump capacity chart with pump number and location indicated shall be marked indicating operating point of pump on the curve. Chart shall then be included in the report.

C. Boilers: (Start-up and initial commissioning by manufacturer only.) Test and balance boilers only after test and balance of pumps have been completed. Boilers shall not be initially operated or tests performed with students or faculty on the Project site. Boilers shall be tested for the following:

1. Heating Hot Water Boilers and Domestic Hot Water Boilers:

a. Current and Voltage: Test and record motor voltage and amperage, and compare data with the nameplate limits. Ensure motor is not in or above the service factor.

b. Test and balance water flow through water boilers.

c. Test and record temperature and pressure profiles of water and/or steam boilers.

d. Upon completion of tests, controls and devices shall be returned to their normal operating condition and boiler shall remain in service.

D. Heat Exchangers:

1. Water to Water Heat Exchanger:

a. Primary Heating Water: Entering and leaving hot water temperatures, gpm flow, and pressure drop.

b. Secondary Heated Water: Entering and leaving hot water temperatures, gpm flow, pressure drop, and control set point.

E. Coils:

1. Tolerances: Test and balance all chilled-water and hot-water coils within 5 percent of design requirements.

2. Verify the type, location, final pressure drop, and GPM of each coil.

F. System Mains and Branches including chilled water, heating hot water, cooling tower water, domestic hot water and domestic cold water:

1. Balance water flow in pipes to achieve maximum or design GPM.

I. Heating Systems:

1. Heating Coils: Steam pressure at coils, cfm, coil pressure drop, entering and leaving air dry bulb temperatures.

2. Boilers:

a. Pressure, temperature, and quantity of feed-water (see Testing and Adjusting procedures).

b. Make, type, serial number, and rated capacity.

c. Flue gas temperature at boiler outlet ahead of back-draft diverter.

d. Percent carbon dioxide in flue gas.

e. Condensate quantities and temperatures.

3. Air Conditioning Units: (Start-up and initial commissioning by manufacturer only.)

a. Suction pressure and temperature.

b. Discharge pressure and temperature.

c. Amps and volts.

d. Make, type, and model of unit, capacity rating.

e. Ambient temperature: WB, DB.

f. Supply, return, relief, and exhaust fans shall be balanced as indicated in Section 3.09, A, 1, Air Systems.

g. Proper operation of controls: Temperature controllers and safety devices shall be tested during operating tests, with all other controls and devices, except one under test, being by-passed.

h. Upon completion of tests, controls and devices shall be returned to their normal operating condition and boiler shall remain in service.

4. Condensing and Refrigerating Units: (Start-up and initial commissioning by manufacturer only.)

a. Suction pressure and temperature.

b. Discharge pressure and temperature.

c. Amps and volts.

d. Make, type, and model of unit, capacity rating.

e. Ambient temperature: WB, DB.

f. Proper operation of controls: Temperature controllers and safety devices shall be tested during operating tests, with all other controls and devices, except one under test, being by-passed.

g. Upon completion of tests, controls and devices shall be returned to their normal operating condition and boiler shall remain in service.

5. Split System Heat Pump Units: (Start-up and initial commissioning by manufacturer only.)

a. Suction pressure and temperature.

b. Discharge pressure and temperature.

c. Amps and volts.

d. Make, type, and model of unit, capacity rating.

e. Ambient temperature: WB, DB.

f. Supply, return, relief and exhaust fans shall be balanced as indicated in Sub-paragraph 3.09.A.1, Air Systems.

g. Proper operation of controls: Temperature controllers and safety devices shall be tested during operating tests, with all other controls and devices, (except one under test) being by-passed.

h. Upon completion of tests, controls and devices shall be returned to their normal operating condition and boiler shall remain in service.

6. MISCELLANEOUS:

a. Electric Heaters:

1. Amperage.

2. Voltage.

3. Make, type, model, and name plate capacity rating.

3.10 VERIFICATION OF HVAC CONTROLS

A. Agency shall verify in conjunction with CONTRACTOR all control components are installed in accordance with the intent of the Contract Documents and are functioning according to the design intent, including all electrical interlocks, damper sequences, air and water resets, fire stats, and other safety devices.

B. CONTRACTOR shall verify all control components are calibrated and set for design operating conditions and intent.

3.11 TEMPERATURE TESTING

A. To verify system control and operation, agency shall perform a series of three temperature tests taken at approximately two hour intervals in each separately controlled zone. The resulting temperatures shall not vary more than two degrees Fahrenheit from the thermostat or control set point during the tests. Outside temperature and humidity shall also be recorded during the testing periods.

3.12 BUILDING/ZONE PRESSURIZATION

A. Agency shall test and adjust building/zone pressurization by setting the design flows to meet the required flow direction and pressure differentials. Positive/Negative area(s) supply air shall be set to design flow and exhaust air rates adjusted to obtain the required pressure differential(s).

3.13 FIRE AND SMOKE DAMPER TESTING

A. This work is to be performed by OWNER and State Fire Marshall. Do not include in agency scope of work.

3.14 LIFE SAFETY CONTROLS TESTING

A. This work is to be performed by OWNER and State Fire Marshall. Do not include in agency scope of Work.

3.15 FINAL TABULATION

A. After heating, ventilating, and air conditioning components are satisfactorily tested and balanced, entire system shall be put into operation and all pressures, temperatures, gpm, cfm, velocities, etc., shall be recorded and checked against design schedules. Design requirements shall be listed on reports and final tabulation shall be within a tolerance of plus or minus five percent of design requirements.

B. Readings at various locations as described herein will be made every hour for four (4) hours, during normal working hours for three (3) days. Boilers and, forced air furnaces shall be started up far enough in advance to meet design conditions during period of testing.

3.16 VIBRATION TESTING

A. Furnish instruments and perform vibration measurements if specified in Division 23. Provide measurements for all rotating HVAC equipment half horsepower and larger, including reciprocating/centrifugal/screw/scroll compressors, pumps, fans, and motors.

B. Record initial and final measurements for each unit of equipment on test forms. Where vibration readings exceed allowable tolerance and efforts to make corrections have proved unsuccessful, forward a separate report to ARCHITECT.

3.17 SOUND TESTING

A. Perform and record sound measurements as specified in this Section and in Section 23 05 48: HVAC Sound, Vibration and Seismic Control. Take additional readings if required by ARCHITECT.

B. Measuring equipment and methods shall comply with the current requirements of the AABC, NEBB, TABB and ANSI S12.60. Take measurements with a calibrated Type 1 sound level meter and octave band analyzer.

C. Sound reference levels, formulae, and coefficients shall be according to ASHRAE Handbook: HVAC Applications, Chapter on Sound and Vibration Control.

D. Where sound pressure levels are specified as noise criteria or room criteria in Section 23 0548: HVAC Sound, Vibration and Seismic Control determine compliance with the Contract Documents as follows:

1. Reduce background noise as much as possible by shutting off unrelated audible equipment.

2. Measure octave band sound pressure levels with specified equipment "off".

3. Measure octave band sound pressure levels with specified equipment "on".

4. Use difference in corresponding readings to determine sound pressure due to equipment. Sound pressure level, due to equipment equals sound pressure level with equipment "on" minus factor.

DIFF.:	0	1	2	3	4	5	9-10 or More
FACTOR:	10	7	4	3	2	1	0

5. Plot octave bands of sound pressure level due to equipment for typical rooms, on a graph, which also shows, noise criteria (NC) curves.

E. Where sound levels are required in dbA, measure sound levels using the A-frequency-weighting of meter. Single value readings will be used instead of octave band analysis.

F. Measure sound levels at each octave band as NC or RC (room criteria) if indicated in the Drawings or other Spec Sections. Where measured sound levels exceed specified level, CONTRACTOR shall take all remedial action and necessary sound tests shall be repeated. Sound tests after remedial action shall be in octave band in NC or RC for the room and also at each diffuser, grille, or register in occupied areas. Sound levels shall be measured approximately five feet above floor on a line approximately 45 degrees to center of opening, on the A- and C-frequency-weighting of the measuring instrument.

G. Measure and record sound levels in decibels for each room per current ANSI S12.60.

H. Report shall include ambient sound levels, taken without air-handling equipment operating, of rooms in which above openings are located. A report shall also be made of any noise caused by mechanical vibration.

END OF SECTION

COMPTON COMMUNITY COLLEGE DISTRICT

TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section specifies requirements for temporary services and facilities, including utilities, construction and support facilities, security and protection.

B. Temporary utilities required include but are not limited to:

1. Water service and distribution.

2. Temporary electric power and light.

3. Telephone service with separate Fax line.

4. Storm and sanitary sewer.

C. Temporary construction and support facilities required include but are not limited to:

1. Temporary heat.

2. Field offices and storage sheds.

3. Sanitary facilities, including drinking water.

4. Temporary enclosures.

5. Temporary Project identification sign.

6. Waste disposal services.

D. Security and protection facilities required include but are not limited to:

1. Temporary fire protection. Coordination of Fire Watch.

2. Barricades, warning signs.

3. Environmental protection.

4. Temporary security fencing when required and in compliance with the Phase temporary fencing provided by Bid Package xx.

1.2 SUBMITTALS

A. Temporary Utilities: Submit reports of tests, inspections, meter readings and similar procedures performed on temporary utilities.

1.3 RELATED WORK

A. All equipment furnished by subcontractors shall comply with all requirements of pertinent safety regulations. The ladders, planks, hoists, and similar items normally furnished by the individual trades in execution of their own portions of the work are not part of this section.

B. Permanent installation and hook-up of the various lines are described in the other pertinent sections.

1.4 QUALITY ASSURANCE

A. Regulations: Comply with industry standards and applicable laws and regulations of authorities having jurisdiction, including but not limited to:

1. Building Code requirements.

2. Health and safety regulations.

3. Utility company regulations.

4. Police, Fire Department and Rescue Squad rules.

5. Environmental protection regulations.

B. Standards: Comply with NFPA Code 241, "Building Construction and Demolition Operations", ANSI-A10 Series standards for "Safety Requirements for Construction and Demolition", and NECA Electrical Design Library "Temporary Electrical Facilities."

1. Refer to "Guidelines for Bid Conditions for Temporary Job Utilities and Services", prepared jointly by AGC and ASC, for industry recommendations.

2. Electrical Service: Comply with NEMA, NECA and UL standards and regulations for temporary electric service. Install service in compliance with National Electric Code (NFPA 70).

C. Inspections: Arrange for authorities having jurisdiction to inspect and test each temporary utility before use. Obtain required certifications and permits.

1.5 PROJECT CONDITIONS

A. Conditions of Use: Keep temporary services and facilities clean and neat in appearance. Operate in a safe and efficient manner. Take necessary fire prevention measures. Do not overload facilities, or permit them to interfere with progress. Do not allow hazardous dangerous or unsanitary conditions, or public nuisances to develop or persist on the site.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Provide new materials; if acceptable to the Architect/Engineer, undamaged previously used materials in serviceable condition may be used. Provide materials suitable for the use intended.

B. Water: Provide potable water approved by local health authorities.

2.2 FIELD OFFICE

A. Provided by this Bid Package; Provide on-site, adequate field space for use by construction forces, the District Inspector, and the Architect during the time construction is in progress. The offices shall be conveniently located and shall be watertight and waterproof, clean, insulated, heated, cooled, lockable, provided with windows to give adequate light and ventilation, have electrical service outlets, and have a floor. Minimum size of temporary site construction is 360 square feet.

1. The Contractor shall provide and pay for separate telephone service for phone and fax machine. Telephone and fax machines are to be on separate telephone line.

2. Equip with a minimum of one desk and a layout table. Equip with additional folding chairs for field meetings.

3. The offices, equipment, and furniture shall remain the property of the Contractor and shall be removed by contractor upon completion of work.

4. A complete set of approved plans and specifications shall be kept in the office at all times.

B. Inspectors Field Office: Contractor is required to provide for the use of the School District's Inspector a temporary office space to be located as directed by the Inspector and to be maintained until removal is authorized by the School District. Space is to have a lockable separate room area with a table for plans and a desk with two chairs. At least one entrance to Inspector office space is to be from the outside and not through the Contractors field office space. Provide and pay for high speed internet service. Maintain for Inspector until completion of the Contract.

2.3 TOILET FACILITIES

A. Provided by Each Bid Package for their personnel; Provide, install and maintain, for during of the work, temporary outside toilet facilities for use of construction personnel. Toilet facilities shall be constructed, maintained and supplied as required for the numbers of construction personnel required, and according to local regulations.

2.4 FIRST AID

A. Maintain such first aid supplies as may be required for minor accidents. Make arrangements with local emergency center and nearest hospital to receive cases requiring medical attention, including emergencies. Such information shall be conspicuously displayed at the construction office.

2.5 WATCHMAN SERVICES

A. Provided by this Bid Package; The Contractor shall provide such watchman services as he may deem necessary to properly safeguard materials, tools, appliances, and work during all hours that operations under the Contract are not actively proceeding. The District will not assume any responsibility for the loss of or damage to materials, tools, appliances or work arising from acts of theft, vandalism, malicious mischief, or other causes.

2.6 FIRE PROTECTION

A. Provide fire extinguisher on the premises during the course of construction of the type and sizes recommended by the NBFU to control fires resulting from the particular work being performed. Instruct employees in their use. Place extinguisher in the immediate vicinity of the work being performed, ready to be used.

B. During the use of hazardous equipment such as acetylene torches, welding equipment, bitumen kettles, salamanders and similar devices, no work shall be commenced or equipment used unless fire extinguisher of an approved type and capacity are placed in the working area and available for use by the workmen using such hazardous equipment.

C. Provide fire extinguisher conforming to the requirements, as minimums, of NFPA 10 and 241.

2.7 SAFETY AND PROTECTION

A. Provided by this Bid Package the Contractor shall furnish and erect temporary or permanent fences around the areas, as indicated on the drawings, and elsewhere where required for protection of the work, and to prevent unauthorized persons from entering the construction area. Temporary fences shall be at least eight feet (6'-0") above grade, of chain link or other substantial construction. Necessary gates for access to the site shall be placed where directed by the School District.

B. Furnish or construct barricades, lights and other guards about the work area that may be required by local ordinance or for public safety and necessity. Protect all work from vandalism.

2.8 TEMPORARY UTILITY SERVICES

A. Provided by this Bid Package; Power and Lighting: Furnish, install and maintain temporary wiring, poles, meter board, service entrance switch, lamps and equipment necessary to provide temporary lighting and power for the construction site.

1. Temporary power is available from location as directed by the Power Company.

2. Any temporary transmission lines required shall be installed by Contractor.

3. Provide power sources within eighty feet of any working position to allow the use of one hundred foot extension cords.

B. Water: Install required temporary connections to existing water. Locate temporary pipelines so that they do not interfere with traffic or drainage. Design and construct such pipelines so that they do not leak or cause damage or nuisance.

1. Upon completion of work, remove all temporary piping.

2.9 HEAT AND VENTILATION

A. Provide temporary heat and ventilation as required to maintain adequate environmental conditions to facilitate the progress of the work, to meet specified minimum conditions for the installation of materials, and to protect materials and finishes from damage due to temperature and humidity.

1. Pay costs of installation, maintenance, operation and removal, and fuel consumed.

2.10 CONSTRUCTION AIDS

A. Provide construction aids and equipment required by personnel and to facilitate the execution of the work; scaffolds, staging, ladders, stairs, ramps, runways, platforms, railings, hoists, cranes, chutes and other such facilities and equipment.

B. Provide all necessary facilities and means of access to all parts of the structure so that Governmental Agency Inspectors, Special Inspectors and the Architect and Structural Engineer may inspect any portion of the structure.

1. Means of access includes, but is not limited to, ladders, and/or scaffolds.

2.11 ACCESS ROADS AND PARKING AREAS

A. Prior to starting work, the Contractor, District and the Architect or his representative shall make a thorough survey of the site and approaches thereto. The Contractor will maintain temporary access roads required to perform the work and locate construction offices at locations approved by the Architect/Engineer and the District. The Contractor shall verify all grade elevations indicated on the Drawings at the site and immediately notify the Architect/Engineer if any

deviations are found. The Contractor shall assume all responsibility if any work proceeds without such notification.

B. Maintain specific vehicular access as required for the orderly progress of the work. Fill, compact and grade areas as necessary to provide suitable support during all weather conditions for anticipated loads including municipal fire apparatus. Provide adequate surface drainage and do not interrupt natural flow of existing drainage.

C. Provide designated parking areas for use by construction personnel.

D. Restore temporary vehicular access and parking areas to original or to specified conditions at completion of work.

2.12 TEMPORARY CONTROLS

A. Provide and maintain methods, equipment, and temporary construction, as necessary to provide controls over environmental conditions at the construction site and related areas under Contractor's control; remove physical evidence of temporary facilities at completion of work.

B. Dust Control: Provide positive methods and apply dust control materials and methods to minimize raising dust from construction operations. Provide positive means to prevent air-borne dust from dispersing into the atmosphere.

C. Water Control: Provide methods to control surface water to prevent damage to the Project, the site, or adjoining properties.

1. Control fill, grading and ditching to direct surface drainage away from excavations, pits, tunnels, and other construction areas; and to direct drainage to proper runoff.

2. Provide, operate and maintain hydraulic equipment of adequate capacity to control surface water.

3. Dispose of drainage water in a manner to prevent flooding, erosion, or other damage to any portion of the site or to adjoining areas.

D. Pollution Control:

1. Provide methods, means and facilities required to prevent contamination of soil, water or atmosphere by the discharge of noxious substances from construction operations.

2. Provide equipment and personnel; perform emergency measures required to contain any spillages, and to remove contaminated soils or liquids.

E. Excavate and dispose of any contaminated earth off-site, and replace with suitable compacted fill and topsoil.

1. Take special measures to prevent harmful substances from entering public waters and atmosphere.

a. Prevent disposal of wastes, effluent, chemicals, or other such substances in sanitary or storm sewers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Use qualified personnel for installation of temporary facilities. Locate facilities where they will serve the Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required.

B. Provide each facility ready for use when needed to avoid delay. Maintain and modify as required. Do not remove until facilities are no longer needed, or are replaced by authorized use of completed permanent facilities.

3.2 TEMPORARY UTILITY INSTALLATION

A. General: Engage the appropriate local utility company to install temporary service or connect to existing service. Where the company provides only part of the service, provide the remainder with matching, compatible materials and equipment; comply with the company's recommendations.

1. Arrange with the company and existing users for a time when service can be interrupted, where necessary, to make connections for temporary services.

2. Provide adequate capacity at each stage of construction. Prior to temporary utility availability, provide trucked-in services.

3. Obtain easements to bring temporary utilities to the site, where the Owner's easements cannot be used for that purpose.

4. Use Charges: Cost or use charges for temporary facilities are not chargeable to the Owner or Architect, and will not be accepted as a basis of claims for a Change Order.

B. Water Service: Install water service and distribution piping of sizes and pressures adequate for construction until permanent water service is in use. Water may be taken from existing site water supply.

1. Sterilization: Sterilize temporary water piping prior to use.

C. Temporary Electric Power Service: Provide weatherproof, grounded electric power service and distribution system of sufficient size, capacity, and power characteristics during construction period. Include meters, transformers, overload protected disconnects, automatic ground-fault interrupters and main distribution switch gear.

3.3 PROJECT IDENTIFICATION AND SIGNS

A. Project Identification and Temporary Signs: Prepare project identification and other signs of the size indicated; install signs where indicated to inform the public and persons seeking entrance to the Project. Support on posts or framing of preservative treated wood or steel. Do not permit installation of unauthorized signs.

B. Provide temporary on-site informational signs.

1. As required by codes, laws and regulatory agencies.

2. To identify key elements of the construction facilities.

3. To direct traffic.

C. Project Identification Sign: Size, design and information lettered as specified and as shown on drawing located at the end of this section. Finish with 3 coats of paint. Locate sign as indicated or directed by the Architect and School District.

3.4 OWNERSHIP OF TEMPORARY FACILITIES AND CONTROLS

A. Items provided by the Contractor under this section shall remain the property of the Contractor and shall be removed from the job site immediately upon completion of the work.

3.5 COLLECTION AND DISPOSAL OF WASTE

A. Collect waste from construction areas and elsewhere daily. Comply with requirements of NFPA 241 for removal of combustible waste material and debris. Enforce requirements strictly. Do not hold materials more than 7 days during normal weather or 3 days when the temperature is expected to rise above 80 deg F (27 deg C). Handle hazardous, dangerous, or unsanitary waste materials separately from other waste by containerizing properly. Dispose of material in a lawful manner.

3.6 OPERATION, TERMINATION AND REMOVAL

A. Termination and Removal: Unless the Architect requests that it be maintained longer, remove each temporary facility when the need has ended, or when replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with the temporary facility. Repair damaged Work, clean exposed surfaces and replace construction that cannot be satisfactorily repaired.

1. Materials and facilities that constitute temporary facilities are property of the Contractor. The School District reserves the right to take possession of Project identification signs.

END OF SECTION

SECTION 01 57 23 - STORM WATER POLLUTION CONTROL

PART 1 – GENERAL

1.1 SUMMARY

A. This section includes the following:
   1. Requirements for compliance with the Storm Water Pollution Prevention Plan (SWPPP) developed specifically for this Project are the responsibility of the Contractor.
      a. SWPPP satisfies the mandates of Federal Clean Water Act as enforced by State of California Water Resources Control Board and its Regional Water Quality Boards.
      b. In accordance with the State Water Resources Control Board's (SWRCB) General Construction Activities Storm Water Permit, Order No. 2009-0009-DWQ, NPDES No. CAS000002, the SWPPP Major objective is to:

         (1) Identify the sources of sediment and other pollutants that affect the quality of storm water discharges

         (2) Describe and ensure the implementation of Best Management Practices, (BMPs) to reduce or eliminate sediment and other pollutants in storm water as well as non-storm water discharges.

B. Related Sections
   1. Contractor shall retain a California State Certified Qualified SWPPP Practitioner (QSP) to implement and maintain the SWPPP and file all necessary documents to the State.
   2. SWPPP requires compliance of all trades on Project that use or manipulate materials of any nature which can potentially enter storm-water drainage system.
   3. Representative materials controlled by the SWPPP include erosion of native soils and fill materials, groundwater, leakage or spills from construction vehicles and machinery, stored fuels, concrete truck washout, chemical treatments, curing, compounds, paints, plasters, paving materials, adhesives and sealants, trash and general construction debris, pesticides, fertilizers, and any other material which can be carried by running water or percolate into earth.

1.2 SUBMITTALS

A. Provide name and certification documents of the Qualified SWPPP Practitioner (QSP).

B. Trough the entirety of construction, prepare inspection reports, rain gauge readings, stormwater sampling and analysis, bio assessment reports, Annual Reports and submit through the State's Storm Water Multiple Application and Report Tracking System (SMARTS) as required by the General Construction Permit.

C. Closeout Submittals: Submit to owner documentation certifying compliance with the SWPPP, site monitoring reports, and notification of Agencies of completion of operations as required by the General Construction Permit.

D. Provide a Rain Event Action Plan (REAP) if project is considered a RISK LEVEL 2 or 3. REAP shall be prepare by the project QSP.

E. SWPPP plan.
1. The SWPPP will be prepared by a Qualified SWPPP Developer (QSD) certified by the RWQCB, as required by the General Construction Permit.
2. Implementation and report processing of the SWPPP shall be conducted by a Qualified SWPPP Practitioner as required by the General Construction Permit.

1.3 REGULATORY BACKGROUND

A. As required by Federal Water Pollution Control Act (Clean Water Act) and regulations of U.S. Environmental Protection Agency and of State of California Water Resources Control Board current General construction Permit, any construction activity of ONE acre or more must be covered by National Pollutant Discharge Elimination System (NPDES) permit.

B. The Act further decrees fines of as much as $37,500 per day per violation.

C. It is implicit that SWPPP satisfies requirements of NPDES permit.

D. If Owner is cited for violation of Clean Water Act due to failure of SWPPP to address requirement, Contractor shall be liable for any fines or penalties that might be imposed by regulatory agency, he shall be obligated to perform mandated corrective measures at his own expense.

E. If Owner, Architect, or Owner's Inspector becomes aware of violations of SWPPP, they will immediately inform Contractor in writing. Contractor shall immediately cease violation and shall restore site, at his own expense, to same conditions it was in before violation, to approval of Owner.

F. Should Contractor continue to violate requirements of SWPPP, or refuse to comply, or refuse to repair results of violation to Owner's approval, for purposes of this Contract it shall be considered as any other violation of Contract. Owner will take necessary measures as set forth in General Conditions.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Provide all temporary and permanent Best Management Practices (BMP’s) storm water pollution prevention equipment, material, and facilities as required by or as necessary to comply with the SWPPP and meet the General Construction Permit requirements.

PART 3 - EXECUTION

3.1 IMPLEMENTATION

A. Measures required in SWPPP shall be executed as dictated by SWPPP itself.

B. Legally Responsible Person (LRP) authorized by the Owner shall file Notice of Intent and obtain project WDID number.

C. Contractor shall not commence construction until a Notice of Intent has been filed to the State and project WDID number has been issued.
   1. Concurrent with commencement of construction activities, Contractor shall implement and retain at project site, the Storm Water Pollution Prevention Plan and a monitoring program and reporting plan throughout construction in accordance with the General Permit.

D. Contractor shall be responsible for paying the necessary permit fees and complying with State Water Resources Control Board Order No. 2009-009-DWQ, implementing provisions of the Clean Water Act relating to storm water discharges.

E. The plan will address all potential sources of pollutants which may enter the storm water system, it must explain what steps will be taken during construction to minimize the risk of storm water contamination and must address management procedures to be utilized during construction to prevent pollution discharges such as spills, leaking, and dumping.

F. A copy of said plan shall be provided to owner and upon request contractor shall certify, in writing, compliance with the relevant rules, regulations and laws.
Additional information regarding State Water Resources Control Board requirements can be obtained from State Water Resources Control Board, Division of Water Quality:

Attention: Storm Water Permit Unit,
P.O. Box 1977, Sacramento, CA 95812-1977.
Telephone Number (916) 657-1146.

G. During construction, make changes as necessary for proper functioning of SWPPP measures. Notify QSP on recommended changes.

H. At completion of work, Contractor shall remove temporary SWPPP measures and dispose of any pollutants in legal manner offsite, or as otherwise required by SWPPP

3.2 PERFORMANCE

A. Minimum Water Quality Protection Requirements
   1. The Contractor is required to meet the following minimum standards of good housekeeping:
      a. Eroded sediments and other pollutants must be retained on site and may not be transported from the site via sheet flow, swales, area drains, natural drainage, or wind.
      b. Stockpiles of earth and other construction-related materials must be protected from being transported from the site by wind or water.
      c. Fuels, oils, solvents, and other toxic materials must be stored in accordance with their listing and are not to contaminate the soil nor the surface waters. All approved toxic storage containers are to be protected from the weather. Spills must be cleaned up immediately and disposed of in a proper manner. Spills may not be washed into the drainage system.

d. Excess or waste concrete may not be washed into the public way or any drainage system. Provisions shall be made to retain concrete wastes on-site until they can be appropriately disposed of or recycled.
e. Trash and construction-related solid wastes must be deposited into a covered receptacle to prevent contamination of rainwater and dispersal by wind.
f. Sediments and other materials may not be tracked from the site by vehicle traffic. The construction entrance roadways must be stabilized so as to inhibit sediments from being deposited into the public ways. Accidental depositions must be swept up immediately and may not be washed down by rain or by any other means.

B. Stormwater Pollution Prevention Plan
1. The Contractor shall comply with The Stormwater Pollution Prevention Plan (SWPPP). The Contractor shall implement Best Management Practices (BMPs) necessary to control stormwater pollution from sediments, erosion, and construction materials leaving the construction site.
2. The BMPs contained in the Development Best Management Practices Handbook – Part A, Construction Activities cover the following categories of construction activities:
   a. Site preparation/earth removal
   b. Underground structures
   c. Aboveground structures
   d. Roadways, walkways and parking lots
   e. Planting and landscaping
3. The SWPPP document shall include the following information:
   a. The name, location, period of construction, and a brief description of the Project.
   b. Contact information for the Contractor, including name, address, and telephone number.
   c. Name, location, and description of any environmentally sensitive areas located on or adjoining the Project.
   d. A list of major construction materials, waste, and activities.
   e. A list of BMPs to be used to control pollutant discharges from major construction materials, wastes, and activities.
   f. A site plan (a construction plan may be used) indicating the location of BMPs where appropriate.
   g. A developer's certification statement that all required and selected BMPs will be effectively implemented.
4. Whenever the Contractor is required to get any type of permit from the Department of Building and Safety (DBAS), the Contractor shall submit the SWPPP document to the DBAS for review and approval before obtaining the permit. At least one copy of the approved SWPPP shall be kept at the construction site and accessible to City inspectors.
5. Publication on the General Construction Permit details are available at:

   State Water Resources Control Board Website:

   http://www.waterboards.ca.gov/water_issues/programs/stormwater/construction.shtml

   California Stormwater Quality Association
   http://www.cabmphandbooks.com

END OF SECTION

DIVISION 02
EXISTING CONDITIONS

SECTION 02 41 13 - SITE DEMOLITION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the following

1. Demolition and removal of site improvements and all other related contiguous improvements as required. Refer to Contract Drawings for items and location.

2. Demolition, dismantling, cutting and alterations as indicated, specified, and required for completion of the Contract; for new construction, modernization and rehabilitation projects, as applicable. Includes items such as the following:
    1. Protecting existing work to remain.
    2. Salvageable items to be retained.
    3. Cleaning soiled materials that are to remain.
    4. Disconnecting and capping utilities.
    5. Removing debris and equipment.
    6. Removal of items indicated on drawings.

B. Demolition of Existing Building Foundations

1. Demolition and removal of all existing building foundations, footings, slabs, retaining walls, etc. shall be carried in a careful and orderly manner, and according to all applicable codes and regulations for demolition of structures, safety of adjacent structures, dust control and disposal of materials.
2. Sprinkle Work with water to minimize dust. Provide hoses and water connections for that purpose.

D. Demolition and Removal of Pavements

1. Markup all existing utilities on site.
2. Sawcut all Concrete Pavements, as indicated on Drawings.
3. Remove all indicated pavements, walkways, curb and gutter, concrete ditches, landscape areas, etc.
4. Protect all manhole and valve covers, lids, vaults and other site fixtures, marked to remain.

E. Related Sections: The following Sections contain requirements that relate to this Section:

1. Sections for “Photographic Documentation”, “Special Environmental Procedures”, ”Temporary Facilities”, “Tree and Plant Protection”, “Cutting and Patching” as applicable.

2. Division 31 for "Site Clearing" and “Earthwork” as applicable.

3. Asbestos-Containing Materials (ACMs) and/or other Hazardous Materials Report.

1.03 DEFINITIONS

A. Remove: Remove and legally dispose of items except those indicated to be reinstalled, salvaged, or to remain the owners' property.

B. Asbestos-Containing Materials (ACMs) and other hazardous materials: As identified in the Report, remove asbestos-containing materials (ASMs) and other identified hazardous materials.

C. Remove and Salvage: Items indicated to be removed and salvaged remain the Owner's property. Remove, clean, and pack or crate items to protect against damage. Identify contents of containers and deliver to Owner's designated storage area.

D. Remove and Reinstall: Remove items indicated; clean, service, and otherwise prepare them for reuse; store and protect against damage. Reinstall items in locations indicated or as directed by Owner.

E. Existing to Remain: Protect construction indicated to remain against damage and soiling during demolition. When permitted by the Architect and Owner, items may be removed to a suitable, protected storage location during demolition and then cleaned and reinstalled in their original locations.

1.04 MATERIALS OWNERSHIP

A. Except for items or materials indicated to be reused, salvaged, or otherwise indicated to remain the Owner's property, demolished materials shall become the Contractor's property and shall be removed from the site with further disposition at the Contractor's option.

B. Historical items indicated remain the Owner's property. Carefully remove and salvage each item in a manner to prevent damage and deliver promptly to the Owner.

C. Historical items, archeological or paleontological findings, relics, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, commemorative benches, antiques, and other items of interest or value to the Owner, which may be encountered during demolition, remain the Owner's property. If such items are encountered, all project operations shall cease in the area of discovery immediately. The Owner shall secure the services of an archeological consultant to assess the resources and determine a course of action.

1. Cooperate with Owner's archaeological consultant or historical adviser. Mitigated Negative Declaration (MND) for related requirements.

D. Human Remains: In the event that human remains are discovered, there shall be no disposition of such human remains, other than in accordance with the procedures and requirements set forth in the California Health and Safety Code and Public Resources Code. All project operations shall cease in the area of discovery immediately. In conjunction with the Owner, the Code provisions require immediate notification of the County Coroner and the Native American Heritage Commission.

1. Cooperate with the County Coroner, the Native American Heritage Commission representative and other related officials. Refer to the Mitigated Negative Declaration (MND) for related requirements.

1.05 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 01 Specification Sections, for information only, unless otherwise indicated.

B. Proposed dust-control measures.

C. Proposed noise-control measures.

D. Proposed signage.

E. Schedule of demolition activities indicating the following:

1. Detailed sequence of demolition and removal work, with starting and ending dates for each activity.

2. Dates for shutoff, capping, and continuation of utility services.

F. Inventory of items to be removed and salvaged.

G. Inventory of items to be removed by Owner, if any.

H. Photographs or videotape, sufficiently detailed, of existing conditions of adjoining construction and site improvements that might be misconstrued as damage caused by demolition operations.

I. Record drawings at Project closeout according to Section "Project Record Documents".

1. Identify and accurately locate capped utilities and other subsurface structural, electrical, or mechanical conditions.

J. Landfill records for record purposes indicating receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.

1.06 QUALITY ASSURANCE

A. Demolition Firm Qualifications: Engage an experienced firm that has successfully completed demolition Work similar to that indicated for this Project.

B. Regulatory Requirements: Comply with governing EPA & SCAQMD notification regulations before starting demolition. Observe applicable Best Practices and implementation of the Storm Water Pollution Prevention Plan (SWPPP). Comply with hauling and disposal regulations of authorities having jurisdiction.

C. Pre-demolition Conference: Conduct conference at Project site to comply with pre-installation conference requirements of Division 01 Section "Project Meetings."

1.07 PROJECT CONDITIONS

A. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical. Bidders shall make themselves fully aware of the existing conditions within the site. Scope limits scheduled for demolition and items/areas to remain protected in supplement to the Bid Drawings and Documents.

B. If conditions are encountered that vary from those indicated on plan, notify the Architect for instructions prior to proceeding.

C. Buildings immediately adjacent to demolition area will be occupied. Conduct building demolition so operations of occupied buildings will not be disrupted.

1. Provide not less than 72 hours' notice of activities that will affect operations of adjacent occupied buildings.
2. Maintain access to existing walkways, exits, and other facilities used by occupants of adjacent buildings. Do not close or obstruct walkways, exits, or other facilities used by occupants of adjacent buildings without written permission from owner.

D. Contractor to obtain all necessary encroachment and excavation permits from the local jurisdiction of authority for demolition of existing improvements in public right-of-way.

1.08 SCHEDULING

A. Arrange demolition schedule so as not to violate city construction ordinances.
B. Arrange demolition schedule with Owner.

PART 2 - PRODUCTS

2.01 SOIL MATERIALS

A. Requirements for satisfactory soil materials are specified in Division 31 Section "Earthwork". Refer to the Geotechnical Investigation Report, dated July 7, 2021 prepared by Atlas Technical Consultants LLC and subsequent amendment reports for site soil requirements

1. Obtain approved borrow soil materials off-site when sufficient satisfactory soil materials are not available on-site.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that utilities have been disconnected and capped. Test lines as required.

B. Survey existing conditions and correlate with requirements indicated to determine extent of demolition required.

C. Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.

D. Survey existing conditions of the improvements such as light standards and trees to determine the best method(s) for removal so as not to cause potential damage to persons and property during the course of removal.

E. Perform surveys as the Work progresses to detect hazards resulting from demolition activities.

3.02 UTILITY SERVICES

A. Maintain existing utilities indicated to remain in service and protect them against damage during demolition operations.

1. Do not interrupt existing utilities serving occupied or operating facilities on or off the property, except when authorized in writing by Owner and authorities having jurisdiction. Provide temporary services during interruptions to existing utilities, as acceptable to Owner and to governing authorities.

a. Provide not less than 72 hours' notice to Owner if shutdown of service is required during changeover.

B. Utility Requirements: Locate, identify, disconnect, and seal or cap off indicated utility services serving structures to be demolished.

1. Arrange to shut off indicated utilities with utility companies.

C. Utility Requirements: Refer to Division 33 Sections and Contract Drawings, for shutting off, disconnecting, removing, and sealing or capping utility services. Do not start demolition work until utility disconnecting and sealing have been completed and verified in writing.

3.03 PREPARATION

A. Drain, purge, or otherwise remove, collect, and dispose of chemicals, gases, explosives, acids, flammables, or other dangerous materials before proceeding with demolition operations.

B. Conduct demolition operations and remove debris to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by governing regulations.

C. Conduct demolition operations to prevent injury to people and damage to adjacent buildings and facilities to remain. Ensure safe passage of people around demolition area.

D. Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction.

E. Protect existing site improvements, appurtenances, and landscaping to remain.

1. Erect a plainly visible fence around drip line of individual trees or around perimeter drip line of groups of trees to remain.

3.04 CUTTING EXISTING CONCRETE

A. Cutting of existing concrete shall be done by experienced workers familiar with the requirements and space necessary for placing concrete. Perform concrete cutting with concrete cutting wheels and hand chisels. Take care not to damage concrete that is intended to remain.

B. Extent of cutting of concrete shall be as indicated on drawings and in accordance with standard plans for public works construction plan no. 132-3. Replace concrete that is removed in excess of amount indicated or required.

C. Prior to cutting or coring concrete, determine locations of hidden utilities and take necessary measures to protect them from damage.

D. If an existing pavement joint or cracked area is within two feet outside of a designated sawcut line shown on the Drawings, removal and resurfacing shall be to that joint, and/or shall include the crack or cracked area, unless otherwise approved by Architect.

3.05 EXPLOSIVES

A. Explosives: Use of explosives will not be permitted.

3.06 POLLUTION CONTROLS

A. Use water mist, temporary enclosures, and other suitable methods to limit the spread of dust and dirt. Comply with governing environmental protection regulations.

1. Do not create hazardous or objectionable conditions, such as ice, flooding, and pollution, when using water.

B. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

1. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level.

C. Clean adjacent buildings and improvements of dust, dirt, and debris caused by demolition operations. Return adjacent areas to condition existing before start of demolition.

3.07 DEMOLITION

A. Demolition: Demolish improvements completely and remove from the site. Use methods required to complete Work within limitations of governing regulations and as follows:

B. Below-Grade Construction: Demolish foundation walls and other below-grade construction, as follows:

1. Completely remove below-grade construction, including foundation walls and footings unless noted otherwise on the drawings.

2. Break up and remove below-grade concrete slabs, unless indicated to remain.

C. Filling Below-Grade Areas: Completely fill below-grade areas and voids resulting from demolition of buildings and pavements with soil materials according to requirements specified in Division 31 Section "Earthwork."

D. Damages: Promptly repair damages to adjacent facilities caused by demolition operations.

3.08 DISPOSAL OF DEMOLISHED MATERIALS

A. General: Promptly dispose of demolished materials. Do not allow demolished materials to accumulate on-site.

B. Burning: Do not burn demolished materials.

C. Disposal: Transport demolished materials off Owner’s property and legally dispose them.

END OF SECTION

DIVISION 03
CONCRETE

SECTION 03 10 00 - CONCRETE FORMING AND ACCESSORIES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Formwork for cast-in-place concrete as indicated.

2. Installation of items to be embedded in concrete, such as anchor bolts, inserts, embeds, and sleeves.

B. Related Requirements:

1. Division 01 - General Requirements.

2. Section 03 2000: Concrete Reinforcing.

3. Section 03 3000: Cast-In-Place Concrete.

1.02 REFERENCES

A. American Concrete Institute (ACI) Publication:

1. ACI 318 – Building Code Requirements for Structural Concrete, Chapter 6, Formwork, Embedded Pipes, and Construction Joints.

2. ACI 347 – Guide to Formwork for Concrete.

B. American Plywood Association (APA):

1. Form No. V345 - Concrete Forming Design/Construction Guide.

C. National Institute of Standards and Technology (NIST):

1. NIST Voluntary Product Standard PS 1.

1.03 SUBMITTALS

A. Shop Drawings: Submit Shop Drawings indicating locations of forms, construction and expansion joints, embedded items, and accessories.

B. Product Data: Submit manufacturer's Product Data for form materials and accessories.

1.04 REGULATORY REQUIREMENTS

A. California Building Code (CBC), Chapter 19A.

B. California Code of Regulations, Title 8, Division 1, Chapter 4, Subchapter 4, Construction Safety Orders, Article 6, Excavations, Sections 1713 and 1717.

1.05 DELIVERY, STORAGE AND HANDLING

A. Storage shall prevent damage and permit access to materials for inspection and identification.

PART 2 - PRODUCTS

2.01 GENERAL

A. Form materials may be reused during progress of the Work provided they are completely cleaned and reconditioned, recoated for each use, capable of producing formwork of required quality, and are structurally sound.

B. Form Lumber: WCLIB Construction Grade or Better, WWPA No. 1 or Better.

C. Plywood: NIST Voluntary Product Standard PS 1, Group 1, Exterior Grade B-B Plyform or better, minimum 5-ply and 3/4 inch thick for exposed locations and at least 5/8 inch thick for unexposed locations, grade marked, not mill oiled. Furnished plywood with medium or high density overlay is permitted.

D. Coated Form Plywood: For exposed painted concrete, plastic overlaid plywood of grade specified above, factory coated with a form coating and release agent Nox-crete", or equal.

E. Form Ties: Prefabricated rod, flat band, wire, internally threaded disconnecting type, not leaving metal within 1 1/2-inch of concrete surface.

F. Form Coating: Non-staining clear coating free from oil, silicone, wax, not grain-raising, "Formshield" by A.C. Horn, Inc., "Release" by Edoco/Dayton Superior, "Cast-Off" by Sonneborn/BASF Building Systems or equal. Where form liners are furnished, provide form coatings recommended by form liner manufacturer.

G. Form Liner: Rigid or resilient type by L.M. Scofield, Symons, Greenstreak, or equal.

PART 3 - EXECUTION

3.01 GENERAL

A. Forms shall be constructed so as to shape final concrete structure conforming to shape, lines and dimensions of members required by Drawings and Specifications, and shall be sufficiently tight to prevent leakage of mortar. They shall be properly braced or tied together to maintain position and shape. Forms and their supports shall be designed so that previously placed structures will not be damaged.

B. Use form coating at all surfaces in contact with concrete.

3.02 TOLERANCES

A. Permitted abrupt or gradual irregularities in formed surfaces as measured within a 5 feet length with a straightedge shall per ACI 347, Table 3.1:

Class of Surface			
A	B	C	D
1/8 inch	1/4 inch	1/2 inch	1 inch

Edit Note: Edit tolerances indicated below for project specifics.

1. Class A: Use for concrete surfaces prominently exposed to public view.

2. Class B: Use for coarse-textured concrete-formed surfaces intended to receive plaster, stucco or wainscoting.

3. Class C: Use as a general standard for permanently exposed surfaces where other finishes are not specified.

4. Class D: Use for surfaces where roughness is not objectionable and will be permanently concealed.

3.03 ERECTION

A. Plywood shall be installed with horizontal joints level, vertical joints plumb and with joints tight. Back joints by studs or solid blocking, and fill where necessary for smoothness. Reused plywood shall be thoroughly cleaned, damaged edges or surfaces repaired and both sides and edges oiled with colorless form oil. Nail plywood along edges, and to intermediate supports, with common wire nails spaced as necessary to maintain alignment and prevent warping.

B. Openings for Cleaning: Provide temporary openings at points in formwork to facilitate cleaning and inspection. At base of walls and wide piers, bottom form board on one face for entire length shall be omitted until form has been cleaned and inspected.

C. Chamfers: Provide 3/4 inch by 3/4 inch chamfer strips for all exposed concrete corners and edges unless otherwise indicated.

D. Reglets and Rebates: As specified in Section 03 3000: Cast-In-Place Concrete.

3.04 REMOVAL OF FORMS

A. Forms shall not be removed until concrete has sufficiently hydrated to maintain its integrity and not be damaged by form removal operations. Unless noted otherwise and/or permitted by the Architect, columns and wall forms shall not be removed in less than five days, floor slabs in less than seven days, beams and girders in less than 15 days, pan

forms for joists may be removed after three days, but joist centering shall not be removed until after 15 days, and ramp, landing, steps and floor slabs shall not be removed in less than seven days. Shoring shall not be removed until member has acquired sufficient strength to support its weight, load upon it, and added load of construction.

B. Compressive strength of in-place concrete shall be determined by testing field-cured specimens representative of concrete location or members, as specified in Section 03 3000: Cast-In-Place Concrete.

3.05 PROTECTION

A. Protect the Work of this section until Substantial Completion.

3.06 CLEAN UP

A. Remove rubbish, debris and waste materials and legally dispose of off the Project site.

END OF SECTION

SECTION 03 20 00 - CONCRETE REINFORCING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Concrete steel reinforcement.

B. Related Requirements:

1. Division 01 - General Requirements.
2. Section 03 10 00: Concrete Forming.
3. Section 03 30 00: Cast-In-Place Concrete.
4. Section 04 22 00: Concrete Unit Masonry.

1.02 REGULATORY REQUIREMENTS

A. Fabrication and placement of reinforcing shall be in accordance with requirements of CBC, Chapter 19A.

1.03 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. ASTM A82 - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
2. ASTM A184 - Standard Specification for Fabricated Deformed Steel Bar Mats for Concrete Reinforcement.
3. ASTM A185 - Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
4. ASTM A496 - Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement.
5. ASTM A497 - Standard Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete.
6. ASTM A615 - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
7. ASTM A706 - Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.

B. American Concrete Institute (ACI) Publication:

1. ACI SP-66 – ACI Detailing Manual.

2. ACI 318 – Building Code Requirements for Structural Concrete, as modified by CBC.

C. American Welding Society (AWS):

1. AWS D1.4 – Structural Welding Code – Reinforcing Steel.

1.04 SUBMITTALS

A. Shop Drawings: Submit steel reinforcement Shop Drawings in accordance with ACI 315. Include assembly diagrams, bending charts and slab plans. Indicate lengths and location of splices, size and lengths of reinforcing steel.

B. Closeout Submittals: Record exact locations of reinforcing that vary from Shop Drawings.

1.05 QUALITY ASSURANCE

A. Comply with the following as a minimum requirement:

1. Concrete Reinforcing Steel Institute (CRSI) Manual of Standard Practice.

2. American Welding Society (AWS).

3. American Concrete Institute (ACI).

4. CBC, Chapter 19A, Concrete.

B. Source Quality Control: Refer to Division 01 Sections for general requirements and to the following paragraphs for specific procedures. Testing laboratory retained by the OWNER shall select test Samples of bars, ties, and stirrups from the material at the Project Site or from the place of distribution, with each Sample consisting of not less than two 18 inch long pieces, and perform the following tests according to ASTM A615, or ASTM A706, as applicable:

1. Identified Bars: If Samples are obtained from bundles as delivered from the mill, identified as to heat number, accompanied by mill analyses and mill test reports, and properly tagged with the identification certificate so as to be readily identified, perform one tensile and one bend test for each 10 tons or fraction thereof of each size of bars. Submit mill reports when Samples are selected.

2. Unidentified Bars: When positive identification of reinforcing bars cannot be performed and when random Samples are obtained; perform tests for each 2.5 tons or fraction thereof, one tensile and one bend test from each size of bars.

C. Certification of Welders: Shop and Project site welding shall be performed by welding operators certified by AWS.

1.06 DELIVERY, STORAGE AND HANDLING

A. Avoid exposure to dirt, moisture or conditions harmful to reinforcing.

B. Reinforcing steel bars, wire, and wire fabric shall be stored on the Project site to permit easy access for examination and identification of each shipment. Material of each shipment shall be separated for size and shape.

PART 2 - PRODUCTS

2.01 GENERAL

A. Provide reinforcing of sizes, gages and lengths indicated, bent to indicated shapes.

2.02 MATERIALS

A. Steel Reinforcing Bars: ASTM A615, or ASTM A706 deformed grade 60 billet steel unless otherwise specified or indicated.

B. Bars or Rod Mats: ASTM A184.

C. Welded Wire Fabric for Reinforcement: ASTM A185.

D. Tie Wire: ASTM A82, fully annealed, copper-bearing steel wire, 16 gage minimum.

E. Chairs, Spacers, Supports, and Other Accessories: Standard manufacture conforming to ACI 315 fabricated from steel wire of required types and sizes. For reinforcement supported from grade, provide properly sized dense precast blocks of concrete.

2.03 FABRICATION OF REINFORCING BARS

A. Comply with CRSI Manual of Standard Practice for Reinforced Concrete Construction for fabrication of reinforcing steel.

B. Bending and Forming: Fabricate bars of the indicated sizes and bend and form to required shapes and lengths by methods not injurious to materials. Do not heat reinforcement for bending. Bend bars No. 6 size and larger in the shop only. Bars with unscheduled kinks or bends are not permitted. Provide only tested and permitted bar materials.

C. Welding: Provide only ASTM A706 steel where welding is indicated. Perform welding by the direct electric arc process in accordance with AWS D1.4 and specified low-hydrogen electrodes. Preheat 6 inches each side of joint. Protect joints from drafts during the cooling process; accelerated cooling is not permitted. Do not tack weld bars. Clean metal surfaces to be welded of loose scale and foreign material. Clean welds each time electrode is changed and chip burned edges before placing welds. When wire brushed, the completed welds must exhibit uniform section, smooth welded metal, feather edges without undercuts or overlays, freedom from porosity and clinkers, and good fusion and penetration into the base metal. Cut out welds or parts of welds deemed defective, using chisel, and replace with proper welding. Prequalification of welds shall be in accordance with CBC requirements.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Bars shall be bent cold. Bars partially embedded in concrete shall not be field bent except as indicated on reviewed Shop Drawings.

B. Before installation and just prior to placing concrete, clean reinforcing of loose scale, rust, oil, dirt and any coating that could reduce bond.

C. Accurately position, install, and secure reinforcing to prevent displacement during the placement of concrete.

D. Provide metal chairs to hold reinforcement the required distance above form bottoms. In beams and slab construction, provide chairs under top slab reinforcement as well as under bottom reinforcement. Space chairs so that reinforcement will not be displaced during installation. Provide metal spacers to secure proper spacing. Stirrups shall be accurately and securely wired to bars at both top and bottom. At slabs, footings, and beams in contact with earth, provide concrete blocks to support reinforcement at required distance above grade.

E. Install and secure reinforcement to maintain required clearance between parallel bars and between bars and forms. Lapped splices shall be installed wherever possible in a manner to provide required clearance between sets of bars. Stagger lapped splices. Dowels and bars extending through construction joints shall be secured in position against displacement before concrete is installed and subsequently cleaned of concrete encrustations while they are still soft.

F. Do not install reinforcing in supported slabs and beams until walls and columns have been installed to underside of slabs and beams or until construction joints have been thoroughly cleaned. Reinforcing shall be inspected before placement of concrete and cleaned as required.

G. Use deformed bars unless otherwise indicated, except for spiral reinforcement.

3.02 CLEAN UP

A. Remove rubbish, debris and waste materials and legally dispose of off the Project site.

3.03 PROTECTION

A. Protect the Work of this section until Substantial Completion.

END OF SECTION

SECTION 03 30 00 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Cast-in-place normal weight and lightweight concrete, placement and finishing.

B. Related Requirements:

1. Division 01 - General Requirements.
2. Section 03 10 00: Concrete Forming and Accessories.
3. Section 03 20 00: Concrete Reinforcing.
4. Section 07 26 16: Vapor Barriers.
5. Section 32 13 13: Concrete Paving.

1.02 REFERENCES

A. American Concrete Institute (ACI) Publication:

1. ACI 117 – Specifications for Tolerances for Concrete Construction and Materials.
2. ACI 301 – Specifications for Structural Concrete.
3. ACI 302.1R – Guide for Concrete Floor and Slab Construction.
4. ACI 305R - Specification for Hot Weather Concreting.
5. ACI 306.1 – Standard Specification for Cold Weather Concreting.
6. ACI 308R – Guide to External Curing of Concrete.
7. ACI 318 - Building Code Requirements for Structural Concrete, as modified by CBC Sections 1903A and 1905A.

B. American Society for Testing and Materials (ASTM) Standards:

1. ASTM C31 – Standard Specification for Making and Curing Concrete Test Specimens in the Field.
2. ASTM C33 - Standard Specification for Concrete Aggregates.
3. ASTM C39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
4. ASTM C42 - Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.

5. ASTM C88 - Standard Test Method for Soundness of Aggregates by use of Sodium Sulphate or Magnesium Sulphate.

6. ASTM C94 - Standard Specification for Ready-Mixed Concrete.

7. ASTM C143 - Standard Test Method for Slump of Hydraulic Cement Concrete.

8. ASTM C150 - Standard Specification for Portland Cement.

9. ASTM C156 – Standard Test Method for Water Loss (from a Mortar Specimen) Through Liquid membrane-Forming Curing Compounds for Concrete.

10. ASTM C171 - Standard Specification for Sheet Materials for Curing Concrete.

11. ASTM C172 – Standard Practice for Sampling Freshly Mixed Concrete.

12. ASTM C173 – Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.

13. ASTM C260 – Standard Specification for Air-Entraining Admixtures for Concrete.

14. ASTM C289 - Standard Test Method for Potential Alkali-Silica Reactivity of Aggregates (Chemical Method).

15. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.

16. ASTM C330 - Standard Specification for Lightweight Aggregates for Structural Concrete.

17. ASTM C494 - Standard Specification for Chemical Admixtures for Concrete.

18. ASTM C567 - Standard Test Method for Determining Density of Structural Lightweight Concrete.

19. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.

20. ASTM C845 - Standard Specification for Expansive Hydraulic Cement

21. ASTM C989 - Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars.

22. ASTM C1107 - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).

23. ASTM C1064 - Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete.

24. ASTM C1240 - Standard Specification for Silica Fume Used in Cementitious Mixtures.

25. ASTM C1315 – Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.

26. ASTM D1308 – Standard Test Method for Effect of Household Chemicals on Clear and Pigmented Organic Finishes.

27. ASTM C1567 - Standard Test Method for Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method).

28. ASTM D1751 - Standard Test Method for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types).

29. ASTM D7234 – Standard Test Method for Pull-Off Adhesion Strength of Coatings on Concrete Using Portable Pull-Off Adhesion Testers.

30. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.

31. ASTM E1155 - Standard Test Method for Determining F_F Floor Flatness and F_L Floor Levelness Numbers.

32. ASTM E1643 - Standard Practice for Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill under Concrete Slabs.

33. ASTM E1745 - Standard Specification for Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.

34. ASTM F710 – Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring.

35. ASTM F1869 – Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.

36. ASTM F2170 – Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using In Situ Probes.

37. ASTM F3010 – Standard Practice for Two-Component Resin Based Membrane-Forming Moisture Mitigation Systems for Use under Resilient Floor Coverings.

1.03 SUBMITTALS

A. Shop Drawings: Submit Shop Drawings indicating locations of cast-in-place concrete Work and accessory items such as vapor barriers. Include details and locations of reinforcing, embedded items, and interfacing with other Work.

B. Mix Design Data: Submit concrete mix designs as specified herein and in Article 2.02.

1. Submit name, address and telephone number of the concrete production facility which the contractor intends to engage to design the concrete mixes. Submit name and qualifications of the proposed concrete technologist.

2. Mix Design: Submit a concrete mix design for each strength and type of concrete indicated in the drawings or specified. Include water/cement ratio, source, size and amount of coarse aggregate and admixtures. Predict minimum compressive strength, maximum slump and air content percentage. Clearly indicate locations where each mix design will be used.

a. Water/cement ration for concrete slabs on grade shall be 0.45 maximum.

3. Test Reports: Submit copies of test reports showing that the proposed mixes produce concrete with the strengths and properties specified. Include tests for cement, aggregates and admixtures. Provide gradation analysis.

C. Material Samples: Submit Samples illustrating concrete finishes and hardeners, minimum 12-inch by 12-inch.

D. Certificates: Submit certification that each of the following conforms to the standards indicated:

1. Portland cement: ASTM C150.

2. Normal weight concrete aggregates: ASTM C33.

3. Lightweight concrete aggregates: ASTM C330.

4. Aggregates: Submit evidence that the aggregate is not reactive in the presence of cement alkalis. In the absence of evidence, aggregate shall be tested by one of the methods in ASTM C33 Appendix XI, Methods for Evaluating Potential for Deleterious Expansion Due to Alkali Reactivity of an Aggregate. Aggregates deemed to be deleterious or potentially deleterious may be used with the addition of a material that has been shown to prevent harmful expansion in accordance with Appendix XI of ASTM C33, when approved by the building official, in accordance to CBC Section 1903A5A.

5. Curing materials: ASTM C171.

E. Admixtures: Submit product data for proposed concrete admixtures.

1.04 QUALITY ASSURANCE

A. Continuous inspection shall be provided at the batch plant and for transit-mixed concrete to run check sieve analysis of aggregate, check moisture content of fine aggregate, check design of mix, check cement being used with test reports, check loading of mixer trucks, and certify to quantities of materials placed in each mixer truck.

B. Inspection shall be performed by a representative of a testing laboratory selected by the OWNER. OWNER will pay for inspection costs. Notify the laboratory 24 hours in advance of time concrete is to be mixed. Notify the laboratory of postponement or cancellation of mixing within at least 24 hours of scheduling time.

C. CONTRACTOR shall assist the testing laboratory in obtaining and handling samples at the project site and at the source of materials.

D. Special Inspections and Tests shall be in accordance with CBC Chapter 17A, Reinforcement and Anchor testing per CBC Section 1910A.

1.05 DELIVERY, STORAGE AND HANDLING

A. Store cement and aggregate materials so as to prevent their deterioration or intrusion by foreign matter. Deteriorated or contaminated materials shall not be furnished.

B. Packaged materials shall bear the manufacturers and brand name label, and shall be stored in their original unbroken package in a weather tight place until ready for use in the work.

1.06 PROJECT CONDITIONS

A. Cold Weather Requirements: Batching, mixing, delivering and placing of concrete in cold weather shall comply with the applicable requirements of ACI 306.1.

B. Hot Weather Requirements: Batching, mixing, delivering and placing of concrete in hot weather shall comply with the applicable requirements of ACI 305R.

C. Concrete temperature of freshly mixed concrete shall be determined per ASTM C1064.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Cement: ASTM C150. Portland Cement.

B. Aggregates: Conform to the following standards:

1. Normal weight concrete: ASTM C33.

2. Lightweight concrete: ASTM C330, with fine aggregates per ASTM C33.

3. Aggregate shall be tested for Potential Alkali Reactivity of Cement-Aggregate Combinations per ASTM C289.

4. Nominal maximum size of coarse aggregate shall be no larger than:

a. 1/5 the narrowest dimension between sides of forms, nor

b. 1/3 the depth of slabs, nor

c. 3/4 the clear spacing between individual reinforcing bars or wires, bundles of bars, individual tendons, or ducts.

d. CONTRACTOR may request the ARCHITECT and DSA waiver of the above limitations reported per ACI 318, provided that the workability and methods of consolidation are such that the concrete can be placed without honeycombs or voids.

C. Water: Water for concrete mixes, curing and cleaning shall be potable and free from deleterious matter.

D. Admixtures: Shall be shown capable of maintaining essentially the same composition and performance throughout the work as the product used in establishing concrete proportions in accordance with ACI 318, Section 26.4.1.4.

1. Admixtures containing chlorides or sulfides are not permitted.

2. Air-entraining admixtures shall comply with ASTM C260. Air-entrained admixtures shall not be used for floor slabs to receive steel trowel finish.

3. Admixtures for water reduction and setting time modification shall conform to ASTM C494.

4. Admixtures for producing flowing concrete shall conform to ASTM C1017.

5. Fly ash, pozzolan and ground granulated blast-furnace slag:

   a. Fly ash or other pozzolan used as a partial substitution for ASTM C150 Portland cement shall meet the following requirements:

      1) Shall conform to ASTM C618 for Class N or F materials (Class C is not permitted).

      2) Up to 15% percent by weight of fly ash or other pozzolans may substitute for ASTM C150 Portland cement provided the mix design is proportioned per ACI 318, Section 26.4.3.

   b. Ground-granulated blast-furnace slag used as a partial substitution for ASTM C150 Portland cement shall meet the following requirements:

      1) Shall conform to ASTM C989.

      2) Up to 15% percent by weight of ground-granulated blast-furnace slag may substitute for ASTM C150 Portland cement provided the mix design is proportioned per ACI 318, Section 26.4.3.

6. Admixtures containing ASTM C845 expansive cements shall be compatible with the cement and produce no deleterious effects.

7. Silica fumes used as an admixture shall conform to ASTM C1240.

E. Reinforcement Fibers: Chop strands of alkali-resistant polypropylene or nylon fibers added to the concrete mix for protection against shrinkage cracks.

F. Expansion Joint Fillers: Preformed strips, non-extruding and resilient bituminous type, of thickness indicated, conforming to ASTM D1751.

G. Curing:

1. Curing Paper: Shall conform to ASTM C171 and consist of two sheets of kraft paper cemented together with a bituminous material in which are embedded cords or strands of fiber running in both directions. The paper shall be light in color, shall be free of visible defects, with uniform appearance.

2. Elevated slabs and slabs on grade may be cured at CONTRACTOR's option with curing and proactive water vapor emission and alkalinity control system. Products shall be approved by OWNER's Office of Environmental Health and Safety.

   a. VaporSeal 309, by Floor Seal Technology, Inc., or equal.

      1) ASTM C156: 0.39 kg/m².

      2) ASTM C309: Exceeds requirements.

      3) ASTM C1315: Exceeds requirements.

      4) ACI 308R-01 Compliant.

b. Remedial Treatment: Water vapor emission and alkalinity control treatment, MES 100 by Floor Seal Technology, Inc. or equal.

1) ASTM E96: <0.1 Perms.

2) ASTM D1308: 14pH Resistant.

3) ASTM D7234: 500+psi 100% concrete failure.

4) ASTM F2170: 100%RH resistant.

5) VOC Content: <100 g/L, meets SCAQMD Rule #1113.

6) ASTM F3010: Meets Requirements.

c. Self-leveling Compounds: Ardex Engineered Cements, K15, or V1200, Schonox ZM Rapid, US Self Leveler Armstrong, S-194, or equal.

H. Floor Hardener: Water soluble, inorganic, silicate-based curing, hardening, sealing and dustproofing compound. Aquaseal W20 by Monopole Inc., Kure-N-Harden by BASF, Chem Hard by L&M, Liqui-Hard by W. R. Meadows, or equal.

I. Underlayment: Two component latex underlayment for filling low spots in concrete for both interior and exterior applications, from featheredge to a maximum of 3/8 inch in thickness. Underlayment shall be non-shrink and suitable for repairing exposed concrete surfaces and for underlayment of carpet, resilient, tile and quarry floor coverings. La-O-Tex by TexRite, Underlay C, RS by Mer-Krete Systems, Underlayment 962 by C-Cure, or equal.

J. Vapor Barrier: Refer to Section 07 26 16, Vapor Barriers.

K. Stair Treads and Nosings: Two part stair tread and nosing with ribbed abrasive bars. Fabricated from 6063-T5 or 6063-T6 extruded aluminum, mill finish. Anti-slip abrasive filler consisting of aluminum oxide, silicon carbide, or a combination of both, in an epoxy-resin binder. Color shall extend uniformly throughout filler.

1. American Safety Tread: TP-311R.

2. Balco Inc.: DST-330.

3. Nystrom: STTB-P3.375E.

4. Wooster Products Inc.: WP-RN3SG.

5. Equal.

L. Grout: ASTM C1107, non-shrink type, pre-mixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing additives, capable of developing a minimum compressive strength of 7,000 psi at 7 days; of consistency suitable for application and a 30 minute working time.

2.02 CONCRETE MIX

A. Mix shall be signed and sealed by a Civil or Structural Engineer currently registered in the State of California.

B. Strength of Concrete: Strengths and types of concretes shall be as indicated in the Drawings. Unless otherwise indicated or specified, concrete shall be provided with minimum 28-day strength of 3000 psi (f'c).

C. Concrete mix shall meet the durability requirements of ACI 318, Chapter 19.

D. Concrete proportioning shall be determined on the basis of field experience and/or trial mixtures shall in accordance with ACI 318, Section 26.4.3. Proportions of materials shall provide workability and consistency to permit concrete to be placed readily into forms and around reinforcement under conditions of placement to be employed, without segregation or excessive bleeding.

E. Ready-Mixed Concrete: Mix and deliver in accordance with requirements of ASTM C94.

PART 3 - EXECUTION

3.01 GENERAL

A. Surfaces to receive concrete shall be free of debris, standing water, and any other deleterious substances before start of concrete placing.

B. Time of Placing: Do not place concrete until reinforcement, conduits, outlet boxes, anchors, hangers, sleeves, bolts, and other embedded materials are securely fastened in place. Contact the Inspector at least 24 hours before placing concrete; do not place concrete until inspected by the Project Inspector.

C. Pouring Record: A record shall be kept on the Project site of time and date of placing concrete in each portion of structure. Such record shall be maintained on the Project site until Substantial Completion and shall be available for examination by the ARCHITECT and DSA.

3.02 TOLERANCES

A. Concrete construction tolerances shall be as specified in ACI 117 and as modified herein.

B. Floor Flatness (F_F) and Floor Levelness (F_L) shall be as indicated below:

	Specified Overall Value		Minimum Local Value	
	F_F	F_L	F_F	F_L
Slabs on ground: mechanical and electrical rooms, parking structures and mortar bed set tile and quarry flooring.	20	15	15	10
Slab on ground: carpet.	25	20	17	15
Slab on ground: thinset tile and resilient flooring.	35	25	24	17

C. Refer to ACI 302.1R, Tables 8.1 and 8.2 Slab on Ground and Suspended Flatness/Levelness Construction Guide, for recommended concrete placing and finishing methods.

D. Floor Flatness and Floor Levelness shall be tested in accordance to ASTM E1155. Floor measurements shall be made within 48 hours after slab installation, and shall precede removal of shores and forms.

E. Main gymnasium event area slab on grade shall be steel troweled and finished smooth to a tolerance of 1/8 inch in any 10 foot radius. Refer to architectural specification and floor finish manufacturer for additional tolerance requirements.

3.03 PREPARATION

A. For installation of vapor barrier refer to Section 07 26 16, Vapor Barriers.

B. Reglets and Rebates:

1. Form reglets and rebates in concrete to receive flashing, frames and other equipment as detailed and required. Coordinate dimensions and locations required with other related Work.

2. If concrete slabs on grade adjoin a wall or other perpendicular concrete surface, form a reglet in wall to receive and carry horizontal concrete Work. Reglet shall be full thickness of the slab and shall be 3/4 inch wide, unless otherwise indicated. Requirement does not apply to exterior walks, unless specifically indicated.

C. Screeds: Install screeds accurately and maintain at required grade or slab elevations after steel reinforcement has been installed, but before starting to place concrete. Install screeds adjacent to walls and in parallel rows not to exceed 8 feet on centers.

3.04 INSTALLATION

A. Conveying and Placing:

1. Concrete shall be placed only under direct observation of the Project Inspector. Do not place concrete outside of regular working hours, unless the Inspector has been notified at least 48 hours in advance.

2. Concrete shall be conveyed from mixer to location of final placement by methods that will prevent separation or loss of materials.

3. Concrete shall be placed as nearly as practicable to its final position to avoid segregation due to re-handling or flowing. No concrete that has partially hydrated or has been contaminated by foreign materials shall be placed, nor shall re-tempered concrete or concrete which has been remixed after initial set be placed.

4. In placing concrete in columns, walls or thin sections, provide openings in forms, elephant trunks, tremies or other recognized devices, to prevent segregation and accumulation of partially hydrated concrete on forms or metal reinforcement above level of concrete being placed. Such devices shall be installed so that concrete will be dropped vertically. Unconfined vertical drop of concrete from end of such devices to final placement surface shall not exceed 6 feet.

5. Concrete shall be placed as a continuous operation until placing of panel or section is completed. Top surfaces of vertically formed lifts shall be level.

6. Concrete shall be thoroughly consolidated by suitable means during placement, and shall be thoroughly worked around reinforcement and embedded fixtures and into corners of forms.

7. Where conditions make consolidation difficult or where reinforcement is congested, batches of mortar containing same proportions of cement, sand, and water as provided in the concrete, shall first be deposited in the forms to a depth of at least one inch.

B. Cold Weather:

1. Provide adequate equipment for heating concrete materials and protecting concrete during freezing or near-freezing weather. All ground with which concrete is to come in contact shall be free from frost. No frozen materials or materials containing ice shall be used.

2. The temperature of concrete at the time of placement shall not be below the minimum temperatures given in Table 3.1 of ACI 306.1.

3. Concrete shall be maintained at a temperature of at least 50° F. for not less than 72 hours after placing or until it has thoroughly hardened. Cover concrete and provide sufficient heat as required. When necessary, aggregates shall be heated before mixing. Special precautions shall be taken for protection of transit-mixed concrete.

C. Hot Weather:

1. Concrete to be placed during hot weather shall comply with the requirements of ACI 318, Section 26.5.5.

2. Maintain concrete temperatures indicated in Table 2.1.5 of ACI 305R to prevent the evaporation rate from exceeding 0.2 pound of water per square feet of exposed concrete per hour.

3. Cool concrete using methods indicated in ACI 305R Appendix B.

4. Place and cure concrete as specified in ACI 305R Chapter 4.

D. Compaction and Screeding:

1. Tamp freshly placed concrete with a heavy tamper until at least 3/8 inch of mortar is brought to surface. Concrete shall then be tamped with a light tamper and screeded with a heavy straightedge until depressions and irregularities are eliminated, and surface is true to finish grades or elevations. Remove excess water and debris.

2. Where slabs are to receive separate cement finish or mortar setting bed, continued tamping to raise mortar to surface is not performed. Laitance shall be removed by brushing with a stiff brush or by light sandblasting to expose clean top surface of coarse aggregate.

E. Floating and Troweling:

1. When concrete has hydrated sufficiently, it shall be floated to a compact and smooth surface. After floating, wait until concrete has reached proper consistency before troweling. Top surfaces shall receive at least 2 troweling operations with steel hand trowel. Prior to and during final troweling, apply a fine mist of water frequently with an atomizing type fog sprayer. Omit troweling for slabs to receive a separate cement finish.

2. For interior finish slabs, final troweling shall provide a hard, impervious, and non-slip surfaces, free from defects and blemishes. Finished surface shall be within tolerances indicated in Article 3.02. Avoid burnishing. Do not add cement or sand to absorb excess moisture.

   a. Floor of Walk-In Refrigerator: Finish as specified above, to a smooth finish.

   b. Floor of Gymnasium Locker Rooms: After floating, and while the surface is still plastic, provide a fine textured finish by drawing a fine fiber bristle broom uniformly over the surface in one direction only. Floors sloped for drainage should be brushed in the direction of flow.

3. Vertical concrete surfaces shall be finished smooth and free from marks or other surface defects.

3.05 CURING

A. Length of time, temperature and moisture conditions for curing concrete shall be in accordance with ACI 318, Section 26.5.3.

B. Forms containing concrete, top of concrete between forms, and exposed concrete surfaces after removal of forms shall be maintained in a thoroughly wet condition for at least 7 consecutive days after placing.

C. If weather is hot or surface has dried out, spray surface of concrete slabs and paving with fine mist of water, starting not later than 2 hours after final troweling and continuing until sunset. Surface of finish shall be kept continuously wet until curing medium has been installed.

D. Immediately after finishing, monolithic floor slabs shall be covered with curing paper. Paper shall be lapped 4 inches at joints and sealed with waterproof sealer. Edges shall be cemented to finish. Repair or replace paper damaged during construction operations.

E. When curing slabs with proactive water vapor emission and alkalinity control system:

   1. Coordinate and schedule application of curing compound with concrete pour schedule, while conforming to manufacturer’s application instructions.

   2. When the surface of the concrete has hardened sufficiently to sustain foot traffic pre-cure slabs with liquefied product application following manufacturer’s written instructions. Application shall be by trained applicators.

   3. Monitor Environmental Conditions: Set up weather station 20 to 30 inches above freshly placed concrete. Record temperature, humidity and wind velocity measurements at 15 minute maximum intervals.

   4. Calculate Evaporation Rate: Use recorded weather information in combination with nomograph per ACI 308R, Figure 4.1, Guide to Curing Concrete, to evaluate relevant evaporation rate.

   5. When the bleed water rate of the concrete is approximately equal to the surface water evaporation rate, spray curing compound material throughout surface of slabs and decks, following manufacturer’s written instructions. Application shall be by trained applicators.

6. Perform the following tests at least 28 days after placement of concrete and prior to floor covering installation. Submit to OAR test results indicating locations that do not comply with scheduled flooring installation requirements.

   a. Calcium chloride testing per ASTM F1869.

   b. Relative humidity testing per ASTM F2170.

   c. Alkalinity testing per ASTM F710.

   d. Perform concrete bond layer humidity meter testing to determine substrate surface acceptability.

7. Areas emitting moisture and alkalinity at rates exceeding floor covering manufacturer's published ASTM F1869 limits, shall receive a corrective coating, at no cost to the OWNER, as follows:

   a) Mask and protect adjacent walls and floor surfaces from effects of scarification and application of remedial treatment.

   b) Scarify slab surface in area of application by shot blasting or other method acceptable to corrective coating manufacturer.

   c) Prepare and fill cracks, control joints and cold joints.

   d) Apply two-component modified epoxy penetrant and coating with roller and squeegee over required treatment area; saturate surfaces to ensure a through mechanical bond.

   e) Clean and fill divots, chips, voids and other surface irregularities with one hundred percent Portland cement based patching compound or cementitious fill.

   f) Apply cementitious surfacing over coating in areas to receive resilient and wood floor coverings to facilitate adhesion; apply to a thickness of 1/8 inch.

3.06 FILLING, LEVELING AND PATCHING

A. Concrete slabs exhibiting high or low spots and indicated to receive resilient floor covering or soft floor covering, shall have surfaces repaired. High spots shall be honed, or ground with power-driven machines to required tolerances. Low spots shall be filled with latex underlayment, installed in strict accordance with manufacturer's written recommendations.

B. Holes resulting from form ties or sleeve nuts shall be solidly packed, through exterior walls, by pressure grouting with cement grout, as specified. Grouted holes on exposed surfaces shall be screeded flush and finished to match adjoining surfaces.

C. Cement Base: Cement base shall be of the height, thickness, and shape detailed. Base shall be reinforced with one inch mesh, 18 gage, zinc-coated wire fabric. Base finish mixture shall be one part Portland cement, 2 parts of fine aggregate and one part pea gravel. Colored cement base shall include a chemically inert mineral oxide pigment in the mix.

3.07 FINISHING

A. Soda and Acid Wash: Concrete surfaces to receive plaster, paint or other finish, and which have been formed by oil coated forms, shall be scrubbed with a solution of 1-1/2 pounds of caustic

soda to one gallon of water. Surfaces where smooth wood or waste molds have been furnished shall be scrubbed with a solution of 20 percent muriatic acid. Wash with clean water after scrubbing.

B. Sacking: Exposed concrete curbs, walls, and other surfaces shall be sacked by an application of Portland cement grout, floated, and rubbed. Sacking shall not be performed until patching and filling of holes has been completed. Entire sacking operation for any continuous area shall be started and completed within the same day.

1. Mix one part Portland cement and 1-1/2 parts fine sand with sufficient water to produce a grout having consistency of thick paint. Wet surface of concrete sufficiently to prevent absorption of water from grout. Apply grout uniformly with a brush or spray gun, then immediately float surface with a cork or other suitable float, scouring wall vigorously.

2. While grout is still plastic, finish surface with a sponge-rubber float, removing excess grout. Allow surface to dry thoroughly, then rub vigorously with dry burlap to completely remove dried grout. No visible film or grout shall remain after rubbing with burlap.

C. Sandblasting: Exterior concrete surfaces to receive stucco dash coat finish, where plywood or other smooth forms have been furnished, shall be uniformly sand-blasted with sharp quartz sand under sufficient air pressure to remove dirt, form oil and other foreign materials, and roughen surface to provide a proper bond. Such surfaces shall be thoroughly washed with clean water after sandblasting.

D. Abrasive: Concrete stair treads, landings, ramps and steps on interior and exterior of buildings, and interior exposed concrete floors in shop buildings shall receive an abrasive finish.

E. Floor Hardener: Exposed interior concrete floors throughout shall be treated with floor hardener.

1. Protect adjacent surfaces. Clean surfaces to receive treatment in accordance with manufacturer's instructions, ensuring that all stains, oil, grease, form release agents, laitance, dust and dirt are removed prior to application.

2. Apply hardener in accordance with manufacturer’s instructions as soon as concrete is firm enough to work on after final troweling.

F. Cement Grout and Dry-Pack Concrete: Cement grout shall be mixed at the Project site and shall be composed of one volume of Portland cement and 2-1/2 volumes of fine aggregate. Materials shall be mixed dry with sufficient water added to make mixture flow under its own weight. When grout is used as a dry pack concrete, add sufficient water to provide a stiff mixture, which can be molded into a sphere.

G. Broom Finish: Exterior stair treads, stair landings, and pool building restrooms shall be provided with a non-slip broom finish in addition to abrasive finish specified.

H. Abrasive Stair Nosing: Nosing shall be installed according to manufacturers written recommendations.

3.08 EXPANSION AND CONSTRUCTION JOINTS

A. Construction Joints: Details and proposed location of construction joints shall be as indicated on the Drawings, located to least impair strength of structure, in accordance with the following:

1. Thoroughly clean contact surface by sand blasting entire surface not earlier than 5 days after initial placement.

2. A mix containing same proportion of sand and cement provided in concrete plus a maximum of 50 percent of coarse aggregate shall be placed to a depth of at least one inch on horizontal joints. Vertical joints shall be wetted and coated with a neat cement grout immediately before placing of new concrete.

3. Should contact surface become coated with earth, sawdust, or deleterious material of any kind after being cleaned, entire surface shall be re-cleaned before applying mix.

B. Expansion Joints: Provide expansion joints where indicated in walks and exterior slabs. Space approximately 20 feet apart, unless otherwise indicated. Joints shall extend entirely through slab with joint filler in one piece for width of walk or slab. Joint filler shall be 3/8 inch thick, unless otherwise indicated.

C. Tooled Joints: Slabs, walks and paving shall be marked into areas as indicated with markings made with a V-grooving tool. Marks shall be round-edged, free from burrs or obstructions, with clean cut angles and shall be straight and true. Walks, if not indicated, shall be marked off into rectangles of not more than 12 square feet and shall have a center marking where more than 5 feet wide.

3.09 TESTING

A. Molded Cylinder Tests:

1. Inspector or testing lab personnel will prepare cylinders and perform slump tests. Samples for concrete strength shall be taken in accordance to ASTM C172. Each cylinder shall be dated, given a number, point in structure from which sample was obtained, mix design number, mix design strength and result of accompanying slump test noted.

2. Separate tests of molded concrete cylinders obtained at same place and time shall be made at age of three days, seven days, and 28 days. A strength test shall be the average of the compressive strength of two cylinders, obtained from the same sample of concrete and tested at 28 days or at test age designated for determination of f'c.

3. Test cylinders shall be prepared at the Project site and stored in testing laboratory in accordance with ASTM C31, and tested in accordance with ASTM C39.

B. Core Test: At request of the ARCHITECT, cores of hardened concrete shall be cut from portions of hydrated structures for testing, in accordance with CBC and ASTM C42.

1. Provide 4 inch diameter cores at representative places throughout the structure as designated by the ARCHITECT.

2. In general, provide sufficient cores to represent concrete placed with at least one core for each 4,000 square feet of building area, and at least 3 cores total for each Project.

3. Where cores have been removed, fill voids with drypack, and patch the finish to match the adjacent existing surfaces.

C. Concrete Consistency: Measure consistency according to ASTM C143. Test twice each day or partial day's run of the mixer.

D. Adjustment of Mix: If the strength of any grade of concrete for any portion of Work, as indicated by molded test cylinders, falls below minimum 28 days compressive strength specified or

indicated, adjust mix design for remaining portion of construction so that resulting concrete meets minimum strength requirements.

E. Air Content Testing: Measure in accordance to ASTM C173 or ASTM C231, for each composite sample taken in accordance to ASTM C172.

F. Defective Concrete:

1. Should strength of any grade of concrete, for any portion of Work indicated by tests of molded cylinders and core tests, fall below minimum 28 days strength specified or indicated, concrete will be deemed defective Work and shall be replaced or adequately strengthened in a manner acceptable to the ARCHITECT and DSA.

2. Concrete Work that is not formed as indicated, is not true within 1/250 of span, not true to intended alignment, not plumb or level where so intended, not true to intended grades and levels, contains sawdust shavings, wood or embedded debris, or does not fully conform to Contract provisions, shall be deemed to be defective Work and shall be removed and replaced.

G. Concrete for Equipment Pads, Mechanical and Electrical Work: Unless otherwise indicated, strength shall have a minimum f'c = 3,000 psi. Exposed concrete shall be provided with a hand trowel finish with radius corners and edges. Form and place concrete where necessary as described in Section 03 1000 Concrete Forming and Accessories, and reinforced as described in Section 03 2000 Concrete Reinforcing. Calcium chloride shall not be furnished in any concrete mix provided for the installation of underground electrical conduits. For concrete encasement of more than one conduit, furnish 3/4 inch maximum aggregate.

3.10 CLEAN UP

A. Remove rubbish, debris and waste materials and legally dispose of off the Project site.

3.11 PROTECTION

A. Protect the Work of this section until Substantial Completion.

END OF SECTION

SECTION 03 33 00 – ARCHITECTURAL CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Finishing formed decorative concrete surfaces (CONC-1).
2. This Section supplements Section 03 30 00.

B. Related requirements:

1. Other Section of Division 03 for finishing concrete surfaces.
2. Division 07 for sealants.
3. Division 32 for finishing Portland cement concrete pavement outside building perimeter is specified in Section.

1.2 PREINSTALLATION CONFERENCE:

A. Conduct conference at Project site to comply with requirements in Division 01.

1. Require representatives of each entity directly concerned with cast-in-place architectural concrete to attend, including the following:

    a. Contractor's superintendent.
    b. Ready-mix concrete manufacturer.
    c. Waterproofing manufacturer’s representative.
    d. Cast-in-place architectural concrete subcontractor.

2. Review concrete design mixture and examine procedures for ensuring quality and consistency of concrete materials. Review hot-weather concreting procedures, curing procedures, construction joints, forms and form-removal limitations, reinforcement accessory installation, concrete repair procedures, and protection of concrete.

1.3 STANDARDS

A. Comply with the requirements of the structural requirements of Sections 03 31 00, 03 32 00 and 03 30 00 Cast-in-Place Concrete, Reinforcement & Formwork Sections, and as specified herein.

1.4 DEFINITIONS

A. Architectural Concrete: Formed concrete that is exposed to view on surfaces of completed structure and that requires special concrete materials, formwork, placement or finishes to obtain specified architectural appearance. Surfaces of architectural concrete elements that are not exposed to view in the completed work, need not conform to requirements of this Section.

1.5 SUBMITTALS

A. Data: Manufacturer Product Data, including installation instructions where applicable, for the following items.

1. Curing and curing/hardening compounds.
2. Curing paper.
3. Bonding agents.

4. Control joint filler.

B. Design mixtures. Indicate amounts of mixing water to be withheld for later addition at the site.
C. Formwork Shop Drawings: Show formwork construction including form-facing joints, rustications, construction and contraction joints, form joint-sealant details, form tie locations and patterns, inserts and embedments, cutouts, cleanout panels, and other items that visually affect architectural concrete.

1. Indicate and call special attention to butted form joints. Indicate method of sealing joints and maintain alignment.
2. Review of formwork drawings is only for features affecting visual quality.

D. Placement schedule indicating locations of all construction joints.
E. Samples for Board Form Material Selection:

1. Match Architect's sample pattern and texture.
2. Submit samples at least 30 days prior to constructing mock-up panels.
3. Submit three 24-inch-long samples representative of the range of material to be expected for each width and finish.
4. Based on review of samples, Architect will identify boards to be used for field sample panels.

F. Mockup for formed concrete work:

1. After all Samples, Product Data, and the Shop Drawings for the mockup are approved, construct mockups of the CIPAC in a location approved by the Architect as specified below.
2. Mockups and mockup submissions for the concrete work shall consist of the following:

    a. Mockup showing the following: Board-formed planter wall (CONC-1).
    b. Additional mockups or partial mockups shall be required if the above mockups are deficient in producing the quality required for the Project.

3. Mockup of board-formed concrete planter wall shall consist of the following:

    c. Foundation of a size and reinforcement adequate to support the work.
    d. Scope of mockup:

        1) 3-ft by 6-ft "L" shaped planter wall.

            a) One vertical construction joint in wall.
            b) One horizontal construction joint in wall.
            c) Form ties with layout as shown in the wall.

    e. Reinforce as in a similar detail on the Drawings and add necessary reinforcement and/or supports to maintain stability.
    f. Use approved form face materials, reinforcement and accessories and assemble formwork as intended for the building construction
    g. Place concrete in the wall with methods to be used for typical long wall in building, including anticipated time delays between deposit lifts.
    h. Finish exposed hardened surfaces of the walls with specified finish treatments when directed by the Architect and with the Architect present. Finish wall with minimum 2 feet wide areas as directed by the Architect.
    i. Use same concrete mix design for the mockup as will be used in the construction of the final board formed walls.

4. If mockups are rejected by the Architect, remove and replace them at no cost to the Owner.

j. Locate mockups so they will remain throughout construction. Protect mockup from damage at all times; remove when directed by the architect.

G. Concrete mix designs: As specified in Section 03 30 00, "Cast-in-Place Concrete" and as specified herein.

1.6 QUALITY ASSURANCE

A. The work of this Section shall be performed by a concrete subcontractor specialized in the type of architectural cast-in-place concrete work required for this Project, with a minimum of 5 years of documented successful experience and shall be performed by skilled workmen thoroughly trained in the necessary crafts to perform architectural concrete work.

1. The cast in place concrete subcontractor, carpenter foreman, labor foreman and the reinforcement erector foremen shall have successful experience in performing cast-in-place concrete work that shows the ability to perform architectural quality work and shall be approved for work on project. Submit projects, including name, description of responsibilities, scope of work, and references.

B. Concrete quality control technician: Assign a quality control person to oversee the architectural concrete work. The primary duty is to be responsible for the required execution of the work. The Concrete Quality Control Technician shall develop a check list for execution of the work and for sign off by the concrete superintendent and be submitted to the Architect.

1. Board-formed concrete vertical surfaces (CONC-1).
2. Smooth-sacked concrete finish (CONC-1).

1.7 HANDLING/PROJECT CONDITIONS

A. Protect adjacent surfaces from staining and damage by covering them with impermeable coverings securely taped in place.

PART 2 - PRODUCTS

2.1 CONCRETE MATERIALS

A. As specified in Section 03 30 00.
B. Water: Fresh, clean, and free of oil and other materials injurious to concrete.

2.2 CURING COMPOUNDS

A. See Section 03 30 00 for general curing materials.

2.3 MISCELLANEOUS MATERIALS

A. Board-formed materials:

1. Board Forms: Textured wood boards of species and surface finish to be selected based on sample panel program. Select material for straightness and appearance characteristics matching approved samples. Take measures, as necessary, to prevent warping and cupping of boards prior to formwork removal. Take measures as necessary to obtain desired appearance of seams between adjacent boards.
2. Material: Douglas Fir, FAS Grade, free of knots
3. Backing Panels (for board-forms): PS 1 plywood, minimum 19/32 inch thick, edge sealed, exterior exposure. Seal surface to prevent absorption of moisture.

4. Form Joint Tape: Compressible foam tape; pressure sensitive; AAMA 800, "Specification 810.1, Expanded Cellular Glazing Tape"; minimum 1/4 inch thick.
5. Form Joint Sealant: Elastomeric sealant complying with ASTM C 920, Type M or S, Grade NS, that adheres to form joint substrates.
6. Sealer: Penetrating, clear, polyurethane wood form sealer formulated to reduce absorption of bleed water and prevent migration of chemicals from wood.
7. Form-Release Agent: Commercially formulated colorless form-release agent that will not bond with, stain, or adversely affect architectural concrete surfaces and will not impair subsequent treatments of those surfaces.
8. Form Ties: Factory-fabricated, internally disconnecting or removable ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal. Ties shall be sealed to prevent staining at exposed face associated with loss of moisture.
9. Provide types and strengths required for each condition.
10. Furnish ties with tapered tie cone spreaders that, when removed, will leave holes 1 inch in diameter on concrete surface.
11. Furnish ties with integral water-barrier plates, when surface is exposed to weather.
12. Steel left in the concrete shall be at least 1 1/2 inches back from surfaces exposed to weather and 1 inch back from other surfaces.
13. Subject to providing necessary strength to resist concrete pressure, Dayton Superior A3 snap ties, with 1 x 1 1/2-inch A 2 plastic cones and A8 waterseal washers, or equal.

B. Bonding agent (non-structural)): ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene, Acryl-Bond by Atlas Tech Products or equal.
C. Skim coat: Use the following in lieu of sacking.

1. Ardex Titl Wall Patch.
2. Rapid Set UnderFixx or Wunderfixx.
3. Euclid Chemicals Tammscrete.
4. WR Meadows Speed Crete.Noxcrete Panel Patch.
5. Or equal.
6. Joint filler: Homex Expansion Joint by Homasote Co. or equal non-bituminous product compatible with sealant specified in Section 07 92 00. Use in combination with plastic joint cap made by Greenstreak or equal.
7. Joint sealant and back-up rod: As specified in Section 07 92 00.

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

A. Finish concrete surfaces to produce a uniform appearance throughout area involved and throughout adjacent areas with the same treatment.
B. Tolerances: Use Fl and Ff numbers. Do not use straightedge method. Do not use Fl numbers for suspended slabs.
C. Where concrete finishing occurs adjacent to finished metal and similar surfaces, particularly where serrated or indented surfaces occur, remove all traces of cement film before allowing concrete to harden.
D. Use no troweling machines within 12 inches of electrical junction and outlet boxes set to finish flush with concrete floors.

1. Float and trowel such areas by hand with wood floats and steel trowels, using caution so that concrete is finished flush with box cover and matches adjacent surfaces.

E. Concrete finish will be considered defective and shall be repaired, when the repairs are acceptable to the Architect, or removed and replaced with proper work conforming to Contract Documents, at no additional cost to Owner, when:

1. It does not match approved sample panels.
2. It is not true to lines and planes.
3. It is not properly troweled and surfaced as required and varies in excess of tolerances specified.
4. Is scuffed or has a rough surface, except where required.
5. Does not connect properly to adjoining work.
6. Does not slope consistently to drains (has bird baths).
7. Is not properly cured.

3.2 FORMWORK

A. General: Comply with Section 03 10 00, “Formwork”, except where more stringent requirements are specified herein. Requirements for formwork apply only at exposed to view surfaces; other surfaces shall conform to requirements for structural concrete.

B. Preparation of Form Surfaces: Apply form sealer to all wood form surfaces to prevent absorption of moisture.

C. Design formwork to permit easy removal. Prying against the concrete surface will not be permitted.

1. Provide 1:6 draft on rustication strips to facilitate removal.

D. Formwork shall be strong enough and sufficiently rigid to withstand pressures that result from rapid filling and high frequency consolidation.

1. Limit deflection of form-facing panels to not exceed ACI 303.1 requirements.

E. Design and construct form work to be water tight under full head hydrostatic pressure of the section to be placed as well as the action of the specified consolidation techniques.

1. Take particular care to seal penetrations, including form ties.

F. Layout form joints, reveals, ties as shown on the Drawings and plumb and true to line. Locate vertical construction joints behind rustications and away from corners.

G. Nail or screw heads shall not occur at contact surface with concrete. Form surfaces in contact with concrete shall be screw attached from backside, glued, or fastened using other approved method.

H. Form exposed architectural faces first. Indicate butted form joints on shop drawings and locate in field only as shown on the approved shop drawings. Perform work necessary to align and seal joints of abutting panels prior to placement of reinforcement.

1. Limit concrete surface irregularities, designated by ACI 347R as abrupt or gradual, to Class A, 1/8 inch.

I. Board-Form Finish: Construct formwork with wood plank face forms secured to minimum 5/8-inch-thick plywood backing panels. Bond face layer and back-up panels together with waterproof contact glue or screwed together from back side so as not to penetrate the finished face.

1. Splice boards only at locations shown.
2. Fit edges of boards as approved by Architect. Place foam gaskets between adjacent boards, held back 1/8 inch from contact surface.

J. Coat contact surfaces of forms with a light uniform coating of form-release agent, according to manufacturer's written instructions, before placing reinforcement.

1. Do not allow excess form-coating materials to accumulate in forms or come in contact with concrete surfaces against which fresh concrete will be placed.
2. Coat forms with release agent prior to erection, where coating cannot be applied in place.

3.3 MARKINGS

A. At control joints and elsewhere as indicated, provide markings with a rounded edging or marking tool, to a 1/4-inch radius. In textured work, edge and mark with a combination edging and smoothing tool approximately 1-1/2-inch wide.
B. Make markings within a tolerance not exceeding 1/4-inch in 10 feet.
C. Where indicated, provide cut markings sawn into surface of cured concrete. Coordinate this work with the work of other Sections to avoid damage to adjacent surfaces.
D. Complete sawcutting within 16 hours after casting.
E. Use sawcutting equipment specifically designed to cut 1/8-inch-wide joints crisp, sharp, unchipped edges in newly cast concrete. Use cutting machine with a high speed (10,000 rpm minimum), self-propelling without forcing the speed, with a 4-inch blade specially made for green concrete. Equipment and blades made by Soff-Cut Corp., Corona, CA, or equal that will provide similar results.
F. Make marking lines straight, or curved where required by the Drawings, equally spaced and parallel to adjacent lines and walls, edges and other construction, and of uniform depth and cross section, with intersections accurately formed. Continue markings to vertical surfaces interrupting the flatwork.

3.4 BUILT-IN ITEMS

A. Set items furnished under this or other Sections and finish to floor fixtures and other floor features as indicated. Adjust finish to properly connect and fit to other work. Slope floor to drain where indicated.
B. Floor drains and other items furnished and installed under other Sections: Finish concrete surface flush with rims unless detailed otherwise.
C. Exercise particular care with respect to drains to ascertain that they are installed at proper elevations to permit drainage. Do not proceed until corrective work is performed and accepted.

3.5 CONCRETE PLACEMENT

A. Placement in accordance with Chapter 6, ACI 304 and Chapter 7, ACI 303R and the following:
B. Depositing Concrete:

1. Deposit concrete using pump hoses or tremies inserted into the form cavity to minimize segregation and accumulated concrete on formwork and reinforcement. Do not drop concrete more than 30 inches.
2. Deposit concrete continuously between joints in layers not exceeding 30 inches in height and in a manner to avoid inclined lift lines.

    a. First layer of concrete placed against hardened concrete shall not exceed 24 inches in height.

3. Allow fresh face to stand not more than 15 minutes prior to placement of succeeding layer.

C. Consolidating Concrete:

1. Consolidate placed concrete with internal vibration according to ACI 303.1.

2. Use two vibrators at each placement. Optimum size of vibrator head shall be 1 inch to 1 1/2 inches.
3. Do not use vibrators to transport concrete in forms.
4. Vibrators shall be placed into the concrete vertically at a consistent spacing that will thoroughly blend deposits, remove entrapped air and consolidate concrete. Vibrator head shall be inserted rapidly and penetrate at least 12 inches into preceding layer, then withdrawn slowly and uniformly to blend layers and remove a maximum amount of entrapped air.
5. After top layer is placed, the concrete shall be allowed to set for 10 to 15 minutes and then given a final vibration of the top 24 inches.
6. Do not place vibrators against formwork.

3.6 FINISHING FORMED SURFACES

A. General:

1. Remove fins, laitance and loose materials from concrete surfaces when forms are removed.
2. Repair honeycombs, rock pockets, sand runs, spalls and other damaged surfaces by removing the damaged or unsatisfactory area to sound concrete, with slightly undercut edges, and filling-in with the same mix as the adjacent concrete minus the coarse aggregate.
3. Fill-in tie holes with the same mix as the adjacent concrete minus the coarse aggregate.
4. Tamp and float, or trowel patches flush with adjacent surface and to match adjacent concrete texture.

B. Grout cleaned finish (CONC-1): This finish may be indicated as “Smooth Sacked” on the Drawings.

1. No form pattern shall be visible after surfaces are finished as specified.
2. Provide grout cleaned finish to surfaces that have received smooth form finish treatment.
3. Combine one part Portland cement to 1-1/2 parts fine sand by volume, and mix with water to consistency of thick paint. Blend standard Portland cement and white Portland cement, amounts determined by trial patches, so that the final color of dry grout will closely match adjacent concrete surfaces.
4. Thoroughly wet the concrete surface and apply grout uniformly by brushing or spraying immediately on the wet surfaces.
5. Scrub surface with cork float or stone to coat surface and completely fill surface holes.
6. Remove excess grout by scraping, followed by rubbing with clean burlap and remove any visible grout film.
7. Keep grout damp during setting period by means of fog spray at least 36 hours after final rubbing.
8. Complete any area the same day it is started to a natural break such as a corner.
9. In lieu of the above, Contractor may skim coat concrete surfaces using one of the premixed material specified above, after providing a satisfactory sample panel in a location acceptable to the Architect.

C. Related unformed surfaces:

1. At tops of wall, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces, strike off smooth and finish with textured matching the adjacent formed surfaces.
2. Continue the final surface treatment of formed surfaces uniformly across the adjacent unformed surface, unless otherwise shown.

D. Curing:

1. Wet the tops and exposed portions of formed concrete and keep moist until forms are removed.
2. If forms are removed before 14 days after concrete is cast, coat concrete with curing compound Type II applied as specified for curing compound Type III for flatwork below.

3.7 CURING - GENERAL

A. See Section 03 30 00.
B. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
C. Where supplementary cementitious materials are used, take extra precautions to prevent premature drying. Where fly-ash replacement is 35% or higher, floor slabs shall receive at least a 3-day moist cure before application of a curing compound. Other surfaces with the exception of foundations shall receive the approved curing compound immediately after removal of formwork.

3.8 BOARD-FORM REMOVAL AND CURING

A. Use consistent stripping time and curing method for exposed surfaces. Maintain surface appearance that matches approved field sample panels and mockups.
B. For surfaces exposed to weather, leave formwork securely in place for 7 days and cover exposed top surface tightly with impervious sheeting.
C. In hot weather, cover forms during curing period to protect from direct sunlight.
D. Thoroughly wet surface immediately after loosening forms and again after form removal.

3.9 BOARD-FORMED FINISHING

A. General: Match approved mockup, identified and described as indicated, to satisfaction of Architect.
B. As-Cast Formed Finishes: Concrete shall have uniform as-cast surface with minimal additional finishing being anticipated or required. Remove fins and projections, where necessary, by grinding without marring adjacent surface. Repair honeycombed concrete and other defects; surface blemishes will not be filled. Fill tie holes and strike flush with adjacent surfaces.

1. Type 1 Finish: Board formed with 7-1/4” wide boards oriented vertical.

C. Fill tie holes with patching mortar, recessing 1/2 inch from finished surface.
D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces.
E. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.
F. Maintain uniformity of finishes, including alignment of boards, over construction joints, unless otherwise indicated.

3.10 MOISTURE CONTROL

A. In addition to finishing requirements specified, use a water fog spray to reduce plastic shrinkage cracks during flatwork finishing operations when conditions of low humidity and high temperature exist, or use evaporation retarder specified.

1. Immediately after wet concrete has been leveled, or sloped as required, and the shiny film of moisture disappears, start fog spraying and continue until final troweling, by applying a light film of moisture with an atomizing type sprayer.
2. Use frequent light applications of moisture rather than excessive amounts at any one time. Adjust the amount and frequency of fog spray as required by variable conditions of weather, wind, temperature and humidity.

3.11 PATCHING

A. Do not patch any area without specific approval from the Architect on a case-by-case basis.
B. Develop patching technique on mock-up prior to patching in-place concrete for review and approval by the Architect. Use only the same mix for patching as finally developed for the approved sample on the mock-up.
C. Remove all loose concrete prior to patching and thoroughly wet the surface to prevent moisture loss form the patch mix.
D. Pack patch mix into the void and hand dress to match texture and color of adjoining concrete.

3.12 ADJUSTING/CLEANING

A. Clean architectural concrete surfaces to remove gasket adhesives, markings, laitance, dust, and debris.
B. Protect corners, edges, and surfaces of architectural concrete from damage. Pay particular attention to surfaces near the work of other trades.
C. Protect concrete from staining during remainder of construction period, including rust, paint, and oils.
D. Wash and rinse surfaces according to concrete finish applicator's written recommendations. Protect other Work from staining or damage due to cleaning operations.
E. Do not use cleaning materials or processes that could change the appearance of cast-in-place architectural concrete finishes.
F. Protect exposed concrete work as necessary to prevent damage resulting from impact or from subsequent work or rubbish.
G. Protect adjacent work from damages by this work with heavy Kraft paper or polyethylene film.
H. Maintain protection in effective condition for as long as need for protection exists.
I. Control use of water within the building so that no damage to previously installed work or existing structures and finish occurs.

3.13 FORM REUSE

A. Forms shall not be reused for architectural concrete, if there is evidence of surface wear, or other defects that would impair the quality or consistency of appearance of the surface.
B. Board forms shall not be reused.

3.14 FIELD QUALITY CONTROL

A. Conduct a water test, in the Architect’s presence to verify that flatwork drains away from the building and that water flows to drains.
B. Correct non-conforming concrete, or remove and replace defective paving, to the Architect’s satisfaction.

C. Except as specified, acceptance of structure for dimensional tolerances, appearance, and strength will be based on ACI-301, Chapter 18.

END OF SECTION

SECTION 03 35 00 - CONCRETE FINISHING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Finishing formed decorative concrete surfaces and interior concrete flatwork.
2. This Section Supplements Section 03 30 00.

B. Related requirements:

1. Other Section of Division 03 for finishing concrete surfaces.
2. Division 07 for sealants.
3. Division 32 for finishing Portland cement concrete pavement outside building perimeter is specified in Section.

1.2 SUBMITTALS

A. Data: Manufacturer Product Data, including installation instructions where applicable, for the following items.

1. Curing and curing/hardening compounds.
2. Curing paper.
3. Bonding agents.
4. Patching and surfacing compounds.
5. Abrasive aggregates.
6. Control joint filler.
7. Concrete wall polishing equipment and operator qualifications.

1.3 QUALITY ASSURANCE

A. Installer qualifications: Qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.

B. Field Samples: Provide 4-foot by 4-foot Field Samples of each concrete finish specified for the Architect's approval prior to commencing concrete work. Repeat sample panels if first ones prove unsatisfactory. Locate Field Samples where directed at the site.

1. Broom, float and trowel finishes.
2. Sandblasted finish; CONC-2.

1.4 HANDLING/PROJECT CONDITIONS

A. Protect adjacent surfaces from staining and damage by covering them with impermeable coverings securely taped in place.

PART 2 - PRODUCTS

2.1 CONCRETE MATERIALS

A. As specified in Section 03 30 00.
B. Water: Fresh, clean, and free of oil and other materials injurious to concrete.

2.2 ADMIXTURES AND PIGMENTS

A. Admixtures for colored concrete: Only air-entraining admixture permitted.

2.3 CURING COMPOUNDS

A. General: See Section 03 30 00 for Curing requirements.

2.4 MISCELLANEOUS MATERIALS

A. Bonding agent (non-structural)): ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene, Acryl-Bond by Atlas Tech Products or equal.
B. Skim coat: Use the following in lieu of sacking.

1. Ardex Tilt Wall Patch.
2. Rapid Set UnderFixx or Wunderfixx.
3. Euclid Chemicals Tammscrete.
4. WR Meadows Speed Crete.Noxcrete Panel Patch.
5. Joint filler: Homex Expansion Joint by Homasote Co. or equal non-bituminous product compatible with sealant specified in Section 07 92 00. Use in combination with plastic joint cap made by Greenstreak or equal.
6. Joint sealant and back-up rod: As specified in Section 07 92 00.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Joints in flatwork:

1. Set premolded expansion joint strip below finished surface with a slightly tapered, dressed, wood strip, temporarily secured to top of expansion strip to provide space for sealant, or use an extruded plastic strip, approved by the Architect.
2. Install expansion joints in straight or curved lines as indicated within a tolerance not exceeding 1/4-inch in 10 feet.
3. After concrete finishing operations are completed, and concrete is cured, fill void formed by the strip with sealant as specified in Section 07 92 00. Provide joints where indicated and in all cases where concrete flatwork abuts vertical elements such as walls, columns and curbs.

3.2 GENERAL REQUIREMENTS

A. Finish concrete surfaces to produce a uniform appearance throughout area involved and throughout adjacent areas with the same treatment.
B. Where concrete finishing occurs adjacent to finished metal and similar surfaces, particularly where serrated or indented surfaces occur, remove all traces of cement film before allowing concrete to harden.
C. Use no troweling machines within 12 inches of electrical junction and outlet boxes set to finish flush with concrete floors.

    1. Float and trowel such areas by hand with wood floats and steel trowels, using caution so that concrete is finished flush with box cover and matches adjacent surfaces.

D. Concrete stairs:

    1. As soon as concrete is set up sufficiently to permit working, remove riser forms and finish treads and risers in a continuous operation, working from top to bottom.
    2. Slope treads 1/8-inch from base of riser to nosing, run nosings straight and level to template.
    3. Finish nosings and coves at junction of treads and vertical surfaces to a uniform profile throughout. Where abrasive nosings are indicated, embed them in the fresh concrete, level and centered on the tread.

E. Concrete finish will be considered defective and shall be repaired, when the repairs are acceptable to the Architect, or removed and replaced with proper work conforming to Contract Documents, at no additional cost to Owner, when:

    1. It does not match approved sample panels.
    2. It is not true to lines and planes.
    3. It is not properly troweled and surfaced as required, and varies in excess of tolerances specified.
    4. Is scuffed or has a rough surface, except where required.
    5. Does not connect properly to adjoining work.
    6. Does not slope consistently to drains (has bird baths).
    7. Is not properly cured.

3.3 MARKINGS

A. At control joints and elsewhere as indicated, provide markings with a rounded edging or marking tool, to a 1/4-inch radius. In textured work, edge and mark with a combination edging and smoothing tool approximately 1-1/2-inch wide.
B. Make markings within a tolerance not exceeding 1/4-inch in 10 feet.
C. Where indicated, provide cut markings sawn into surface of cured concrete. Coordinate this work with the work of other Sections to avoid damage to adjacent surfaces.
D. Complete sawcutting within 16 hours after casting.
E. Use sawcutting equipment specifically designed to cut 1/8-inch wide joints crisp, sharp, unchipped edges in newly cast concrete. Use cutting machine with a high speed (10,000 rpm minimum), self propelling without forcing the speed, with a 4-inch blade specially made for green concrete. Equipment and blades made by Soff-Cut Corp., Corona, CA, or equal that will provide similar results.
F. Make marking lines straight, or curved where required by the Drawings, equally spaced and parallel to adjacent lines and walls, edges and other construction, and of uniform depth and cross section, with intersections accurately formed. Continue markings to vertical surfaces interrupting the flatwork.

3.4 BUILT-IN ITEMS

1. Set items furnished under this or other Sections and finish to floor fixtures and other floor features as indicated. Adjust finish to properly connect and fit to other work. Slope floor to drain where indicated.
2. Floor drains and other items furnished and installed under other Sections: Finish concrete surface flush with rims unless detailed otherwise.
3. Exercise particular care with respect to drains to ascertain that they are installed at proper elevations to permit drainage. Do not proceed until corrective work is performed and accepted.

3.5 FINISHING FORMED SURFACES

A. General:

1. Remove fins, laitance and loose materials from concrete surfaces when forms are removed.
2. Repair honeycombs, rock pockets, sand runs, spalls and other damaged surfaces by removing the damaged or unsatisfactory area to sound concrete, with slightly undercut edges, and filling-in with the same mix as the adjacent concrete minus the coarse aggregate.
3. Fill-in tie holes with the same mix as the adjacent concrete minus the coarse aggregate.
4. Tamp and float, or trowel patches flush with adjacent surface and to match adjacent concrete texture.

B. Rough form finish:

1. Provide as-cast rough form finish to formed concrete surfaces that will be concealed in the finish work or by other construction, unless otherwise indicated.
2. Standard rough form finish shall be concrete surface having the texture imparted by the form facing material used, with tie holes and defective areas repaired and patched, and fins and other projections exceeding 1/4-inch high rubbed down or chipped off.

C. Smooth form finish:

1. Provide as-cast smooth form finish for formed concrete surfaces that will remain exposed-to-view, or that will be covered with a material applied directly to the concrete, or a material bonded to the concrete such as waterproofing, painting, and similar system.
2. Select form material to impart a smooth, hard, uniform texture and arrange forms in an orderly and symmetrical pattern, with a minimum of seams.
3. Repair and patch defective areas with fins or other projections completely removed and smooth.

D. Smooth rubbed finish:

1. Provide smooth rubbed finish to concrete surfaces so indicated, not later than the day after form removal.
2. Moisten concrete surfaces and rub with carborundum brick or other abrasive until a uniform color and texture is produced.
3. Do not apply cement grout other than that created by the rubbing process.

E. Grout cleaned finish: This finish may be indicated as “Sack and Rub” on the Drawings.

1. See Section 03 30 00 paragraph 3.07 B.

2. In lieu of the above, Contractor may skim coat concrete surfaces using one of the premixed material specified above, after providing a satisfactory sample panel in a location acceptable to the Architect.

F. Related unformed surfaces:

1. At tops of wall, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces, strike off smooth and finish with textured matching the adjacent formed surfaces.
2. Continue the final surface treatment of formed surfaces uniformly across the adjacent unformed surface, unless otherwise shown.

G. Abrasive blasting (sandblasting):

1. Sandblast accent paving panels indicated on the Drawings to expose fine aggregates with occasional exposure of coarse aggregate for a 1/16-inch aggregate exposure.
2. Protect corners with boards when sandblasting so that they remain sharp.
3. Remove loose aggregates, after desired exposure is achieved, with clean air under pressure.

H. Curing:

1. Wet the tops and exposed portions of formed concrete and keep moist until forms are removed.
2. If forms are removed before 14 days after concrete is cast, coat concrete with curing compound Type II applied as specified for curing compound Type III for flatwork below.

3.6 COMPACTING AND FLOATING FLATWORK

A. Bring slabs with monolithic finish to proper level using screeds and strike off with a straightedge. Remove excess water and laitance.

1. Compact and consolidate to embed coarse aggregates.
2. Float and test surfaces with a 10-foot straightedge and eliminate high and low spots to comply with tolerances specified.
3. From this point, use methods and tools necessary to produce surface finish specified.

B. Use continuous screeds of such type and construction and so spaced and located as to produce surface tolerances specified.

3.7 CURING - GENERAL

A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
B. Where supplementary cementitious materials are used, take extra precautions to prevent premature drying. Where fly-ash replacement is 35% or higher, floor slabs shall receive at least a 3-day moist cure before application of a curing compound. Other surfaces with the exception of foundations shall receive the approved curing compound immediately after removal of formwork.

3.8 METHODS OF FINISHING AND CURING FLATWORK

A. See Section 03 30 00 PART 3.

3.9 MOISTURE CONTROL

A. In addition to finishing requirements specified, use a water fog spray to reduce plastic shrinkage cracks during flatwork finishing operations when conditions of low humidity and high temperature exist, or use evaporation retarder specified.

1. Immediately after wet concrete has been leveled, or sloped as required, and the shiny film of moisture disappears, start fog spraying and continue until final troweling, by applying a light film of moisture with an atomizing type sprayer.
2. Use frequent light applications of moisture rather than excessive amounts at any one time. Adjust the amount and frequency of fog spray as required by variable conditions of weather, wind, temperature and humidity.

3.10 FLATWORK FINISHES

A. Integral float finish:

1. Use for curbs, gutters, surfaces to receive roofing and waterproofing membrane, and ceramic and paver tile whether on conventional setting bed over a cleavage membrane or dry-set over concrete slab.
2. After screeding and compacting, finish with a wood float using a rotary or darbied circular motion to produce a uniform texture and finish throughout.

B. Integral smooth steel trowel finish:

1. Use for surfaces to receive carpet, resilient flooring, and surfaces that have no other specific finish specified.
2. Trowel surface until the slabs are finished to a smooth, hard, burnished surface.
3. Consolidate the concrete surface by final hand troweling operation, free of trowel marks, uniform in texture and appearance, and with surface plane tolerance specified. Grind smooth surface defects that would telegraph through applied floor covering system.
4. Where surfaces will receive elastomeric coating and thin set tiles, in lieu of the final troweling, brush surface lightly with a broom or floor brush as recommended by the coating manufacturer. Coordinate finishing operations with the trades applying the elastomeric coating and performing the tile work.

C. Raked or scratched finish:

1. Use for surfaces to receive a bonded topping slab or cementitious setting bed.
2. After screeding and compacting, roughen finish with a garden rake or other appropriate tool to provide a mechanical bond for topping slabs.

D. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces indicated on Drawings where ceramic or quarry tile is to be installed by either thickset or thinset method. While concrete is still plastic, slightly scarify surface with a fine broom perpendicular to main traffic route.

1. Coordinate required final finish with Architect before application.
2. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.

E. Broom finish:

1. After screeding, compacting and floating, sweep the finish with a coarse broom, against a straightedge at right angle to the slope or direction of travel, to produce a uniform non-skid surface with the depressions parallel and at a uniform depth.

2. Time this operation to texture slabs at the same age to obtain a uniform finish throughout.
3. Provide a heavy broom finish at the Pool House Restrooms.

F. Abrasive aggregate finish:

1. Apply abrasive aggregates after first troweling, at uniform rate of not less than 25 lb./100 sq.-foot.
2. After second troweling rub surface of concrete with steel wool pads to remove cement film and expose the aggregates uniformly, or treat surface with a 10 percent solution of muriatic acid.
3. Wash the acid completely from the concrete after treatment and dispose of it legally

3.11 CONCRETE SAW CUTTING

A. Discharge of water, dust or debris from concrete saw cutting to storm or sanitary systems is prohibited. Protect storm and sanitary drains from clogging by dust and debris.

1. Contain and collect water used in concrete saw cutting and sweeping for proper disposal. Suggested controls include wet vacuum and/or absorbents.
2. Use good housekeeping practices at the jobsite. Minimize dust.

3.12 ADJUSTING/CLEANING

A. Protect exposed concrete work as necessary to prevent damage resulting from impact or from subsequent work or rubbish.
B. Protect adjacent work from damages by this work with heavy Kraft paper or polyethylene film.
C. Maintain protection in effective condition for as long as need for protection exists.
D. Control use of water within the building so that no damage to previously installed work or existing structures and finish occurs.

3.13 FIELD QUALITY CONTROL

A. Conduct a water test, in the Architect’s presence to verify that flatwork drains away from the building and that water flows to drains.
B. Correct non-conforming concrete, or remove and replace defective paving, to the Architect’s satisfaction.
C. Except as specified, acceptance of structure for dimensional tolerances, appearance, and strength will be based on ACI-301, Chapter 18.

END OF SECTION

SECTION 03 35 43 - POLISHED CONCRETE FINISH

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Polished concrete finish in accordance with specified requirements to produce:

   a. Aggregate Exposure B.
   b. Concrete Appearance 2 (see Part 3 charts for assistance).

1.2 ADMINISTRATIVE REQUIREMENTS

A. Pre-Concrete Conference, Mandatory.

1. Schedule: Two (2) weeks prior to pouring cast-in-place concrete.
2. Attendance: Concrete installer, polishing installer and batch plant.
3. Review and discuss:

   a. Concrete placement.
   b. Floor flatness (ff) requirements.
   c. Admixtures, additives and mix design approval.

1.3 SUBMITTALS

A. Submittals for Review:

1. Product Data: Manufacturer’s descriptive data for the following:
2. Cleaner
3. Densifier
4. Sealer
5. Accessories
6. Samples: 6-inch x 6-inch samples with sheen level and aggregate exposure.

B. Quality Control Submittals:

1. Manufacturer’s approval of applicator certificate

C. Post-installation surface testing of the following:

1. ASTM D5767 Distinctness-of-Image, %
2. ASTM D4039 Reflection Haze of High-Gloss Surfaces, less than 10

1.4 QUALITY ASSURANCE.

A. Installer Qualifications:

1. Minimum 5 years documented experience in work of this Section.
2. Certified, approved, and accepted manufacturer applicator.
3. Supervisor certified as Craftsman or Master Craftsman by CPAA.

B. Concrete:

1. Installer to accept concrete mix design, finishing agents, admixtures, and curing methods prior to concrete placement.

C. Mockup:

1. Size: Minimum 25 square feet.
2. Install specified materials to for approval.
3. Locate in areas subjected to direct and indirect sunlight during review.
4. Approved mockup may be remain as part of the Work when approved by Architect.

D. Mock- Up Approval Conference, Mandatory

1. Schedule: Four (4) weeks prior to installation
2. Attendance: Owner, Architect, polishing installer,
3. Review and discuss installed mock-up and the following for approval:

   a. Interior environmental requirements.
   b. Approved submittal samples.
   c. Approved aggregate exposure and appearance requirement.

E. ASTM D5767 Distinctness-of-Image requirements
F. ASTM D4039 Reflection Haze of High-Gloss Surfaces requirements

1. Staging and sequencing.
2. Protection of completed work.

G. Coefficient of Friction: Range of 0.35 to 0.45 under wet conditions when tested to ANSI B101.3 upon completion of polishing.

1.5 PROJECT CONDITIONS

A. Prohibit concrete surfaces from the following prior to and after application process:

1. Vehicular traffic and pipe cutting operations in, around and above surfaces
2. Storage of wood, ferrous metals, plastic, or any other materials to could potential create damage
3. Liquid drippings, sprinkler discharge and sprinkler testing on surfaces.
4. Chemical storage, acids and acidic detergents
5. Prevent painting over surfaces without 100% floor protection from overspray.
6. Diaper all hydraulic lines of equipment that must enter polished floor spaces.

B. Maintain interior room conditions of 50 and 90 degrees F.
C. Ventilate areas to promote proper curing of components.
D. Restrict trade traffic from work areas during and after application process.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers:

1. Lythic (www.lythic.com)
2. MirrorCrete (www.floorseal.com)
3. Or equal.

2.2 MATERIALS

A. Surface Cleaner:

1. Type: Water-based, Colloidal silica blended surfactant used as a cutting aid, silica dust reducer and minimize concrete surface scratches during grinding process.
2. Source: Lytic Cleaner by Solomon Colors.
3. VOC Content: Less than 0.5 grams per liter. pH Level: 10.0pH, non-hazardous waste per EPA requirements.

B. Hardener and Densifier:

1. Type: Odorless, non-hazardous, colloidal silica based
2. Source: Lythic Densifier & XL by Solomon Colors
3. VOC Content: max. 50 grams per liter.
4. pH level: 10.0pH, non-hazardous waste per EPA requirements.

C. Sealer and Water Repellent:

1. Type: Water-based, UV resistant, non-yellowing, impregnating sealant, meeting ASTM D1308 stain resistance requirements.
2. Source: Stealth Seal by Solomon Colors.
3. VOC Content: max. 20 grams per liter.

2.3 ACCESSORIES

A. Crack and Spall Repair: Color matching system by MatchPatch Pro (www.MatchPatchPro.com)
B. Concrete Grout: Epoxy- Polyurea based material by one of the following:

1. Quick Mender by VersaFlex: www.versaflex.com
2. TX3 by Hi-Tech Systems: www.hitechpolyurea.com

C. Temporary Protection: Seamless, spill, stain and water resistant sheeting.

1. MT Commercial by Skudo: www.skudousa.com
2. Ram Board by Ram Board: www.ramboard.com

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrate with installer present for conditions affecting work performance of finish.
B. Installation deems acceptance of onsite conditions.

3.2 PREPARATION

A. Clean concrete surfaces of contaminants and patch imperfections as required by manufacturer to match adjacent surfaces/
B. Protect surrounding areas, equipment and finished surfaces from overspray.

3.3 APPLICATION

A. Mechanically clean and polish surface in accordance with the approved gloss and aggregate exposure as approved by Architect and onsite mockup, following the Concrete Polishing Council terminology.

B. Provide all required polishing steps to achieve approved aggregate exposure and appearance to meet approved mockup.
C. Floors shall be smooth with no scratches in polish finish.
D. Crack and Spall Repair: Apply repair in accordance with manufacturer's instructions.
E. Concrete Grout: Apply as needed to provide a smooth floor surface in accordance with manufactures instructions.
F. Polished Concrete Aggregate Exposure Chart

Class	Name	Approximate Surface Cut Depth	Surface Exposure, %
A	Cream Fines	Very little	85 – 95% Cement Fines 5 – 15% Sand Aggregates
B	Sand Aggregate	1/16 inch	85 – 95% Sand Aggregates 5 – 15% blend of cement fines and course aggregates
C	Coarse Aggregate	1/8 - 1/4 inch	80 - 90% Coarse Aggregate 10 - 20% Blend of cement fines and sand aggregates

G. Polished Concrete Appearance Chart

Level	Name	Distinctness –of-Image (DIO) Gloss, ASTM D5767	ASTM D5767, D4039	ASTM D4039
1	Flat (Ground)	Images of objects being reflected have a flat appearance.	0 - 9	< 10
2	Satin (Honed)	Images of objects being reflected have a matte appearance.	10 - 39	
3	Polished	Images of objects being reflected do not have a sharp and crisp appearance but can be easily identified.	40 - 69	
4	Highly Polished	Images of objects being reflected do not have a sharp and crisp as would be seen in a near-mirror like reflection. May require grouting.	70 - 100	

H. Sealer and Water Repellant:

1. Prior to application, perform a five (5) of the following tests at various locations:

   a. ASTM D5767 Distinctness-of-Image
   b. ASTM D4039 Reflection Haze of High-Gloss Surfaces

I. Proceed with sealer and water repellant application, when results of testing are deemed compliant.

3.4 SEALER AND WATER REPELLANT

A. Apply in accordance with manufacturer's instructions.
B. Burnish sealer, as recommended by manufacturer, to produce maximum water resistance.

3.5 FIELD QUALITY CONTROL

A. Measure slip resistance using BOT-3000 slip-tester; ensure compliance with slip resistance rating.
B. Allow floors to cure for 24 hours and install protective covering in high traffic areas; main hallways and entry ways where foot traffic will proceed until substantial completion.

3.6 PROTECTION

A. Close areas to traffic until concrete treatment has cured.
B. Apply manufacturer approved non-staining protective coverings.

END OF SECTION

SECTION 03 35 53 - INTERIOR CONCRETE FLOOR SEALER

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Surface preparation.
2. Application of clear concrete sealer on exposed surfaces of the interior concrete floors indicated. (CONC-4)

1.2 ADMINISTRATIVE REQUIREMENTS

A. Pre-installation meeting:

1. Prior to start of installation, arrange a pre-installation meeting between the sealer manufacturer, the applicator, and related trades whose work will be in contact with the treated surface, including but not limited to those for colored concrete and joint sealers.
2. Record minutes of the meeting, file in the Project file, and send a copy to the Architect.

B. Phasing

1. Where feasible delay sealer application until installation of sealants is complete in joints adjoining surfaces to be coated.
2. Sealer work may precede sealant application only if sealant adhesion and compatibility have been tested and verified using substrate, sealer, and sealant materials identical to those used in the Work.

1.3 SUBMITTALS

A. Data: Manufacturer Product Data of the proposed sealer, including recommended coverage rates, include material test reports indicating and interpreting test results for compliance of water-repellent sealer with criteria specified.

B. Manufacturer certification:

1. Letter from the sealer manufacturer to verify its acceptance of the applicator, acceptance of substrates as satisfactory to receive the specified sealer, and affidavit that sealer is compatible with concrete curing agent used.
2. Duplicate copies of manufacturer affidavit with each shipment of materials delivered to the jobsite certifying that material furnished complies with specified requirements.

1.4 QUALITY ASSURANCE

A. Installer qualifications: Firm with a minimum of 3 consecutive years of experience in application of the sealer proposed for use, or similar sealers, on projects of similar size and scope, and licensed or approved in writing by the sealer manufacturer.

B. Sample panels: When requested by the sealer manufacturer, or necessary to adjust sealer formulation, provide sealer manufacturer with sufficient samples of substrate to be coated to determine exact formulation and coverage rates.

C. Manufacturer inspections:

1. Obtain materials only from manufacturer who will send a qualified technical representative to the Project site before start of this work to verify substrate acceptability. Schedule subsequent visits as required thereafter to review installation procedures and completed work, and to issue warranty specified.

2. Unsatisfactory conditions disclosed by the manufacturer visits to the site shall be promptly and satisfactorily repaired and the areas re-inspected by the manufacturer before work starts or resumes in affected areas.

1.5 JOB CONDITIONS

A. Comply with manufacturer's recommendations regarding environmental requirements, and temperature and conditions of surfaces to receive sealer.

PART 2 - PRODUCTS

2.1 SEALER/MANUFACTURER

A. Basis of design is Liqui-Hard Ultra manufactured by W. R. Meadows or equal by one of the following:

1. Consolideck LS by Prosoco,
2. Hydrozo Silane 40 VOC by BASF.
3. Seal Hard by L&M Construction Chemicals, Inc.
4. L3000 by Pecora Corp.
5. Or equal.

2.2 PERFORMANCE REQUIREMENTS

A. Provide sealer with the following properties based on testing manufacturer standard products, according to test methods indicated, applied to substrates simulating Project conditions using same materials and application methods to be used for Project.

1. Absorption: Minimum 90 percent reduction of absorption after 24 hours in comparison of treated and untreated specimens for hardened concrete: ASTM C 642.
2. Water-vapor transmission: Maximum 10 percent reduction in rate of vapor transmission in comparison of treated and untreated specimens, ASTM E 96.
3. Durability: Maximum 5 percent loss of water repellency after 2500 hours of weathering in comparison to specimens before weathering, ASTM G 53.
4. Permeability: Minimum 80 percent breathable in comparison of treated and untreated specimens, ASTM D 1653.

B. Appearance: When compared visually to an untreated sample under same lighting conditions, the sealer shall not change the color and sheen of the coated substrate and shall be invisible after application and over the life of the building.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Obtain the services of a factory-authorized technical service representative, from the sealer manufacturer, to inspect and approve the substrates before application and to instruct the applicator on the product and application method to be used.
B. Verify that slabs to be sealed are clean, dry and free of dust, dirt, oil, grease and other foreign material that would affect the application and performance of the sealer.
C. Correct detrimental conditions before proceeding with installation.

3.2 PROTECTION

A. Protect adjacent work, including sealant bond surfaces, from spillage or blow-over of sealer.

3.3 APPLICATION

A. Test application:
   1. Before performing this work, including bulk purchase and delivery of products, prepare a small application in an unobtrusive location and in a manner approved by Architect to demonstrate the final effect (visual, physical, and chemical) of planned application.
   2. Proceed with work only after Architect review of test application.

B. Sealer shall be applied by manufacturer-approved applicators using recommended methods and equipment. Do not exceed the application rate recommended by the manufacturer.
C. Do not dilute concrete densifier and chemical hardener.
D. Fresh Concrete
   1. Apply undiluted concrete densifier and chemical hardener as soon as concrete is firm enough to work on after final troweling.
   2. Apply undiluted concrete densifier and chemical hardener at approximately 650 - 800 ft.2/gal. using a low-pressure sprayer.
   3. Do not allow material to puddle on the surface.

3.4 FIELD QUALITY CONTROL

A. The Owner may employ a testing agency to test the in-place sealer in compliance with standards specified.
B. The Owner will pay cost of test, except when test discloses that the sealer tested does not comply with these Specifications; the Contractor shall pay subsequent retests until application meets Specifications requirements.
C. In the event test shows that the sealer is deficient, apply additional sealer.
D. Repetition of the above procedure on all previously treated surfaces will be at Contractor's expense.

3.5 CLEANING

A. Clean sealer from adjacent surfaces immediately after spillage.
B. Comply with manufacturer’s recommendations for cleaning.

END OF SECTION

SECTION 03 54 16 - SELF-LEVELING CEMENTITIOUS UNDERLAYMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes self-leveling cementitious underlayment where monolithic concrete floor slabs to be covered by a finish material do not comply with the tolerances specified either in Section 03 30 00 or the Sections where the floor finishes are specified.
B. Related Requirements: Division 03 for structural concrete.

1.2 SUBMITTALS

A. Data: Manufacturer Product Data for product proposed for use.
B. Tests: Test results as specified below.

1.3 QUALITY ASSURANCE

A. Installer qualifications: Licensed and approved in writing by the underlayment manufacturer.
B. Sample panel:

1. Provide, on a floor slab at the job site, a 10-foot square Sample panel of the cementitious underlayment to demonstrate texture of finish surface and test levelness of finish assembly.
2. Make such modifications as necessary to achieve a Sample panel satisfactory to the Architect or remove and construct additional Sample panel(s).
3. Approved Sample panel may remain in place shall serve as the standard for the same work on the building.

1.4 HANDLING

A. Deliver materials in their unopened packages and protect them from extreme temperatures and moisture.

1.5 JOB CONDITIONS

A. Do not place underlayment when the floor is covered with standing water or if surface temperature is 50 degrees or below.
B. Follow these Specifications and the self-leveling underlayment manufacturer's instructions for placing, finishing, curing and protecting self-leveling underlayment when the conditions require hot weather installation.

PART 2 - PRODUCTS

2.1 MANUFACTURER/MATERIALS

A. Ardex, Inc., Ardex K-15” (basis of design.)
B. Atlas Tech Products “Tech-Level Premier.”
C. Mapei “UltraPLan 1.”
D. Dayton “Levelayer 1.”
E. Tec Specialties “Level Set 300.”

2.2 MATERIALS

A. Cementitious material: Ardex K-15, with total binder of 80 percent cement binder per ASTM C 114.
B. Aggregate: Well-grade, washed gravel for use when underlayment is installed thicker than 1-1/2 inch.
C. Water: Fresh, potable and not warmer than 70 degrees F.
D. Primer: Ardex P-51.
E. Feather edge skim finish: Ardex “Feather Finish.”

2.3 MIX DESIGN

A. As recommended by the underlayment manufacturer’s instructions to obtain a homogenous concrete mass that will flow freely, self-level and screed to a smooth, even surface within the tolerance specified, and shall meet the following:

1. Minimum compressive strength: 4,000 psi at 28-day when tested in accordance with ASTM C 109 MOD.
2. Minimum flexural strength: 1,000 psi at 20-day when tested in accordance with ASTM C 348.

PART 3 - EXECUTION

3.1 EXAMINATION/PREPARATION

A. Verify conditions affecting the work of this Section at the site.
B. Correct detrimental conditions before proceeding with installation.
C. General: Prepare and clean substrate according to manufacturer's written instructions.

1. Treat nonmoving substrate cracks according to manufacturer's written instructions to prevent cracks from telegraphing (reflecting) through underlayment.
2. Fill substrate voids to prevent underlayment from leaking.

D. Concrete Substrates: Mechanically remove, according to manufacturer's written instructions, laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants that might impair underlayment bond.

1. Moisture Testing: Perform tests so that each test area does not exceed [200 sq. ft. (18.6 sq. m)] [1000 sq. ft. (304.8 sq. m)] <Insert area>, and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.

a. Anhydrous Calcium Chloride Test, ASTM F1869: Proceed with installation only after substrates do not exceed a maximum moisture-vapor-emission rate of [3 lb of water/1000 sq. ft.] <Insert value> in 24 hours.
b. Relative Humidity Test: Using in situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum [85] <Insert number> percent relative humidity level measurement, or as recommended by hydraulic cement underlayment manufacturer.

E. Wood Substrates: Mechanically fasten loose boards and panels to eliminate substrate movement and squeaks. Sand to remove coatings that might impair underlayment bond and remove sanding dust.

1. Install underlayment reinforcement recommended in writing by manufacturer.

3.2 PLACEMENT

A. General: Mix and apply underlayment components according to manufacturer's written instructions.

1. Close areas to traffic during underlayment application and for time period after application recommended in writing by manufacturer.
2. Coordinate application of components to provide optimum adhesion to substrate and between coats.
3. At substrate expansion, isolation, and other moving joints, allow joint of same width to continue through underlayment.

B. Prime subfloor leaving no bare spots.
C. Install screeds as recommended by manufacturer and as required to meet tolerance specified below. Set screeds with a laser level.

1. Set screeds so that the minimum thickness of underlayment will be at least 1/8 inch.
2. Where underlayment covers only a small area, grind, chisel and undercut slab, if required, so that the minimum thickness will not be less than 1/8 inch.

D. Place the underlayment in accordance with its manufacturer's instructions in one continuous operation without cold joints. Screed to required level suitable to receive finish flooring materials.
E. Finish underlayment so that it contacts a 10-foot straightedge with a tolerance not exceeding the following at any location:

1. One-sixteen inch under wood flooring.
2. One-eight inch elsewhere.

3.3 PROTECTING/PATCHING

A. Do not permit traffic on the underlayment until it has developed sufficient strength to withstand traffic without damage (minimum of 24 hours).
B. Patch damaged surfaces flush with adjacent areas in accordance with manufacturer's recommendations.

3.4 FIELD QUALITY CONTROL

A. The Contractor shall have 2-inch cubes tested by a reputable and recognized testing laboratory, in accordance with ASTM C 109 MOD., to determine compliance with compressive strength specified.

END OF SECTION

DIVISION 04
MASONRY

SECTION 04 22 00 - CONCRETE UNIT MASONRY

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Concrete masonry units.
2. Reinforcing steel.
3. Mortar, grout and grouting.
4. Bolts, anchors, hardware, metal frames, and other insert items.

B. Related Requirements:

1. Division 01 - General Requirements.
2. Section 03 10 00 - Concrete Forming and Accessories.
3. Section 03 20 00 - Concrete Reinforcing.
4. Section 03 30 00 - Cast-In-Place Concrete.
5. Section 05 12 00 - Structural Steel Framing.
6. Section 08 11 13 - Hollow Metal Doors and Frames.

1.02 REFERENCES

A. American Society for Testing and Materials International (ASTM):

1. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.
2. ASTM C90 - Standard Specification for Load Bearing Concrete Masonry Units.
3. ASTM C94 - Standard Specification for Ready-Mixed Concrete.
4. ASTM C140 - Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units.
5. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar.
6. ASTM C150 - Standard Specification for Portland Cement.
7. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes.
8. ASTM C270 - Standard Specification for Mortar for Unit Masonry.

9. ASTM C404 - Standard Specification for Aggregates for Masonry Grout.

10. ASTM C426 - Standard Test Method for Linear Drying Shrinkage of Concrete Masonry Units.

11. ASTM C476 - Standard Specification for Grout for Masonry.

12. ASTM C780 - Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry.

13. ASTM C1019 - Standard Test Method for Sampling and Testing Grout.

14. ASTM C1314 - Standard Test Method for Compressive Strength of Masonry Prisms.

15. ASTM C1586 – Standard Guide for Quality Assurance of Mortars.

B. Masonry Standards Joint Committee (MSJC), the Masonry Society (TMS), American Concrete Institute (ACI) and American Society of Civil Engineers (ASCE).

1. TMS 602/ACI 530.1/ASCE 6 – Specification for Masonry Structures.

2. TMS 402/ACI 530/ASCE 5 – Building Code Requirements for Masonry Structures.

1.03 SUBMITTALS

A. Mix Design: Submit grout and mortar mix designs. Mix designs shall be signed and sealed by a Civil or Structural Engineer registered in the State of California.

B. Product Data: Submit manufacturer's Product Data for assembly components, materials, and accessories. Submit certificates and data assuring that the proposed materials meet the specified ASTM standards.

C. Samples: Submit Samples for each type of required masonry unit, including reinforcement and accessories.

D. Shop Drawings: Indicate wall reinforcement, splice locations and bending diagrams.

E. Admixtures: Additives and admixtures to mortar and grout shall not be used unless approved by the enforcing agency. Submit product data for any proposed admixture.

1.04 REGULATORY REQUIREMENTS

A. Perform the Work in accordance with CBC, Chapter 21A.

B. Comply with requirements of TMS 602.

1.05 QUALITY ASSURANCE

A. Concrete Masonry Units:

1. Notify the testing laboratory a minimum of 45 days in advance of installing concrete unit masonry, to allow for preconstruction testing of the units.

a. Units will be sampled and tested in accordance with ASTM C140 for compressive strength, absorption and moisture content.

b. Units will be sampled and tested in accordance with ASTM C426 for linear drying shrinkage.

2. The material testing laboratory shall receive concrete masonry unit specimens for testing from masonry unit manufacturer. Number of specimens shall be as indicated in referenced ASTM standard tests. Testing laboratory will perform and send test results to the ARCHITECT and Project Inspector.

B. Portland Cement: Submit certification from the cement manufacturer that the cement proposed for use on the project has been manufactured in accordance with ASTM C150. Certification shall include test results made on cement samples during production.

C. Mortar and Grout Tests: Prior to the beginning of masonry work, mortar and grout will be tested, unless prism tests will be performed as indicated below.

1. Mortar: Shall conform to ASTM C270 Table 2 for Type S mortar.

a. Provide qualifications of mortar as meeting ASTM C270 at the beginning of the job and whenever mix design is changed.

b. Mortars will be evaluated during preconstruction and tested during construction for proportioning or compressive strength in accordance to ASTM C780.

2. Grout: Shall conform to ASTM C476, and will be tested in accordance with ASTM C1019. Compressive strength shall equal or exceed specified compressive strength (*f'm*) at 28 days, but not less than 2,000 psi.

a. Ready-Mix Grout: Grout manufacturer shall furnish batch ticket information in accordance to ASTM C94.

D. Prism Test: The compressive strength of concrete masonry will be determined by the prism test method prior to the start of construction and during construction.

E. Masonry Core Testing: Core testing will be performed in accordance with CBC, Section 2105A.4.

F. Inspection During Installation: A special inspector will continuously observe the installation of reinforced masonry. The Project Inspector shall be responsible for monitoring the work of the special inspector and testing laboratories to ensure that the testing program is satisfactorily completed.

G. OWNER will be responsible for the costs of original tests and inspection.

1.06 DELIVERY, STORAGE AND HANDLING

A. Store units above grade on level platforms or pallets, in a dry location.

B. Store cementitious materials and aggregates in such a manner as to prevent deterioration or intrusion of foreign matter or moisture.

C. Handle units on pallets or flat bed barrows. Free discharge from conveyor units or transportation in mortar trays is not permitted.

PART 2 - PRODUCTS

2.01 MATERIALS

Pool Building: 50% burnished blocks and 50% Precision blocks, color per architectural drawings.

A. Concrete Unit Masonry: Modular **medium** weight conforming to ASTM C90, hollow load-bearing concrete unit masonry. Masonry units shall meet the minimum compressive strength requirements of ASTM C90, or as indicated on project drawings, whichever is greater.

1. Concrete masonry unit sizes shall be as indicated on the drawings.

2. Provide open-end units at walls to be fully grouted.

3. Provide closed-end units at walls and at openings where ends will be exposed in finish Work; provide bond beam blocks where horizontal reinforcement is indicated.

4. Provide special shapes and accessory units at locations indicated on Drawings.

5. Provide units in colors and textures as indicated in the drawings.

6. Masonry unit shall have been cured for a minimum of 28 days.

7. Masonry unit shall have maximum liner shrinkage of 0.065 percent from saturated to oven dry.

B. Portland Cement: ASTM C150, Type II, from one source.

C. Hydrated Lime: ASTM C207, Type S.

D. Aggregates: ASTM C144 for mortar and ASTM C404 for grout.

E. Mortar: ASTM C270, Type S, conforming to the property specifications of CBC Table 2103A.8 (2).

F. Grout: ASTM C476.

G. Admixture for Grout: Grout Aid, as manufactured by Sika Chemical Corp., or equal.

H. Water: Clean, potable, free from substances deleterious to mortar, grout or reinforcement.

I. Reinforcing Steel: Provide and install reinforcing steel in accordance with Section 03 20 00 - Concrete Reinforcing.

J. Cleaning Materials: Sure Klean No. 600 detergent by ProSoCo.

K. Miscellaneous Materials: As required to complete the Work.

L. Anchor Bolts: Shall be hex headed bolts conforming to ASTM A307 Grade A with the dimensions of the hex head conforming to ANSI/ASME B18.2.1.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Discard units with cracks or other defects not complying with requirements of ASTM C 90.

3.02 CONSTRUCTION

A. Construct per applicable provisions of CBC and TMS 602.

B. Conform to TMS 602 for hot and cold weather masonry construction.

3.03 MORTAR AND GROUT MIXING

A. Mortar: Shall provide a minimum strength of 1,800 psi.

B. Grout: Shall provide a minimum strength of 2,000 psi or as indicated in the drawings, whichever is higher. Grout space requirements for coarse and fine grouts shall be per Table 7 of TMS 602. Add Sika Chemical Corp. Grout Aid per manufacturer's instructions.

C. Measurements: Measure in calibrated devices that can be checked at any time.

1. Add water for workable consistency.

2. Shovel measurements are not permitted.

D. Mixing: Mix in accordance to TMS 602.

1. Mortar: Mix cementitious materials and aggregates between three and five minutes in a mechanically operated mixer. Mix dry ingredients with a sufficient amount of water to provide a workable mix. Batches of less than one sack of cement, and fractional sack batches are not permitted.

2. Factory Blended Mortar: Mix in accordance with manufacturer's recommendations.

3. Grout: Add sufficient water for a workable mix that will flow into all voids of the masonry without separation or segregation. Grout slump shall be between 8 and 11 inches.

E. Re-tempering Time Limit: Use mortar within 2 ½ hours after mixing. Discard any mortar that has been mixed longer or that has begun to set. If necessary re-temper within this time limit, by replacing only water lost due to evaporation and by thoroughly remixing.

3.04 INSTALLATION OF MASONRY UNITS

A. Workmanship: Install masonry plumb and true to line with straight level joints of uniform thickness. Comply with TMS 602 tolerances. Maintain masonry clean during and after installation.

1. Lay-out and incorporate embedded hardware items.

2. Assist other trades with built-in items, which require cutting and fitting of masonry.

3. Cut block units with a diamond saw or carborundum wheel. Trowel or chisel cutting is not permitted.

4. Keep cavities clear of droppings and debris. Remove droppings prior to grouting.

B. Reinforcing Steel: Install as indicated on Drawings. Except as otherwise indicated, install reinforcement in accordance with standards of Concrete Reinforcing Steel Institute and to requirements specified in Section 03 2000 - Concrete Reinforcing. Do not splice vertical reinforcement except where indicated on the Drawings.

C. Shoring: Provide temporary shoring for lintels with sufficient strength to carry load without deflecting. Remove temporary shoring not less than 28 days after masonry has been installed.

D. Block Installation: Clean dirt and dust from surfaces before installation. Do not wet masonry units.

1. Foundation preparation: Clean top surface of concrete foundation of dirt, projections and laitance before starting masonry construction. Wet saw cutting of units immediately prior to laying is permitted.

2. Install masonry with mortar to required joint thickness. Install blocks with 3/8-inch mortar bed. Fill head joints solid, install tightly to adjoining units. Provide 3/8-inch joint thickness.

a. Hold racking to a minimum.

b. No toothing is permitted.

c. If it becomes necessary to move a unit after it has been installed, remove the unit, discard the mortar, and install the unit in fresh mortar.

3. Anchor Bolts:

a. Provide 1/2-inch minimum grout space between bolts and masonry

b. Provide 1-inch minimum grout all around embeded anchor.

4. Bond: Unless otherwise indicated, install units in common running bond.

5. Finish Joint Treatment: Unless otherwise indicated, cut both interior and exterior joints flush, and tool slightly concave to a dense, uniform surface.

6. Grouting: Unless noted otherwise on Drawings, completely fill cells with grout.

E. Steel Door Frames:

1. Locate door frames accurately, install plumb, Set frames to floor with powder driven or expansion anchors to floor surface and brace in position before start of masonry installation.

    a. Frames are specified to be furnished with adjustable anchors.

    b. Fill interior of frames solid with mortar or grout as walls are constructed.

2. Provide temporary wood spreaders from jamb to jamb and from head to floor to ensure that jambs do not bow-in, distort from a straight line, or deflect from superimposed loads during construction.

3.05 GROUTING

A. Prior to grouting all cells shall be cleaned so that all spaces to be filled with grout do not contain mortar projections greater than 1/4 inch, loose mortar or foreign material.

B. Grout materials and water contents shall be controlled to provide adequate fluidity for placement without segregation of the constituents, and shall be mixed thoroughly. Reinforcement shall be properly positioned and solidly embedded in the grout.

C. The grouting of any section of wall shall be completed in one day with no interruptions greater than one hour.

D. Between grout pours, a horizontal control joint shall be formed by stopping all wythes at the same elevation and with the grout stopping at 1 ½ inches below a mortar joint, except at the top of the wall. Where bond beams occur, the grout pour shall be stopped a minimum of ½ inch below the top of the masonry.

3.06 LOW-LIFT GROUTING FOR HOLLOW MASONRY UNITS

A. Grouting shall meet the requirements of CBC Section 2104A.1.3.

B. After mortar joints have set, cells are cleaned of mortar and debris, and reinforcement is installed and inspected, grout cells in 4-foot maximum lifts. Horizontal and vertical reinforcement shall be held in place within permitted tolerances by suitable devices.

C. Grout may be installed by pump, tremie or bucket, using hoppers to avoid spilling on exposed surfaces.

D. All grout shall be consolidated and reconsolidated with a mechanical vibrator after placing so as to completely fill all voids and to consolidate the grout. Grouted walls shall be solid and without voids.

3.07 HIGH-LIFT GROUTING OPTION FOR HOLLOW MASONRY UNITS

A. Grouting shall meet the requirements of CBC Section 2104A.1.3 and DSA IR 21-2.

B. High-lift grouting shall apply only to cell sizes available with 8 inch and wider block units. This method is subject to approval of the Division of the State Architect (DSA).

C. Provide bond beam units, inverted for start course, and omit alternate blocks or remove entire face shell of every other unit to allow access to all cells on bottom course for cleanouts.

D. Plug each cleanout by setting a face shell in mortar into opening and securely bracing it in place to prevent displacement. If masonry is not exposed in finish Work, cleanouts may be formed.

E. Grouting: Grouting shall be done in a continuous pour in lifts not exceeding 5-foot in height. The grouting of any section of a wall between control barriers shall be completed in one day, with no interruptions greater than one hour.

F. Consolidating: Grout shall be consolidated by mechanical vibration only, and shall be reconsolidated after excess moisture has been absorbed, but before plasticity is lost. Vibrating of reinforcing steel is not permitted.

3.08 CURING

A. Remove efflorescence, stains, debris, excess grout, and foreign matter.

B. During curing, or for any other purpose, do not saturate masonry with water.

3.09 PARGE COAT

A. Apply parge coat to the earth side of surfaces that are to receive waterproofing.

B. A Portland cement and sand mix (1:3.5 by volume) or Type S mortar may be used for the parge coat.

C. Parging should be applied to damp (not saturated) concrete masonry in two 1/4 inch thick layers. The first coat should be roughened when partially set, hardened for 24 hours, and then moistened before second coat is applied. The second coat should be trowelled to a smooth, dense surface.

D. The parge coat should be beveled at the top to form a wash, and thickened at the bottom to form a cove between the base of the wall and the top of footing.

3.10 CLEANING

A. At completion of masonry Work, remove misplaced mortar, grout or other foreign substances, and clean surfaces which will be exposed in finish Work with specified cleaner, or with clean water and stiff fiber brushes.

B. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

3.11 PROTECTION

A. Protect the Work of this section until Substantial Completion.

END OF SECTION

DIVISION 05
METALS

SECTION 05 05 12 - HOT DIP GALVANIZING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Surface preparation and zinc galvanic coatings applied in the shop or factory to surfaces of iron and steel installed at exterior locations and either totally or partially exposed to weather, humidity, moisture or precipitation; and elsewhere as indicated.
2. Repair of damaged galvanic coatings.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Scheduling and sequencing.
B. Preinstallation meeting:

1. Arrange for a preinstallation meeting between the Contractor, Architect, fabricator and galvanizer, to be held at least 2 weeks prior to the start of surface preparation and galvanizing to review galvanizing methods and processes.
2. Review Project schedule, scope of work indicated to be galvanized, coordination between fabricator and galvanizer, scheduled finish, application of coatings, submittals and approvals.
3. Review fabricator's Shop Drawings to verify steel chemical composition suitability to receive zinc coating and to evaluate whether proposed fabrication methods will result in components and accessories that are suitable for galvanizing. Identify conditions that would be unsuitable for galvanizing, or that would require special processing techniques, and coordinate required fabrication modifications.
4. Review procedures to be followed in order to provide proper protection and touchup of zinc coatings during and after installation of components and accessories. Determine and reach agreement on the maximum aggregate galvanized coating area and maximum local damage size permitted to be repaired, whether in the shop or field, in compliance with the renovation guidelines of ASTM A 123.
5. Identify potential concerns during the galvanizing process, including handling issues that may require design modification before galvanizing proceeds.
6. Record minutes of the meeting, decisions made and corrective measures to be taken before galvanizing starts. Send copy of the minutes to the Architect no later than 3 days following the meeting.

1.3 SUBMITTALS

A. Submittals:

1. Shop Drawings: Submit galvanizing schedule indicating material category, material thickness and minimum coating grade mil thickness for each item to be galvanized.
2. Samples: Submit three 12-inch square Samples for flat work, and three 12-inch long Samples for each type of linear work, showing full range of spangle variation and general appearance to be expected in the Work.

3. Certificates: Upon completion of the Work, submit certificate signed by the galvanizer stating that coated items have been hot dip galvanized in compliance with the specified requirements.

    a. Indicate ASTM standard used for the hot dip galvanized coating, and certify coating meets or exceeds that ASTM standard's minimum requirements.
    b. Provide detailed description of the material processed and of quenching, if any.

1.4 QUALITY ASSURANCE

A. Galvanizer's qualifications: Firm and individuals with a minimum of 5 consecutive years' experience in the preparation of surfaces and the application of hot dip galvanized coatings for projects similar in material, design, complexity and extent to this Project, and whose work has resulted in applications with a record of successful in-service performance.
B. Follow the procedures in the Quality Assurance Manual of the American Galvanizers Association
C. Coordination Between Fabricator and Galvanizer: Prior to fabrication, fabricators shall submit approved fabrication shop drawings to the galvanizer. The Galvanizer shall review fabricator'' shop drawings for suitability of materials for galvanizing and coatings and coordinate any required fabrication modifications.

1.5 HANDLING

A. Handle all articles to be galvanized to avoid mechanical damage.
B. Storage:

    1. Load and store galvanized products to prevent formation of wet storage film.
    2. Wet storage stain:

        a. When galvanized articles are packed loosely together for periods of time, take adequate precautions against wet storage stain. Minimize wet storage stains by maintaining a low humidity environment around the material and by providing adequate ventilation between stacked pieces.
        b. If outdoor stacking is unavoidable, raise the articles from the ground and separate with strip spacers to provide air circulation to all surfaces of the galvanized piece.
        c. Incline to provide maximum drainage.
        d. Do not leave uncovered material standing where it may be exposed to rain, mist, condensation, and frost.

C. If galvanized components must be stacked or stored in humid environments, apply an after-galvanized treatment to inhibit wet storage stain.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Zinc: ASTM B 6, Prime Western (PW) Grade.

B. Bath composition: ASTM 123.

2.2 ACCESSORIES

A. Galvanizing repair solder:

1. Description: Lead-free high zinc content solder formulated specifically for repairs to galvanized steel surfaces.
2. Products: Provide one of the following.

a. “All-State Galvover” by ESAB.
b. “Galvanizing Solder” by Belmont Metals.
c. “Galvanite” by Kapp Alloy & Wire, Inc.
d. “Zaclon Alloy Repair Rod” by Zaclon, Inc.

B. Galvanizing repair paint: “94-H20 Hydro-Zinc” by Tnemec Co., or equal by Valspar Corp., Devoe Coatings, ZRC Worldwide, or Ameron Protective Coating Division.

2.3 FABRICATION

A. Fabricate structural steel in accordance with Class I, II, III guidelines as described in AGA's Recommended Details for Galvanized Structures.
B. Fabrication practices for products to be in accordance with the applicable portions of ASTM A 143, A 384, and A 385, except as specified herein. Avoid fabrication techniques that could cause steel distortion or embrittlement.
C. Fabricator shall consult with architect/engineer and hot-dip galvanizer regarding potential concerns, including handling issues, during the galvanizing process that may require design modification before fabrication proceeds.
D. Remove all welding slag, splatter, anti-splatter compounds and burrs prior to delivery for galvanizing.
E. Provide holes and/or lifting lugs to allow for handling during galvanizing.
F. Place vent holes where they will drain by gravity in the finished assembly. Plug vent holes with lead or silicone sealant after galvanizing.
G. Avoid unsuitable marking paints. Consult with the galvanizer about removal of grease, oil, paint and other deleterious material prior to fabrication.
H. Remove by blast-cleaning, or other methods, surface contaminants and coatings that are not removable by the normal chemical cleaning process in the galvanizing operation.

2.4 FINISHES

A. Appearance: Bright minimized spangle zinc (galvanized) finish.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions affecting the work of this Section.
B. Consult with Architect and fabricator regarding potential concerns during the galvanizing process, including handling issues that may require design modification before galvanizing proceeds.
C. Correct detrimental conditions before proceeding with installation.
D. Reject excessively pitted and rusted components.

3.2 SURFACE PREPARATION

A. Remove oil, organic materials, mill primers, paint, crayon marks, grease or oil-based marks, and similar materials from metal before galvanizing. When directly identifying an item to be galvanized, provide an identification tag (preferred), or mark component on a surface that will be concealed in the Work, by stamping or with a seep stencil.
B. Pre-clean iron or steel with an alkaline cleaner, then acid pickle and flux; or blast-clean and flux (recommended method of processing high strength steels for galvanizing to avoid hydrogen embrittlement). The flux treatment must be a separate bath (dry kettle galvanizing).
C. Follow procedures outlined in ASTM A 1430 to safeguard against and test for possible embrittlement.

3.3 GALVANIZING

A. Comply with the American Galvanizing Association publication “The Design of Products to be Hot Dip Galvanized After fabrication,” and the following.
B. Coating application:

1. Galvanize non-fabricated materials, fabricated components and assembled steel items in compliance with ASTM A 123.
2. Galvanize castings and hardware items including bolts, nuts, washers and similar threaded fasteners, in compliance with ASTM A 153.
3. Safeguard products against steel embrittlement in conformance with ASTM A 143.
4. Handle all articles to be galvanized in such a manner as to avoid any mechanical damage and to minimize distortion.

C. Coating thickness: Produce galvanized items having continuous, reasonably smooth and uniformly thick zinc coating.

1. Comply with the requirements of ASTM A 123 Table 2 for minimum coating thickness grade, as determined by material category and material thickness indicated in Table 1.
2. When galvanizing assemblies of components of varying material category and material thickness, provide minimum coating thickness grade for all members equal to or exceeding the maximum highest material category coating grade.
3. Allow for thickness of coating in threaded items.
4. Excessive dross, rough surfaces, blisters, lumpiness, runs, edge tears and spikes are not acceptable.

D. Use caution to avoid warpage and distortion in the galvanized assemblies:

1. Assemblies constructed of sheets or plates from 20-gage to 1/4-inch thick assembled by welding or riveting to bar-size shapes, angles. Channels, Tees, etc., commonly distort and warp and shall not be provided for the Project.
2. Warpage is accentuated by use of nonsymmetrical sections such as channels. Channels require straightening after galvanizing. Avoid using channels and other nonsymmetrical sections for the framework of a sheet metal assembly to be hot-dip galvanized where symmetrical shapes or sections can be used.
3. The use of wide radii bends in corners is recommended for sheet metal work.
4. Avoid unequal thickness of metal wherever possible due to the different rates of heating and cooling during the galvanizing operation and the effect of unequal expansion and contraction.
5. Continuously weld joints using balanced welding techniques to reduce uneven thermal stresses.
6. Provide temporary bracing and/or reinforcing to minimize or prevent warpage and distortion during galvanizing.
7. Seal welds to prevent moisture penetration in the welded joint.

E. Coating Appearance: Provide minimized spangled zinc coating. Coated surface for components such as handrails shall be smooth and without pits, craters, dross and other imperfections.

3.4 QUENCHING

A. Items scheduled to receive paint or coating:

1. Do not water-quench galvanized items scheduled to be painted immediately after galvanizing.
2. Do not chromate-quench galvanized items scheduled to be painted.
3. Do not phosphate-quench galvanized items scheduled to receive zinc-rich paint.

B. Items scheduled to remain uncoated: If required to prevent wet storage staining, quench freshly galvanized steel in a passivating solution.

3.5 REPAIR/RESTORATION

A. Repair areas damaged by welding, flame cutting or during handling, transport or erection by one of the approved methods in accordance with ASTM A 780 whenever damage exceeds 3/16-inch in width. Minimum thickness requirements for the repair are those described in ASTM A 123, Section 6.2.
B. Exposed-in-service galvanized surfaces scheduled to remain unfinished: Apply galvanizing repair solder in compliance with method specified in ASTM A 780, Annex A1.
C. Both concealed-in-service galvanized surfaces scheduled to remain unfinished and exposed galvanized surfaces scheduled to receive a field-applied coating: Apply galvanizing repair paint in compliance with method specified in ASTM A 780, Annex A2, to a minimum DFT of 8 mils, and overlapping undamaged area at least 2 inches.

3.6 FIELD QUALITY CONTROL

A. Tests and Inspection: Perform inspection and testing of zinc coatings under the guidelines outlined in the American Galvanizer's Association (AGA) publication "Inspection of Products Hot Dip Galvanized After Fabrication."

1. Take thickness measurements with either a magnetic, electromagnetic, or eddy-current gage to ensure the applied zinc coating is as specified.
2. Determine whether zinc coating thickness on metal surfaces conforms to the minimum specified levels.
3. Re-coat non-conforming work.

3.7 PROTECTION

A. When galvanized items will be packed loosely together for periods of time, take adequate precautions to prevent wet storage stain by providing adequate ventilation between stacked items and by maintaining a low-humidity environment around galvanized material.
B. If outdoor stacking is unavoidable, store galvanized items off the ground and provide strip spacers in order to separate items and to provide air circulation around all surfaces of galvanized items.

1. Incline galvanized items to provide maximum drainage.
2. Do not leave galvanized items uncovered where they may be exposed to rain, mist, high humidity, condensation, or frost.

END OF SECTION

SECTION 05 12 00 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Structural steel.
2. Architecturally exposed structural steel.

B. Related Requirements:

1. Division 01 - General Requirements.
2. Section 03 30 00 - Cast-In-Place Concrete.
3. Section 04 22 00 - Concrete Unit Masonry.
4. Section 05 05 13 – Hot-Dip Galvanizing.
5. Section 05 30 00 - Metal Decking.
6. Section 05 50 00 - Metal Fabrications.
7. Section 05 52 00 – Steel Railings.
8. Section 09 90 00 - Paints and Coatings.

1.02 REFERENCES

A. CBC Chapter 22A.

B. American Institute of Steel Construction (AISC):

1. AISC – Steel Construction Manual:
   a. AISC 360 Specifications for Structural Steel Buildings.
   b. AISC Code of Standard Practice for Steel Buildings and Bridges.
   c. RCSC Specification for Structural Joints Using High Strength Bolts.
2. AISC 341 - Seismic Provisions for Structural Steel Buildings.

C. ASTM International (ASTM):

1. ASTM A36 – Standard Specification for Carbon Structural Steel.

2. ASTM A53 – Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

3. ASTM A108 – Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished.

4. ASTM A123 – Standard Specification for Zinc (Hot-Dipped Galvanized) Coatings on Iron and Steel Products.

5. ASTM A153 – Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

6. ASTM A307 – Standard Specification for Carbon Steel Bolts and Studs, and Threaded Rod 60000 PSI Tensile Strength.

7. ASTM A435 - Standard Specification for Straight-Beam Ultrasonic Examination of Steel Plates.

8. ASTM A500 – Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Round and Shapes.

9. ASTM A501 - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.

10. ASTM A572 – Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.

11. ASTM A653 – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

12. ASTM A673 - Standard Specification for Sampling Procedure for Impact Testing of Structural Steel.

13. ASTM A992 – Standard Specification for Structural Steel Shapes.

14. ASTM C1107 – Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).

15. ASTM E23 - Standard Test Methods for Notched Bar Impact Testing of Metallic Materials.

16. ASTM E112 - Standard Test Methods for Determining Average Grain Size.

17. ASTM F3125 - Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions.

18. ASTM F436 – Standard Specification for Hardened Steel Washers Inch and Metric Dimensions.

19. ASTM F959 - Standard Specification for Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners, Inch and Metric Series.

20. ASTM F1554 – Standard Specification for Anchor Bolts, Steel, 36, 55 and 105-Ksi Yield Strength.

21. ASTM F1852 – Standard Specification for Twist Off Type Tension Control Structural Bolt/Nut/Washer Assemblies, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.

D. American Welding Society (AWS):

1. AWS D1.1 – Structural Welding Code - Steel.

2. AWS D1.8 – Structural Welding Code – Seismic Supplement.

3. AWS A2.4 – Standard Symbols for Welding, Brazing, and Nondestructive Examination.

4. AWS B2.1 – Base Metal Grouping for Welding Procedure and Performance Qualification.

E. SSPC – Steel Structures Painting Council:

1. SSPC-SP2 - Hand Tool Cleaning.

2. SSPC-PA-1 - Shop, Field and Maintenance Coating of Metals.

1.03 REGULATORY REQUIREMENTS

A. Structural steel shall conform to CBC requirements, except that steel manufactured by acid Bessemer process is not permitted for structural purposes.

B. Sheet and strip steel other than those listed in CBC, if provided for structural purpose, shall comply with DSA requirements.

1.04 SUBMITTALS

A. Shop Drawings: Submit Shop Drawings, including complete details and schedules for fabrication and shop assembly of members, and details, schedules, procedures and diagrams showing the sequence of erection. Fully detail minor connections and fastenings not shown or specified in the Contract Documents to meet required conditions using similar detailing as shown in the Contract Documents. Include a fully detailed, well controlled sequence and technique plan for shop and field welding that minimizes locked in stresses and distortion; submit sequence and technique plan for review by the ARCHITECT.

1. Include details of cuts, connections, camber, and holes in accordance with Figure 4.5 of AWS D1.1 or AISC Chapter J, weld position plan and other pertinent data. Indicate welds by standard AWS symbols, and show size, length and type of each weld.

2. Provide setting drawings, templates, and directions for installation of anchor bolts and other anchorages to be installed for Work specified in other sections.

3. Erection and Bracing Plan and Erection Procedure: Submit an erection and framing plan, including columns, beams, and girders, signed and sealed by a Structural or Civil Engineer registered in the State of California in accordance with Title 8 California Code of Regulations, Section 1710, Structural Steel

Erection. Maintain a copy at the Project site as required by the California Division of Industrial Safety.

4. Submit a list of steel items to be galvanized.

5. Include identification and details of Architecturally Exposed Structural Steel (AESS) members, if applicable.

B. Product Data: Submit copies of fabricator's specifications and installation instructions for the following products. Include laboratory test reports and other data required demonstrating compliance with these Specifications:

1. Structural steel, each type; including certified copies of mill reports covering chemical and physical properties.

2. Welding electrodes.

3. Welding gas.

4. Unfinished bolts and nuts.

5. Structural steel primer paint.

6. High-strength bolts, including nuts and washers.

C. Manufacturer's Mill Certificate: Submit, certifying that products meet or exceed specified requirements.

D. Mill Test Reports: Submit manufacturer's certificates, indicating structural yield and tensile strength, destructive and non-destructive test analysis.

E. Charpy-V-Notch (CVN) Impact Test: Submit certified copies of Charpy-V-Notch (CVN) Impact Test by the manufacturer for applicable steel members and components.

1. Charpy-V-Notch (CVN) Impact Test for Base Metal: Moment frame columns and girders subjected to Charpy-V-Notch impact test in accordance with "Seismic Provisions for Structural Steel Buildings", Part I, Section 6.3, as modified by Supplement 1.

2. Charpy-V-Notch test shall be performed by the manufacturer employing Test Frequency (P) in accordance with ASTM A673 and utilizing standard specimen sizes shown in Figure 6 of ASTM E23.

F. Submit certified copies of tests by manufacturer for fine grain practice. Structural steel base material, as described above, shall be manufactured to be fully killed and fine grained having grain size number 5 or better as determined by ASTM E112.

G. Welding Procedure Specifications (WPS): Submit weld procedures for all welding on project to OWNER's testing laboratory for approval. After approval by testing laboratory, submit to ARCHITECT for Record. Weld procedures shall be qualified as described in AWS D1.5, AISC 341 and AISC 358, as applicable. Weld procedures shall indicate joints details and tolerances, preheat and interpass temperature, post-heat treatment, single or multiple stringer passes, peening of stringer passes for groove welds except for the first and the last pass, electrode type and size, welding current, polarity and amperes and root treatment. The welding variables for each stringer pass shall be recorded and averaged;

from these averages the weld heat input shall be calculated. Submit the manufacturer's product data sheet for all welding material used.

H. Welder's Certificates: Field welders shall be Project certified in accordance with AWS D1.1. Shop welders shall be Project certified for FCAW in accordance with AWS D1.1.

I. Test Reports: Submit reports of tests conducted on shop and field welded and bolted connections. Include data on type of test conducted and test results.

J. Welding Material Certification: Provide certificate that welding material complies with specifications. Submit to OWNER's testing laboratory.

1.05 QUALITY ASSURANCE

A. Comply with the following as a minimum requirement, except as otherwise indicated:

1. American Institute of Steel Construction (AISC) "Code of Standard Practice for Steel Buildings and Bridges, modified as follows:

a. Replace "Structural Design Drawings" with "Contract Documents' throughout the document.

b. Paragraph 3.2 is hereby modified in its entirety as follows: "Contract Documents including but not limited to architectural, mechanical, plumbing, electrical, civil and kitchen design drawings and specifications shall be used as supplement to the structural plans to define configurations and construction information."

c. Delete Paragraph 3.3.

d. In Paragraph 4.4, delete the following sentence: "These drawings shall be returned to the Fabricator within 14 calendar days."

e. Delete Paragraph 4.4.1.(a) in its entirety.

f. Paragraph 4.4.2 is hereby modified in its entirety as follows: "No review action, implicit or explicit, shall be interpreted to authorize changes in the Contract Documents."

2. Perform welding in accordance with AWS Standards, AWS D1.1, and California Building Code Section 2204A.1 and approved Weld Procedure Specifications (WPS).

B. Shop fabrication shall be inspected in accordance with CBC.

C. Erect mock-up panel of fabricated structural steel meeting Architecturally Exposed Structural Steel (AESS) tolerances for exposed areas. Approval by ARCHITECT is required. Mock-up to remain for comparison but may not be left as part of the work.

1.06 DELIVERY, STORAGE AND HANDLING

A. Store structural steel above grade on platforms, skids or other supports.

B. Protect steel from corrosion.

C. Store welding electrodes in accordance with AWS D 12.1.

D. Store other materials in a weather-tight and dry place until installed into the Work.

PART 2 - PRODUCTS

2.01 GENERAL

A. Stock Materials: Provide exact materials, sections, shapes, thickness, sizes, weights, and details of construction indicated on Drawings. Changes because of material stock or shop practices will be considered if net area of shape or section is not reduced thereby, if material and structural properties are at least equivalent, and if overall dimensions are not exceeded.

B. Shapes, bars, plates, tubes and pipes shall be made of materials with at least 16 percent recycled content if produced from Basic Oxygen Furnace (BOF) or at least 67 percent recycled content if produced from Electric Arc Furnace (EAF).

2.02 MATERIALS

A. Structural Steel: Wide flange shapes shall conform to ASTM A992 grade 50. Other steel shall conform to ASTM A36.

B. Unfinished Threaded Fasteners: ASTM A307, Grade A, regular low carbon bolts and nuts.

C. High-Strength Threaded Fasteners: ASTM F3125 or ASTM F959 quenched and tempered, steel bolts, nuts and washers.

D. Primers: Lead-free metal primer:

1. SSPC-Paint 20, Zinc-Rich Coating Inorganic and Organic.

2. SSPC-Paint 23, Latex Primer for Steel Surfaces.

E. Steel Pipe: ASTM A53, Type E or S, Grade B.

F. Structural Tubing:

1. Hot-formed, ASTM A501.

2. Cold-formed, ASTM A500, Grade B.

G. Galvanizing: ASTM A123.

H. Shear stud connectors: ASTM A108, Grade 1015 forged steel, headed, uncoated, granular flux filled shear connector or anchor studs by Nelson Stud Welding Division, or equal.

I. Grout: ASTM C1107, non-shrink type, pre-mixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing additives, capable of developing a minimum compressive strength of 7,000 psi at seven days; of consistency suitable for application and a 30 minute working time.

2.03 FABRICATION

A. Fabricate in accordance to AISC Code of Standard Practice for Steel Buildings and Bridges and AISC 360.

B. Cleaning and Straightening Materials: Materials being fabricated shall be thoroughly cleaned of scale and rust, and straightened before fabrication. Cleaning and straightening methods shall not damage material. After punching or fabrication of component parts of a member, twists or bends shall be removed before parts are assembled.

C. Cutting, Punching, Drilling and Tapping: Unless otherwise indicated or specified, structural steel fabricator shall perform the cutting, punching, drilling and tapping of Work so that Work of other trades will properly connect to steel Work.

D. Milling: Compression joints depending on contact bearing shall be furnished with bearing surfaces prepared to a common plane by milling.

E. Use of Burning Torch: Oxygen cutting of members shall be performed by machine. Gouges greater than 3/16 inch that remain from cutting shall be removed by grinding. Reentrant corners shall be shaped notch free to a radius of at least 1/2 inch. Gas cutting of holes for bolts or rivets is not permitted.

F. Galvanizing: After fabrication, items indicated or specified to be galvanized shall be galvanized per Section 05 5013, Hot-Dip Galvanizing.

G. Welding:

1. Type of steel furnished in welded structures shall provide chemical properties suitable for welding as determined by chemical analysis. Welds shall conform to the verification and inspection requirements of CBC Chapter 17A. Conform to AWS D1.1, and CBC Chapter 22A.

2. Materials and workmanship shall conform to the requirements specified herein and to CBC requirements, modified as follows:

   a. No welded splices shall be permitted except those indicated on Drawings unless specifically reviewed by the ARCHITECT.

   b. Drawings will designate joints in which it is important that welding sequence and technique be controlled to minimize shrinkage stresses and distortion.

3. Welding shall be performed in accordance with requirements of the AWS Structural Welding Code.

4. Architecturally Exposed Structural Steel: Verify that weld sizes, fabrication sequence, and equipment used for Architecturally Exposed Structural Steel will limit distortions to allowable tolerances. Prevent surface bleeding of back-side welding on exposed steel surfaces. Grind smooth exposed fillet welds ½ inch and larger. Grind flush butt welds. Dress exposed welds.

5. Remove erection bolts on welded, Architecturally Exposed Structural Steel; fill holes with plug welds; and grind smooth at exposed surfaces.

H. Shop Finish:

1. Notify the Project Inspector when Work is ready to receive shop prime coat. Work shall be inspected by the Project Inspector before installation of primer.

2. Structural steel and fittings shall receive a coat of primer, except:

   a. Surfaces that will be galvanized.

   b. Surfaces that will be fireproofed.

   c. Surfaces that will be field welded.

   d. Surfaces in contact with concrete.

   e. Surfaces high strength bolted.

3. The primer specified shall be spray applied, filling joints and corners and covering surfaces with a smooth unbroken film. The minimum dry film thickness of the primer shall be 2.0 mils.

I. Comply with fabrication tolerance limits of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for structural steel.

J. Fabricate Architecturally Exposed Structural Steel with exposed surfaces smooth, square, and free of surfaces blemishes, including pitting, rust and scale seam marks, roller marks, rolled trade names, and roughness.

1. Remove blemishes by filling, grinding, or by welding and grinding, prior to cleaning, treating and shop priming.

2. Comply with fabrication requirements, including tolerance limits of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for Architecturally Exposed Structural Steel.

K. Architecturally Exposed Structural Steel: use special care in unloading, handling and erecting the steel to avoid marking or distorting the steel members. Minimize damage to any shop paint when temporary braces or erection clips are used. Avoid unsightly surfaces upon removal. Grind smooth tack welds and holes filled with weld metal or body solder. Plan and execute all operations in such a manner that the close fit and neat appearance of the structure will not be impaired.

2.04 SHOP AND FIELD QUALITY CONTROL

A. A special inspector, approved by DSA to inspect the Work of this section, shall inspect high-strength bolted connections. OWNER will provide a DSA approved independent testing laboratory to perform tests and prepare test reports in accordance with CBC 1704A. The Project Inspector shall be responsible for monitoring the work of the special inspector and testing laboratories to ensure that the testing program is satisfactorily completed.

B. An AWS certified welding inspector (CWI), approved by DSA to inspect the Work of this section, shall inspect welded connections in accordance with CBC 1705A.2.5. The OWNER will provide a DSA approved independent testing laboratory to perform tests and prepare test reports. The Project Inspector shall be responsible for monitoring the work of the special inspector and testing laboratories to ensure that the testing program is satisfactorily completed.

C. The independent testing laboratory shall conduct and interpret test and state in each report whether test specimens comply with requirements, and specifically state any deviations there from.

D. Provide access to all places where structural steel Work is being fabricated or produced so required inspection and testing can be performed.

E. The independent testing laboratory may inspect or test structural steel at plant before shipment; however, ARCHITECT reserves the right at any time before Contract Completion to deem materials not in compliance with the specified requirements as defective Work.

F. Correct defects in structural Work when inspections and laboratory test reports indicate noncompliance with specified requirements. Perform additional tests as may be required to reconfirm noncompliance of original Work, and as may be required to show demonstrate compliance of corrected Work.

G. Inspection of Structural Tube Steel/Hollow Structural Sections (HSS): Structural tube steel members (round, square, rectangular), disregarding steel origin, will be inspected during shop fabrication per DSA Bulletin 07-03. Inspector will perform a visual examination of the seam weld area for visible discontinuities. When defects are suspected, non-destructive testing will be considered.

H. Welding: Inspect and test during fabrication and erection of structural steel assemblies as follows:

1. Certify welders and conduct inspections and tests as required. Record types and locations of defects found in the Work. Record Work required and performed to correct deficiencies.

2. Inspect welds. Welds shall be visually inspected before performing any non-destructive testing. Groove weld shall be inspected by ultrasonic or other approved non-destructive test methods. Testing shall be performed to AWS D1.1 Table 6.3 cyclically loaded non-tubular connections.

3. Ultrasonic testing shall be performed by a specially trained and qualified technician who shall operate the equipment, examine welds, and maintain a record of welds examined, defects found, and disposition of each defect. Repair and test defective welds.

4. Rate of Testing: Completed welds contained in joints and splices shall be tested 100 percent either by ultrasonic testing or by radiography.

5. Welds, when installed in column splices, shall be tested by either ultrasonic testing or radiography.

6. Base metal thicker than 1 ½-inch, when subjected to through-thickness weld shrinkage strains, shall be ultrasonically inspected by shear wave methods for discontinuities directly behind such welds. Tests shall be performed at least 48 hours after completed joint has cooled down to ambient air temperature.

7. Material discontinuities shall be reviewed based on the defect rating in accordance with the criteria of AWS D1.1 table 6.3 by the ARCHITECT and DSA.

8. Other method of non-destructive testing and inspection, for example, liquid dye penetrate testing, magnetic particle inspection or radiographic inspection may be performed on weld if required.

9. Lamellar Tearing: Lamellar-tearing resulting from welding is a crack (with zero tolerance) and shall be repaired in accordance with AWS D1.1.

10. Lamination: The rejection criteria shall be based on ASTM A435.

11. Where testing reveals lamination or conditions of lamellar tearing in base metal, the steel fabricator shall submit a proposed method of repair for review by the ARCHITECT. Test repaired areas as required.

12. Magnetic Particle Testing: Magnetic particle testing when required shall be provided in accordance with AWS D1.1 for procedure and technique. The standards of acceptance shall be in accordance with AWS D1.1 – Qualification.

I. Lamellar Tearing: Prior to welding plates 1 to 1-½ inch thick and greater and rolled shapes within the distance from 6 inches above the top of the joint to 6 inches below the bottom of the joint shall be checked by ultrasonic testing for laminations in base metal which may interfere with the inspection of the completed joint. Should these defects occur, members will be reviewed by the ARCHITECT and DSA. Welding procedure specifications in paragraph 1.04.G specify welding practices to minimize lamellar tearing.

J. Prior Testing of Base Material: Test material before fabrication.

K. Lines and levels of erected steel shall be certified by a State of California licensed surveyor as set forth in related Division 01 section.

L. Welded studs shall be tested and inspected by the special inspector in accordance with requirements of AWS D1.1 – Stud Welding.

M. Record Drawings: After steel has been erected, correct or revise Shop Drawings and erection diagrams to correspond with reviewed changes performed in the field.

PART 3 - EXECUTION

3.01 PREPARATION

A. Verify governing dimensions and conditions of the Work before commencing erection Work.

1. Report discrepancies between drawings and field dimensions to ARCHITECT before commencing work.

2. Beginning of installation means erector accepts existing conditions and surfaces underlying or adjacent to work of this section.

B. Provide temporary shoring and bracing, and other support during performance of the Work. Remove after steel is in place and connected, and after cast-in-place concrete has reached its design strength.

C. Coordinate prime coat repair and application with requirements of Section 09 9000.

3.02 ERECTION

A. Install structural steel accurately in locations, to elevations indicated, and according to AISC specifications and CBC requirements.

B. Clean surfaces of base plates and bearing plates.

1. Install base and bearing plates for structural members on wedges, shims, or setting nuts as required.

2. Tighten anchor bolts after supported members have been positioned and plumbed. Do not remove wedges or shims; cut off flush with edge of base or bearing plate before packing with grout.

C. Maintain erection tolerances of structural steel within AISC Code of Standard Practice for Steel Buildings and Bridges.

1. Architecturally Exposed Structural Steel members and components, plumbed, leveled and aligned to a tolerance not to exceed one-half the amount permitted for structural steel. CONTRACTOR to provide adjustable connections between Architecturally Exposed Structural Steel and the structural steel frame or the masonry or concrete supports, in order to provide the erector with means for adjustment.

D. Align and adjust various members forming part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact after assembly. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

1. Level and plumb individual members of structure.

E. Do not permit thermal cutting during erection of structural steel.

F. Where indicated for field connections, provide standard bolts complying with ASTM A307.

G. Install high strength steel bolts at locations indicated. Assembly and installation shall be in accordance with CBC requirements and AISC specifications.

1. Allowable hole sizes: 1/16 inch larger than bolt size.

2. Use friction type connection with standard hardened steel circular, square or rectangular washer under bolt nut.

3. Thoroughly clean area under bolt head, nut and washer. Remove all paint, lacquer, oil or other coatings except organic zinc-rich paints in accordance with SSPC, SP-2.

4. Tighten bolts by power torque wrench or hand wrench until twist-off.

H. CONTRACTOR shall be responsible for correcting detailing and fabrication errors and for correct fitting of all members and components.

I. Erect structural steel plumb and level and to proper tolerances as set forth in the AISC Manual. Provide temporary bracing, supports or connections required for complete safety of structure until final permanent connections are installed.

J. Install column bases within a tolerance of 1/8 inch of detailed centerlines, level at proper elevations. Support bases on double nuts and solidly fill spaces under bases with cement grout.

K. Provide anchor bolts with templates and diagrams. CONTRACTOR shall be responsible for proper location and installation of bolts. Correct deficiencies and errors.

3.03 FITTING

A. Closely fit members, finished true to line and in precise position required to allow accurate erection and proper joining in the field.

B. Drilling to enlarge unfair holes will not be allowed. Allow only enough drifting during assembly to bring parts into position, but not enough to enlarge holes or distort the metal. Do not heat rolled sections, unless approved by ARCHITECT.

3.04 PUNCHING AND DRILLING

A. Punch material 1/16 inch larger than nominal diameter of bolt, wherever thickness of metal is equal to or less than the diameter of the bolt plus 1/8 inch.

B. Drill or sub-punch and ream where metal is equal to or more than the diameter of the bolt plus 1/8 inch. Make diameter for sub-punched and sub-drilled holes 1/16 inch larger than nominal diameter of bolt.

C. Precisely locate holes to ensure passage of bolt through assembled materials without drifting. Enlarge holes when necessary to receive bolts by reaming; flame cutting to enlarge holes is not acceptable. Structural Steel members with poorly matched holes will be rejected.

3.05 FINISHING

A. After erection, spots or surfaces where paint has been removed, damaged, or burned off, and field rivets, bolts, and other field connections shall be cleaned of dirt, oil, grease, and burned paint and furnished with a spot coat of the same primer installed during shop priming.

B. Touchup:

1. Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint. Install paint to exposed areas with the same material installed during shop painting. Install by brush or spray to provide a minimum dry film thickness of 1.5 mils.

2. Galvanized Surfaces: Clean field welds, connections and damaged areas. Apply two coats of Carbomastic 15, by Carboline or equal product approved by OWNER's OEHS. Brush or roll to a 4 to 6 mil thickness.

3.06 FIELD QUALITY CONTROL

A. OWNER will provide a special inspector and independent testing laboratory to perform field inspections and tests and to prepare test reports.

B. Correct deficiencies in or remove and replace structural steel that inspections and test reports indicate do not comply with specified requirements.

3.07 CLEAN UP

A. Remove rubbish, debris and waste materials and legally dispose of off the Project Site.

3.08 PROTECTION

A. Protect the Work of this section until Substantial Completion.

3.09 HANDLING

A. Both in shop and in the field, transport, handle and erect to prevent damage or overstressing of any component.

END OF SECTION

SECTION 05 12 13 - ARCHITECTURALLY-EXPOSED STRUCTURAL STEEL

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Requirements regarding the appearance and surface preparation of Architecturally Exposed Structural Steel (AESS).
2. Preparation and priming of AESS.
3. Unless otherwise indicated, this Section applies to all structural steel members and their connections that will remain exposed in the Work.

B. Related requirements:

1. Division 05 for the following:

   a. Refer to Section 05 12 00 for all other requirements regarding steel work (including concealed structural steel) not included in this Section.
   b. Section 05 30 00 for steel decking.
   c. Loose steel-bearing plates and miscellaneous steel framing.

2. Finish coat requirements and coordination with primer and surface preparation specified in this Section 09 96 00.

1.2 REFERENCES

A. AISC Code of Standard Practice for Steel Buildings and Bridges, current edition.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Scheduling and sequencing: Coordinate requirements for shipping, special handling, attachment of safety cables and temporary erection bracing, touchup painting, and other requirements for AESS.

B. Pre-installation meeting:

1. Prior to start of installation schedule a pre-installation meeting between the fabricator authorized representative, the Contractor, the installer for the work of this Section, and the Architect, to review supports to receive this work, adjacent work, the Drawings, and the Specifications.
2. Review the following:

   a. Submittals.
   b. Surface preparation and protection.
   c. Installation procedures.
   d. Sequencing and installation priority for the work of this Section and those of adjacent materials.
   e. Inspection, testing, protection and repair procedures.

3. Record meeting minutes and distribute PDF copy to all concerned, including the Architect, within 48 hours of the meeting.

1.4 SUBMITTALS

A. Data: Manufacturer Product Data for products specified, except steel.
B. Shop Drawings:

1. Erection Drawings clearly indicating which members are considered AESS.
2. Provide connections for exposed AESS consistent with the details on the Drawings.
3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length and type of each weld. Identify grinding, finishing and profile of welds as defined below.
4. Indicate type, size, finish, and length of bolts, distinguishing between shop and field bolts. Identify high-strength bolted slip-critical, direct-tensioned shear/bearing connections. Unless otherwise noted, all bolt heads in the Work shall be oriented in the same direction.
5. Indicate which surfaces or edges will be exposed in the Work and what class of surface preparation will be used.
6. Indicate special tolerances and erection requirements noted on the Drawings or defined herein.

C. Qualifications: Data for firms and persons specified in the “Quality Assurance” Article to demonstrate their capabilities and experience. Include lists of completed projects names and address, names and addresses of architects and owners, and other information specified.

1.5 QUALITY ASSURANCE

A. Fabricator qualifications: In addition to those qualifications listed in Section 05 12 00, engage a firm experienced in fabricating AESS similar to that indicated for this Project with a record of successful in-service performance.
B. Erector qualifications: In addition to those qualifications listed in Section 05 12 00, engage an experienced erector who has completed AESS work similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.
C. Standard: Comply with Section 10, AISC Code of Standard Practice, as amended below.

1.6 HANDLING

A. Handling:

1. Erect pre-painted finish pieces using padded slings or other methods such that they are not damaged.
2. Provide padding to protect while rigging and aligning members frames.
3. Weld tabs for temporary bracing and safety cabling only at points concealed from view in the completed structure or where approved by the Architect during the pre-installation meeting acceptable methods of removing temporary erection devices and finishing the AESS.

B. Storage:

1. Store materials to permit easy access for inspection and identification.
2. Keep steel members off ground by using pallets, platforms, or other supports.
3. Protect steel members and packaged materials from erosion and deterioration.
4. Use special care in handling to prevent twisting or warping of AESS members.

1.7 PROJECT CONDITIONS

A. Where AESS is indicated to fit against walls and other construction, verify dimensions by field measurements before fabrication and indicate measurements on shop drawings. Coordinate fabrication schedule with construction progress to avoid delaying the work.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: As specified in Section 05 12 00, except as amended below.
B. High-strength bolts, nuts, and washers: As specified in Section 05 12 00 heavy hex heads and nuts. Provide standard carbon steel mechanically galvanized finish.

2.2 PAINT

A. Shop-applied organic zinc-rich primer for exterior steel: “Tneme-Zinc 90-97” by Tnemec Co., or equal.
B. Primer for all other steel to be primed: “10-99” or “Unibond” by Tnemec Co., or equal.
C. Field-applied galvanizing repair (zinc-rich) paint: “94-H20 Hydro-Zinc” by Tnemec Co., or equal.

2.3 FABRICATION

A. Fabricate, prefit and assemble AESS in the shop to the greatest extent possible to comply with SEAC/RCSCA “Architecturally Exposed Structural Steel” standard Category 1, Category 2 and Category 3 as specified below.
B. Locate field joints in AESS assemblies as indicated and accepted on Shop Drawings.
C. Detail AESS assemblies to minimize field handling and expedite erection.
D. Fabricate AESS with exposed surfaces smooth, square and of surface quality consistent with the approved mockups.
E. Use special care in handling and shipping of AESS both before and after shop priming or painting.
F. In addition to special care used to handle and fabricate AESS, employ the following fabrication techniques:

1. Fabrication tolerance: One-half the normal tolerances specified in the AISC Code of Standard Practice Section 10.
2. Welds: Grind welds of AESS smooth. For groove welds, the weld shall be made flush to the surfaces each side and be within plus 1/16-inch, minus 0-inch of plate thickness.
3. Contouring and blending of welds: Where fillet welds are indicated, ground-contour or blend oversize welds as required and grind to provide a smooth transition and to match profile on approved mockups.
4. Continuous welds: Provide continuous welds of uniform size and profile.
5. Minimize weld show through: Where welding on the far side of an exposed connection occurs, grind distortion and marking of the steel to a smooth profile with adjacent material.
6. Coping and blocking tolerance: Maintain a uniform gap of 1/8-inch (plus or minus 1/32-inch) at copes and blocks.
7. Joint gap tolerance: Maintain a uniform gap of 1/8-inch plus or minus 1/32-inch.
8. Piece marks hidden: Fabricate such that piece marks are fully hidden in the final structure or made with such media to permit full removal after erection.
9. Mill mark removal: Deliver steel with no mill marks (stenciled, stamped, raised etc) in exposed locations. Omit mill marks by cutting mill material to appropriate lengths where

possible. Where not possible, fabricator can fill and/or grind to a surface finish consistent with the approved mockups.

10. Grinding sheared edges: Grind edges of sheared, punched or flame-cut steel to match approved mockups.
11. Seal weld open ends of round and rectangular hollow structural section with 3/8-inch closure plates. Provide continuous, sealed welds at angle to gusset-plate connections and similar locations where AESS is exposed to weather.

G. Galvanizing: As specified in Section 05 50 00.
H. Shop priming: As specified in Section 09 96 00 and compatible with finish coats also specified in Section 09 96 00.

2.4 SHOP CONNECTIONS

A. Bolted connections: Make in accordance with Section 05 12 00. Provide bolt type and finish as specified herein and align bolt heads as indicated on the approved shop erection drawings.
B. Welded connections: Comply with AWS D1.1 and Section 05 12 00. Appearance and quality of welds shall be consistent with the mockups. Assemble and weld built-up sections by methods that will maintain alignment of members without warp exceeding the tolerance of this Section.

2.5 PREPARATION PRIOR TO PRIMING

A. As specified in Section 09 96 00.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine governing dimensions and conditions at the site before starting erection.
B. Verify the location and elevation of anchor bolts and concrete surfaces supporting steel to verify that they meet the following tolerances:

1. Elevation of concrete surfaces: Plus 3/8-inch.
2. Elevation top of anchor bolts: Plus one-inch, minus 3/8-inch.
3. Out-of-position of anchor bolts: Plus 1/8-inch.

C. Check AESS members upon delivery for twist, kinks, gouges or other imperfections which might result in rejection of the appearance of the member. Coordinate remedial action with fabricator prior to erecting steel or return the damaged components and replace with new ones.
D. Correct conditions that would prevent proper and timely completion of this work before proceeding with erection.

3.2 PREPARATION

A. Provide connections for temporary shoring, bracing and supports only where noted on the approved shop drawings.
B. Make temporary connections not indicated at concealed locations in the final structure, or as approved by the Architect.
C. Handle, lift and align pieces using padded slings and/or other protection required to maintain the appearance of the AESS through the process of erection.

3.3 ERECTION

A. Set AESS accurately in locations and to elevations indicated, and according to AISC specifications referenced in this Section.
B. In addition to the special care used to handle and erect AESS, employ the following erection techniques:

1. AESS erection tolerances: In accordance with Chapter 10 of the AISC Code of Standard Practice.
2. Welds: Grind welds smooth in the connections of AESS members.
    a. For groove welds, the weld shall be made flush to the surfaces of each side and be within plus 1/16-inch, minus 0-inch of plate thickness.
3. Contouring and blending of welds: Fillet welds shall be ground contoured, or blended. Grind to provide a smooth transition and to match profile on approved mockup.
4. Continuous welds: Provide continuous welds of a uniform size and profile.
5. Minimize weld show-through: Where welding on the far side of an exposed connection occurs, grind distortion and marking of the steel to a smooth profile with adjacent material.
6. Bolt head orientation: Install all bolt heads in the same direction as accepted on the shop drawings.
7. Removal of field connection aids:
    a. Run-out tabs, erection bolts and other steel members added to connections to allow for alignment, fit-up, and welding in the field shall be removed from the structure.
    b. Select field groove welds to eliminate the need for backing bars or to permit their removal after welding.
    c. Remove welds at run-out tabs to match adjacent surfaces and ground smooth.
    d. Plug weld holes for erection bolts and grind smooth and flush with adjacent surfaces.
8. Filling of weld access holes:
    a. Where holes must be cut in the web at the intersection with flanges on W shapes and structural tees to permit field welding of the flanges, they shall be filled flush with adjacent surfaces.
    b. Filling shall be executed with proper procedures to minimize restraint and address thermal stresses in group 4 and 5 shapes.

C. Field welding: Weld profile, quality, and finish shall be consistent with mockups approved prior to fabrication.
D. Splice members only where indicated.
E. Obtain permission for torch cutting or field fabrication from the Architect. Finish sections thermally cut during erection to a surface appearance consistent with the mockup.
F. Do not enlarge unfair holes in members by burning or by using drift pins. Ream holes that must be enlarged to admit bolts. Replace misaligned connection plates where holes cannot be aligned with acceptable final appearance.

3.4 FIELD CONNECTIONS

A. Bolted connections: Install bolts of the specified type and finish as specified in Section 05 12 00.

B. Welded connections: Comply with AWS D1.1 for procedures, and appearance. Refer to Section 05 12 00 for other requirements.

1. Assemble and weld built-up sections by methods that will maintain true alignment of axes without warp. Verify that weld sizes, fabrication sequence, and equipment used for AESS will limit distortions to allowable tolerances.
2. Obtain Architect's approval for appearance of welds in repaired or field modified work.

3.5 FIELD QUALITY CONTROL

A. Structural requirements: The Owner will engage an independent testing and inspecting agency to perform field inspections and tests and to prepare test reports. Refer to Section 05 12 00 for detailed bolt and weld testing requirements.
B. AESS acceptance: The Architect will review the AESS in place and determine acceptability based on the accepted mockups.

3.6 ADJUSTING AND CLEANING

A. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint shall blend with the adjacent surfaces of AESS. Perform touchup work in accordance with the paint manufacturer's instructions as specified in Section 09 96 00.
B. Galvanized surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

3.7 AESS FINISH SCHEDULE

A. AESS Category 1, Basic Elements:

1. Surface Preparation to SSPC-SP6.
2. Sharp edges ground smooth.
3. Continuous weld appearance.
4. Standard structural bolts.
5. Weld spatters removed.

B. AESS Category 2, Feature Elements not in close view, greater than 20-feet from view:

1. Comply with AESS Category 1, basic elements, and the following:

a. Visual samples, if requested.
b. One-half standard fabrication tolerances.
c. Fabrication marks not apparent.
d. Welds uniform and smooth.

C. AESS Category 3, Feature elements in close view, 20-feet or less from view:

1. Comply with AESS Category 1 and 2 elements, and the following:

a. Mill marks removed.
b. Butt and plug welds ground smooth and filled.
c. HSS weld seam oriented for reduced visibility.
d. Cross sectional abutting surface aligned.
e. Joint gap tolerances minimized.
f. All welded connections, optional.

D. AESS Category 4, Showcase Elements, where specifically identified on Drawings:

1. Comply with AESS Category 1, 2 and 3 elements, and the following:

a. HSS seam not apparent.
b. Welds contoured and blended.
c. Surfaces filled and sanded.
d. Weld show-through minimized.

END OF SECTION

SECTION 05 12 19- BUCKLING RESTRAINED BRACES

PART 1 – GENERAL

1.1 SUMMARY

A. Provide all parts, materials, and labor required for the design, delivery, testing and erection of buckling-restrained braces, which are designed by the manufacturer to meet stiffness, yield strength, and elongation requirements as indicated on the Drawings and other requirements specified herein.

B. Related Sections
   1 Section 05 12 00 Structural Steel Framing

1.2 REFERENCES

A. The following applicable standards are to be adhered to unless indicated otherwise.

B. American Institute of Steel Construction (AISC):
   1 “Code of Standard Practice for Steel Buildings and Bridges”, latest edition.
   2 AISC Seismic Provisions for Structural Steel Buildings (ANSI/AISC 341), latest edition.

C. American Society for Testing and Materials (ASTM) Standard Specifications:
   1. A6 – Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling, latest edition.
   2. A36 – Specification for Carbon Structural Steel, latest edition.
   3. A490 – Specification for Structural Bolts, 150 ksi Minimum Tensile Strength, latest edition.
   4. A500 – Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes, latest edition.
   5. A572 – Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel, latest edition.
   6. F959 – Specification for Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners, latest edition.
   7. F2280 – Specification for “Twist-off” Type Tension Control Structural Bolts, 150 ksi Minimum Tensile Strength, latest edition

D. American Welding Society (AWS):
   1. 2.4 – Standard Symbols for Welding, Brazing and Nondestructive Examination.
   2. A5.1 –Specification for Carbon Steel Electrodes
   3. A5.18 –Specification for Carbon Steel Electrodes and Rods for Gas Shielded Arc Welding
   4. A5.20 – Carbon Steel Electrodes for Flux Cored Arc Welding
   5. D1.1 – Structural Welding Code-Steel, latest edition.

E. Steel Structures Painting Council (SSPC):
   1. Steel Structures Painting Manual, latest edition.

1.3 DEFINITIONS

A. Buckling-Restrained Brace (BRB): A steel brace consisting of an outer steel casing, an inner steel core, and a concrete matrix between the core and the outer steel casing. The inner steel core resists against tensile and compressive axial loads and is restrained from buckling by the concrete contained in the outer steel casing.

1.4 SUBMITTALS

A. The following submittals shall be made. All submittals shall be made in the English language.

B. Proposed Design of Buckling-Restrained Braces:
1. Design Drawings shall clearly display size, thickness and length of exterior brace casing as well as configuration and size of the full length of the core plates.
2. Calculations shall be provided to display the ability of the proposed “BRB’s” to meet the Performance Criteria described herein.
3. The Design Drawings and Calculations shall be sealed and stamped by a Structural Engineer (S.E.) licensed in California.
4. Preliminary design: At contractor’s option, make an initial submittal of the above items without sealed S.E. stamp for review by project Structural Engineer of Record, Architect and Jurisdictional Authority and coordination with structural steel contractor. Once all reviews are complete and incorporated, resubmit with sealed S.E. stamps for record.

C. Shop Drawings
1. Shop drawings shall clearly display all geometries necessary to manufacture BRB’s including plate thickness, lengths, plate dimensions inside and outside of the casing, and casing dimensions
2. Shop drawings shall clearly display all connection information including location of bolts, bolt types, bolt diameters, hole size, and faying surface types.

D. Material Test Reports
1. Tensile tests and chemical analysis for all steel.
2. Independent coupon tests used to verify core plate initial yield stress, tensile stress, and ultimate elongation.
   a. Where core plates are fabricated from plate material, coupon tests shall be performed on each plate.
   b. Where core plates are fabricated from bar stock, coupons shall be made at intervals of each 5 tons of material of same heat and thickness.
   c. Coupon tests to be taken at point of manufacture. Mill test reports (MTR) may not be used.
3. Core plates 2 inches (50mm) and thicker shall be supplied with Charpy V-Notch testing in accordance with ASTM A673, Frequency P, or approved equal. The impact test shall meet a minimum average value of 20 ft-lbs absorbed energy at +70 degrees Fahrenheit and shall be conducted in accordance with AISC Specification, or approved equal.

E. Technical Report
1. The Manufacturer shall submit a BRB testing report. The testing configurations used, and the results obtained shall meet the criteria found in the AISC Seismic Provisions and those indicated in Article 2.5.

F. Welding Certificates
1. Welder Performance Qualification Records (WPQR’s)
2. Welding Procedure Specification (WPS) written in conformance with AWS D1.1 for each proposed type of welded joint, whether pre-qualified or qualified by testing.

G. Manufacturer’s Quality Assurance Plan

H. Manufacturer's in-house Quality Assurance Inspection Report for each brace upon completion of fabrication.

I. Outside Testing Agency Quality Control Report where applicable.

1.5 QUALITY ASSURANCE

A. The Manufacturer shall have a detailed Quality Assurance Plan.
   1. The Quality Assurance Plan shall contain the procedures for manufacturing buckling-restrained braces including:
      a. Welding procedures.
      b. Methodology for verifying and documenting material properties.
      c. Indication of how the product is to be identified, such that it can be traced back to production quality assurance records.
      d. A flow chart of the process by which the product is manufactured, including description of production methods.
      e. Identified manufacturing tolerances for each production process.
      f. In-process quality control including all points of internal inspection for control and monitoring of the fabrication and assembly process.
   2. Design Engineer Requirements: The Design Engineer shall be registered in the state of California as a Structural Engineer, have experience with designing buckling-restrained braced frame systems, and have a thorough knowledge of the submitted BRB test report.
   3. Qualification testing shall conform to Article 2.5.

B. The Manufacturer shall notify Owner of fabrication schedule at least 30 days prior to fabrication in order to allow Owner or Owner's Representative to observe fabrication process.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Plants fabricating buckling-restrained braces shall comply with the following:
   1. Buckling-restrained braces for this project shall be manufactured in the same facility (following the same quality assurance procedures) as the braces manufactured and tested to fulfill the AISC 341 testing requirements.

B. Buckling-Restrained Braces shall be designed, manufactured and supplied by the following vendor or equal.
   1. CoreBrace, LLC
      5789 West Wells Park Road
      West Jordan, UT 84081
      801.280.0701

C. Documentation showing evidence of valid accreditation and experience shall be submitted to the Engineer of Record during the bidding phase for any proposed manufacturer not listed above.

2.2 MATERIALS

A. Core Plate
   1. ASTM A36 with Fy as noted on the drawings.
      a. Fy of all core plate material shall be verified via coupon test per Article 1.4.D.2.
      b. Core plates 2 inches (50mm) and thicker shall be supplied with Charpy V-Notch testing per Article 1.4.D.3.

B. Primer
   1. Standard shop primer.

C. Welding Materials
   1. Shielded metal arc welding electrodes conform to AWS A5.1, flux-cored arc welding electrodes conform to AWS A5.20, and electrodes used for gas metal arc or submerged arc conform to the requirements of AWS A5.18.
   2. The minimum tensile strength of the E70 class electrodes used in production is 70,000 psi (470 MPa).
   3. Materials shall provide production welds with minimum Charpy V Notch properties of 20 ft-lbs (27 J) at -20°F (-30 C).

D. Infill Grout
   1. Manufacturer's standard infill that has been demonstrated suitable by sub-assemblage testing per the Recommended Provisions.

2.3 DESIGN REQUIREMENTS

A. A Structural Engineer shall design the buckling-restrained braces to meet the Performance Requirements. The Engineer shall have a thorough knowledge of the qualifying cyclical tests and competently apply the test results to the Project conditions.

B. Interpolation or extrapolation of test results for different member sizes shall be justified by rational analysis that demonstrates stress distributions and magnitudes of internal strains that are consistent with or less severe than the tested assemblies and that considers the adverse effects of larger material and variations in material properties.

C. Stability calculations shall include beams, columns and gussets adjoining the BRB's.

D. Bracing connections are to be designed to a minimum of 1.0 times the adjusted brace strength as defined in the AISC Seismic Provisions with overstrength parameters determined per Article 2.4.F.

2.4 PERFORMANCE REQUIREMENTS

A. Core plate material shall have yield range within the minimum and maximum yield stress indicated in the structural drawings. Coupon tests taken from plates at point of manufacture of BRBs shall be used to verify conformance. Additional coupon tests may be performed to replace coupon tests that fall out of acceptable range.

B. Increasing amplitude cyclic displacement tests per the AISC Seismic Provisions shall provide stable performance up to a displacement corresponding to 2.0 x Design Story Drift.
   1. Hysteretic behavior shall display no post-yield loss of strength, degradation, or pinching.
   2. Fracture of any portion of the BRB shall not occur during the qualifying tests.

C. The steel core shall resist compression and tension forces. The steel core area shall be as per the project drawings and core material shall be within the yield stress range specified in Article 2.4.A.

D. The concrete fill and steel casing shall prevent the steel core from buckling globally and locally during compressive loading without binding due to longitudinal shortening and transverse expansion. Demand for local and global stability of casing checks shall be based on the adjusted brace strength at the maximum yield stress (Fysc,max) of the specified yield stress range of the core plate material.

E. Steel core projections beyond the steel casing and brace connections shall develop the adjusted brace strength without instigation of fracture or instability. For core plate checks use the minimum (Fysc,min) of the specified yield stress range for determining demand. For all other materials use Fysc,max to determine demand.

F. The overstrength factors (ω, β) shall be determined at a brace strain level associated with the greater of a 2% interstory drift or twice the design story drift, the latter of which is taken as $(2\varphi C_d F_{ysc,min})/(\rho I_e E)$, where C_d is the design drift deflection amplification factor, E is the nominal modulus of elasticity of the core plate material, I_e is the Importance Factor, ρ is the Redundancy Factor. When actual brace demand is provided, twice the design story drift is taken as $(2C_d P_d)/(A_{sc}\rho I_e E)$, where P_d is the axial force demand in the BRBs at the controlling drift design load case.

2.5 QUALIFICATION TESTS

A. Buckling-restrained brace design shall be based on two qualifying cyclic tests conforming to the AISC Seismic Provisions for Buckling Restrained Braced Frames. As stated in the Provisions, at least one of the two qualifying tests needs to be a subassemblage test to demonstrate the ability of the BRB to withstand rotational demands. The other test may be performed uniaxially or may also be a subassemblage test.

B. The requirements of the AISC 341 Seismic Provisions shall be met

C. The strain level during testing shall be equivalent to, or greater than, the strains that the project braces will be expected to withstand.

D. Qualifying tests can be based on full-scale cyclical tests previously reported for projects or research that are deemed similar to project conditions by the Manufacturer and Project Engineer.

2.6 FATIGUE LIFE INSTRUMENTATION

A. Displacement measurement devices shall be installed as indicated on the structural drawings or as a minimum on one BRB at each level in each direction. These devices shall include the following capabilities as a minimum.
   1. Minimum total stroke capacity (oriented axially with brace) of 8”. This capacity shall be increased as required to capture the expected brace deformations corresponding to considered drifts in Article 2.4.F.
   2. Maximum displacement precision of 0.050”.
   3. Minimum recording resolution of 300 readings/second
   4. Minimum internal storage capacity of 5 million measurements.
   5. Minimum expected internal battery life of 8 years.
   6. Documented methodology, validated through testing, for converting recorded data into fatigue damage assessment.

B. Installation of the devices is to be coordinated by the General Contractor and may require additional trades including steel erector, low-voltage subcontractor, general contractor or others.

PART 3 – EXECUTION

3.1 FABRICATION

A. Braces shall be fabricated in accordance with AISC Code of Standard Practice and in an AISC Certified Shop that participates in the AISC Quality Certification Program.

B. Core plates shall be cut to profile shown on Design Drawings.
1. The general roughness cannot exceed 1000 micro-inches in the yielding length.
2. Notches in yield length region up to 1/8–inch may be repaired by grinding to a smooth transition. The length of the transition shall not be less than 10 times the notch depth.
3. Notches in the yielding length region greater than 1/8–inch and less than or equal to 3/8–inch may be repaired using procedures outlined in the Company Quality Assurance Manual. The repairs shall be examined using Ultrasonic Testing (UT) procedures in conformance with AWS D1.1.
4. Notches in the yielding length region greater than 3/8–inch in the yield length shall be rejected.

C. No splices are allowed in the yielding region of the steel core plate.

D. Minimum casing dimensions shall be as required by manufacturer or as specified on the project documents.

E. Holes for bolted connections may be drilled, cut or punched in conformance with AISC standards and burs removed.

F. Finish shall be manufacturer’s standard shop primer. Do not paint connection faying surfaces of connections designated slip critical.

G. Assembly of the different components of the brace shall be done in accordance with the manufacturer’s Quality Assurance Manual in a manner that ensures proper performance of the brace.

H. Pin connection hole shall be no more than 1/32” larger than connecting pin.

3.2 SHIPPING

A. Manufacturer to package BRB’s for protection against shipping damage.

B. Manufacturer shall coordinate delivery dates and quantities with Contractor/Owner. Contractor/Owner shall provide adequate storage space and proper lay-down areas.

C. Braces shall be stored on dunnage not touching the ground.

D. Coordinate erection aid requirements with contractor/Owner.

3.3 ERECTION

A. Braces are to be erected under the Structural Steel Specification Section and according to referenced AISC Specifications.

B. Prior to erection, clean faying surfaces of bolted BRBs to remove any surface contaminants including temporary coatings that may have been applied for transport.

C. Allow for erection loads and for sufficient temporary bracing to maintain structure safe, plumb, and in true alignment until completion of erection and installation of buckling-restrained braces.

D. No field welding to BRB's is allowed, including non-structural pieces unless approved by BRB manufacturer and Engineer of Record (EOR).

E. No field cutting or altering of the BRB's is permitted without the approval of the BRB manufacturer and EOR.

END OF SECTION

SECTION 05 30 00 - METAL DECKING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Floor and roof metal decking.
2. Shear connector studs for composite decking construction.
3. Edge strips, closure strips and decking accessories.

B. Related Requirements:

1. Division 01 - General Requirements.
2. Section 03 30 00 – Cast-In-Place Concrete.
3. Section 05 12 00 - Structural Steel Framing.
4. Section 07 62 00 - Flashing and Sheet Metal.

1.02 REFERENCES

A. ASTM International (ASTM):

1. ASTM A108 – Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished.
2. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
3. ASTM A780 – Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
4. ASTM D746 - Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact.
5. ASTM D1056 - Standard Specification for Flexible Cellular Materials—Sponge or Expanded Rubber.

B. American Welding Society (AWS):

1. AWS D1.1 - Structural Welding Code Sheet – Steel.
2. AWS D1.3 – Structural Welding Code Sheet – Sheet Steel.

C. American Iron and Steel Construction (AISI):

1. AISI – Specifications for the Design of Cold-Formed Steel Structural Members.

D. Underwriters Laboratory (UL):

1. UL – Fire Resistance Directory.

1.03 PERFORMANCE REQUIREMENTS

A. Compute properties of deck sections on basis of effective design width as limited by provisions of the AISI specifications. Provide no less than deck section properties specified, including section modulus and moment of inertia per foot of width.

B. Regulatory Requirements:

1. Decking installed as part of a fire rated assembly shall meet the requirements of the applicable UL Fire Resistance Directory design number.

2. Work of this section shall be in accordance with CBC.

1.04 SUBMITTALS

A. Shop Drawings: Drawings, sections and details indicate type of decking, location, finish, gage of metal, arrangement of sheets, necessary fabrication to incorporate decking into the Work, and relationship to openings and flashing.

B. Product Data: For each type of decking specified, including structural properties, dimensions, profiles and finishes.

C. Welder Certificates: Signed by CONTRACTOR certifying that welders comply with the requirements specified under Article “Quality Assurance”.

1.05 QUALITY ASSURANCE

A. General: Metal decking steel shall conform to requirements of strengths and properties of standards specified.

B. Qualifications of Welders: Properly certified for the type of Work involved in compliance with CBC requirements.

C. Continuous inspection of welding will be performed by a special inspector, approved by DSA to inspect the Work of this section. The Project Inspector will be responsible for monitoring the work of the special inspector to ensure that the inspection program is satisfactorily completed.

D. Identification of metal decking steel shall conform to the standards specified in this section and the Drawings.

1. Fabricator shall furnish sufficient evidence to the ARCHITECT attesting compliance with specified requirements.

2. Conform to CBC requirements. Unclassified or unidentified decking is not permitted. Furnish deck manufacturer's certified mill analyses and test reports for each heat covering decking having a minimum Fy of 33 Ksi. In addition, for

decking having F_y greater than 33 Ksi, testing laboratory shall perform one tension and elongation test and one bend or flattening test for each gage.

E. Unidentifiable Steel: Steel which is not readily identifiable as to grade from markings and test records is not permitted to be provided as part of the Work of this section.

F. Manufacturers shall be members of Steel Deck Institute (SDI).

1.06 DELIVERY, STORAGE AND HANDLING

A. Protect steel deck from corrosion, deformation and other damage during delivery, storage and handling.

B. Deck bundles shall be stored off the ground, with one end elevated to provide drainage. Bundles shall be protected against condensation with a ventilated waterproof covering.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Verco Manufacturing Co.

B. Or equal contingent to review and approval by AOR and SEOR.

2.02 MATERIALS

A. Metal Decking:

1. Roll-formed sheets conforming to ASTM A653, with G90 zinc coating.

2. Section properties conforming to applicable provisions of latest edition of AISI - Specification for the Design of Cold-Formed Steel Structural Members.

3. Cellular acoustical decking and all exposed decking shall be painted per architectural specifications and drawings.

B. Flexible Closure Strips for Deck: Vulcanized, closed-cell, expanded chloroprene elastomer, complying with ASTM D1056, Grade SCE #41.

1. Brittleness Temperature: Minus 40 degrees F, ASTM D746.

2. Flammability Resistance: Self-extinguishing,

C. Decking Accessories: Metal cover plates, sheet metal edging, metal closure strips, valley and ridge strips, seat angles, sump pans, flashings: 22 gage minimum, with ASTM A653, G90 zinc coating.

D. Shear Connectors: Headed stud type, ASTM A108 Grade 1015, cold-finished carbon steel complying with AISC specifications.

E. Galvanizing Repair Paint: Mil. Spec. MIL-P-21035B and approved by the OWNER’s Office of Environmental Health and Safety (OEHS).

2.03 FABRICATION

A. Corrugated sheets or sections shall be designed to support required live load between supporting members.

B. Provide decking in lengths to span over three or more supports.

C. Except as detailed otherwise, provide decking with interlocking side laps, 2 ½-inch minimum end bearing, and 1 ½-inch minimum side bearing.

D. Welding: Provide materials and methods in accordance with recommendations of steel decking manufacturer and reviewed submittals. Hold decking tight to the supporting elements with screws or other means for proper welding or crimping of the decking edges. Conform to AWS D1.3, and to the patterns and weld types indicated, with welds free from sharp edges and protrusions. Field coat welds and abraded surfaces at completion with an anodic type galvanizing repair paint. Omit the field paint coating where welds or abrasions are covered by concrete fill or sprayed fireproofing.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify supporting structure and existing conditions prior to starting work.

B. Remove oil, dirt, paint, and rust from steel surfaces to which metal decking will be welded.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 OPENINGS

A. Cut and reinforce units to provide openings which are located and dimensioned on the structural and mechanical Drawings.

B. Provide openings, or other Work not indicated on the Drawings.

3.03 INSTALLATION

A. Install metal decking in accordance with decking manufacturers' recommendations, requirements of Drawings, Shop Drawings, and Specifications.

B. Install metal decking on supporting steel framework and adjust to final position before permanently fastening in place.

1. Install each unit to proper bearing on supports.

2. Install units in straight alignment for entire length of run of cells with close registration of cells of one unit with those of abutting unit.

C. Fasten decking to steel framework at ends of units and at intermediate supports. Welding shall be as indicated on Drawings.

D. Fasten side laps between supports as indicated on Drawings.

E. Perform field cutting parallel with cells in area between cells, leaving sufficient horizontal material to permit welding to support steel.

F. Weld shear connectors to supports thru decking units as required by Drawings. Weld only on clean, dry surfaces. Do not weld shear connectors thru two layers of decking units.

3.04 METAL FLASHINGS AND CLOSURES

A. Furnish, install, and weld in position, sheet metal closure flashing, closure angles, closure plates, profile plates, and shear plates.

B. Close open ends of cell runs at columns, openings, walls, similar interruptions and termination.

3.05 FIELD QUALITY CONTROL

A. Install steel decking under continuous inspection according to CBC Section 1704A.

B. Welding inspection for steel deck diaphragms shall conform to CBC Section 2204A.1.

3.06 CLEAN UP

A. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

3.07 PROTECTION

A. Protect the Work of this section until Substantial Completion.

END OF SECTION

SECTION 05 41 00 - COLD-FORMED STEEL FRAMING *(NON-AXIAL LOAD BEARING WALLS)*

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes exterior vertical cold-formed steel framing (CFSF) system consisting of non-axial, load bearing punched channel studs and Cee-shaped steel studs.

B. Related requirements:

1. Division 05 for structural steel.
2. Division 07 for thermal insulation in CFSF system.
3. Division 09 for non-structural metal framing, and ceiling and soffit suspension systems.

C. Definition: Design engineer as used in this Section refers to a California-licensed structural engineer engaged by the Contractor to perform the tasks specified below to comply with the “deferred approval “process.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Pre-construction meeting: Prior to starting erection of the CFSF, but not later than one week, arrange a preliminary meeting with trades associated with the work of this Section.

1. Presided over by Contractor, include subcontractor for CFSF, testing company representative, as appropriate, and a representative of the Fire Marshall.
2. Review locations of access panels, fire hose cabinets and fire extinguisher cabinets; the latter with a representative of the Fire Marshall.
3. Identify those locations on the slab. Use an easily removable marker where the slab is scheduled to remain exposed in the Work.
4. Review installation methods, procedures, time schedule and conditions under which this work will proceed, including stud manufacturer's instructions and coordination required with Related Requirements.
5. Review and verify availability of materials and installer’s experience.

B. Coordination:

1. Notify concerned trades of items required to be incorporated into their work. Certain components specified under this Section includes items which are closely integrated with air/water barrier transitions, doors, glazed assemblies, flashing pieces, and work specified in other Sections that require close coordination with the work of this Section.
2. Be responsible for coordination required to ensure correct installation procedures and results.
3. Verify actual locations of embeds and existing adjacent structural supports by field measurements before erection; indicate measurements on Shop Drawings. Coordinate tolerances of other trades that may affect the work of this Section prior to start of Shop Drawings preparation.

1.3 SUBMITTALS

A. Data: Manufacturer Product Data including specifications for the following.

1. Studs and runners.
2. Installation instructions for each item of cold-formed metal framing and accessories.
3. Mill certificates.

4. Galvanizing certificates.

B. Shop Drawings:

1. Large scale (minimum 1:32), dimensioned Shop Drawings of all assemblies.
2. Show elevations of each wall, framing member size and gage designations, number, type, location, and spacing.
3. Indicate connections/attachments, clips, strapping, bracing, splices, bridging, accessories, and details required for proper installation at 1:12 minimum scale.
4. Indicate and identify all fasteners and welds (with AWS symbols).
5. Indicate loads imposed on the primary building structure.

C. Load tables:

1. Complete load tables properly annotated for anticipated use for all studs.
2. Indicate conformance or deviation with design criteria indicated on the Structural Drawings.

D. Preconstruction test reports: Indicate and interpret test results for compliance with requirements.

E. Product test reports: From a qualified testing agency, unless otherwise stated, indicating that each of the following complies with requirements, based on evaluation of comprehensive tests for current products.

1. Steel sheet.
2. Expansion anchors.
3. Power-actuated anchors.
4. Mechanical fasteners.
5. Vertical deflection clips.
6. Horizontal drift deflection clips
7. Miscellaneous structural clips and accessories.

F. Research/evaluation reports: For cold-formed metal framing.

G. Manufacturer installation instructions: For framing members and accessories.

H. Sealant compatibility and adhesion test reports: From sealant manufacturer indicating that materials forming joint substrates and joint sealant backings have been tested for compatibility and adhesion with sealants; include sealant manufacturer's interpretation of test results for sealant performance and recommendations for primers and substrate preparation needed for adhesion.

I. Field test reports: Indicate and interpret test results for compliance with requirements.

J. Closeout: Furnish the Owner a comprehensive plan for replacement of broken glass. Include a local source.

K. Certificates:

1. Mill certificates signed by framing member/accessory manufacturer certifying compliance with material requirements.
2. Welder certificates signed by Contractor certifying that welders comply with specified requirements.

L. Qualification data: For design engineer and testing agency.

1.4 QUALITY ASSURANCE

A. Qualifications:

1. Installer: Firm with minimum 3 years experience in installation of the type of products specified.
2. Welders: Qualified welders experienced in welding lightgage steel in compliance with AWS D1.1 and D1.3.
3. Design engineer: California-licensed professional engineer experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of cold-formed metal framing that are similar to those indicated for this Project in material, design, and extent.
4. Testing agency: Independent testing agency, acceptable to AHJ and qualified according to ASTM E 329 to conduct the testing indicated.

B. Product tests: Mill certificates or data from a qualified independent testing agency, or in-house testing with calibrated test equipment indicating steel sheet complies with specified requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, ductility, and metallic-coating thickness.
C. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code-Steel," and AWS D1.3, "Structural Welding Code-Sheet Steel."
D. Fire-rated assemblies: Where the work of this Section is a component of assemblies indicated to be fire-rated, including those required for compliance with governing regulations, provide units approved by AHJ.
E. Mockup(s): Provide CFSF components for mockups specified elsewhere in these Specifications.

1.5 HANDLING

A. Protect metal framing units from rusting and damage.
B. Store off ground in a dry ventilated space or protect with suitable waterproof coverings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Failure includes, but is not limited to, the following:

1. Noise or vibration created by wind, and thermal and structural movements.
2. Loosening or weakening of fasteners, attachments, and other components.

B. Where stud sizes and connections are indicated on the Drawings, do not substitute with items of lesser structural capacity.

2.2 MANUFACTURERS

A. General: One of the following members of the MSMA or SSMA.
B. Studs:

1. Alabama Metal Industries Corp.
2. CEMCO.
3. ClarkDietrich Building Systems.
4. Dale Industries, Inc.
5. Marino Industries, Inc.

6. SCAFCO Corp.
7. Superior Steel Studs, Inc.
8. Or equal.

C. Tracks: Bottom tracks by stud manufacturer; top track by one of the following.

1. ClarkDietrich Building Systems “Maxtrack 2D.”
2. CEMCO “Exterior Slotted Track.”
3. Or equal.

2.3 STEEL FRAMING COMPONENTS

A. Studs: Channel-shaped with lipped flanges, punched web, size (depth) indicated on Drawings, thickness and grade required by structural design calculations.
B. Tracks: Same designation, coating, and thickness as studs except as otherwise noted, channel-shaped, solid web, depth compatible with studs, size, thickness and grade required by structural design calculations.
C. Accessories: Manufacturer standard steel accessories, including but not limited to the following.

1. Supplementary framing.
2. Bracing, bridging, and solid backing.
3. Web stiffeners.
4. Gusset plates.
5. Stud kickers and girts.
6. Reinforcement plates.

D. Bridging:

1. Cold-rolled channel: 1-1/2 by 1/2-inch by 56-mil thick.
2. Bridging clip: BridgeClip by The Steel Network, Inc., or equal. Provide attachment through stud punch-out clamping onto stud web and wrapping around bridging channel. Provide holes for screw attachment to stud web and channel.
3. Flat strap: Width and thickness required by structural design calculations for rigid attachment to stud flange.
4. Solid bridging: Channel-shaped bridging with lipped flanges and integral formed clips, BridgeBar by the Steel Network, or equal, screw attachment to stud, 33-mil minimum thickness, size as required by structural design calculations.

2.4 MATERIALS

A. Steel - general: ASTM A 653 steel; SS Grade 50, Class 1 minimum tensile strength, unless otherwise indicated on the Drawings.
B. Finish on steel:

1. General: Provide framing components galvanized with a G 60 zinc coating; EQC is not acceptable.
2. Accessories: Finish to match that of main framing components.

C. Fasteners:

1. Screws: Corrosion-resistant coated, self-drilling, pan or hex washer head. Provide screw type and size required by structural design calculations.
2. Anchor bolts and studs: ASTM A 307, Grade A, carbon steel, with hex-head carbon steel nuts and flat steel washers. Hot-dip zinc coated in accordance with ASTM A 153. Provide bolt or stud type and size as required by structural design calculations.

3. Expansion anchors: FS FF-S-325, Group II, Type 4, Class 1. Provide bolts listed or approved by authorities having jurisdiction, and of diameter and length as required by structural design calculations.
4. Powder-actuated fasteners: FS FF-P-395 made from AISI 1062 or 1065 steel, austempered to a minimum core hardness of 50 to 54 HRC and zinc plated in accordance with ASTM B 633. Provide fasteners listed or approved by authorities having jurisdiction, of type, diameter and length required by structural design calculations:
5. Welding electrodes: Comply with AWS Code and as recommended by stud manufacturer.

D. Isolating tape: 1/4 inch thick by 1-1/2 inch wide by 8 feet long “Thermablok” tape by Thermablok, or equal consisting of self-adhering flexible aerogel and fiber composite insulation with a thermal conductivity of 0.0078 Btu/ft/hr/F.
E. Galvanizing repair (zinc-rich) paint: “94-H20 Hydro-Zinc” by Tnemec Co., or equal by Valspar Corp., Devoe Coatings, ZRC Worldwide, or Ameron Protective Coating Division.

2.5 FABRICATION

A. General:

1. Framing components may be prefabricated into assemblies before erection. Design panels to resist handling as well as dead and live loads without damage and permanent deflection.
2. Fabricate units in jig templates to hold members in proper alignment and position and to assure consistent component placement.
3. Space studs no more than 1/8-inch from designated spacing.
4. Prefabricated panels shall be no more than 1/8-inch out-of-square within the panel length.
5. Fabricate panels plumb, square, true to line, and braced against racking with joints welded. Make all stud-to-track connections prior to handling the panel.
6. Lift prefabricated units to prevent damage and distortion.

B. Cutting: Cut members by shearing or sawing.
C. Fastenings:

1. Attach similar components by welding. Attach dissimilar components by welding, bolting, or screw fasteners, as standard with manufacturer and accepted on the Shop Drawings.
2. Wire-tying and screw-attachment of framing components, unless otherwise indicated, is not permitted.

D. Fabrication tolerances: Fabricate CFSF assemblies level, plumb, and true to line to a maximum allowable tolerance variation of 1:960 and as follows.

1. Spacing:

a. Space individual framing members no more than plus or minus 1/8-inch from plan location.
b. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

2. Squareness: Fabricate each CFSF assembly to a maximum out-of-square tolerance of 1/8-inch.

E. Damaged zinc coating: Touchup damaged galvanizing before shipment of assemblies to site.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions and measurements affecting the work of this Section at site.
B. Correct detrimental conditions before proceeding with installation.

3.2 INSTALLATION

A. General:

1. Install CFSF systems in compliance with the DSA approved Drawings, their manufacturer's instructions, ASTM C 1007, and these Specifications.
2. Field cutting is allowed with saws or shears, but not torch cutting. Restore damaged zinc coating as specified.
3. Reinforce holes cut thru the studs.

B. Runner tracks:

1. Install continuous tracks sized to match studs.
2. Align tracks accurately to layout at base and tops of studs. Secure tracks as accepted on Shop Drawings.
3. Fasten tracks securely to supports.

C. Studs:

1. Secure studs to top and bottom runner tracks by either welding or screw fastening at both inside and outside flanges, as accepted on Shop Drawings.
2. Install members in single piece lengths except that tracks may be spliced, butt-welded, or each length anchored to a common building frame element.
3. Set studs plumb within the tolerance specified, except as needed for diagonal bracing or required for out-of-plumb walls or warped surfaces and similar requirements.
4. Where stud system abuts structural columns or walls, anchor ends of stiffeners to supporting structure.
5. Where components are boxed to form closed tubes, fill these areas with insulation that would otherwise remain uninsulated after assembly of the framing members.
6. Install insulation in framing spaces of insulated assemblies made inaccessible after erection.

D. Supplementary framing:

1. Install supplementary framing, blocking, and bracing in metal framing system where walls are indicated to support fixtures, equipment, services, casework, heavy trim and furnishings, and similar work requiring attachment to the wall.
2. Comply with stud manufacturer recommendations and industry standards in each case, considering weight or loading resulting from item supported.

E. Frame wall openings larger than 2 feet square with double stud at each jamb of frame except where more than 2 studs are indicated.

1. Install runner tracks and jack studs above and below wall openings.
2. Anchor tracks to jamb studs with stud shoes or by welding, and space jack studs same as full-height studs of wall.
3. Secure stud system wall opening frame as indicated.

F. Frame both sides of expansion and control joints with separate studs; do not bridge the joint with components of stud system.
G. Install horizontal stiffeners in stud system, spaced (vertical distance) at not more than 54 inches o.c.
H. Welding:

1. Perform welding in compliance with AWS recommendations by welders qualified to weld lightgage metal.
2. Provide stitch plates where studs are burned-through.

I. Isolating tape:

1. Clean contact surfaces of oil, grease and other foreign materials that would prevent adhesion of the isolating tape.
2. Remove protective paper and install tape on exterior face of studs and runners, so that there will be no direct contact between metal framing members and subsequently applied materials, such as sheathing. Butt ends tightly.

J. Erection tolerances:

1. Bolt or weld wall panels (at both horizontal and vertical junctures) to produce flush, even, true-to-line joints.
2. Set exterior edge of studs within 1/8 inch in or out of the theoretical plane of the wall.
3. Maximum variation in plane and true position shall not exceed L/960 from plumb and level with individual framing members no more than plus or minus 1/8 inch from plan location.
4. Cumulative error shall not exceed minimum fastening requirements of sheathing and other finishing materials.

3.3 FIELD QUALITY CONTROL

A. The Owner may employ a qualified testing laboratory to perform the following tests and submit test reports.
B. Testing agency will review and approve Weld Procedure Specifications submitted by the Contractor. The testing agency shall visually observe welding procedures to certify the WPS plan is followed.

1. Perform visual inspection of a minimum of 20 percent of all welds.
2. Additional testing will be required for the following:

a. If more than 5 percent of the tested welds are rejected, than an additional 20 percent of all welds shall be tested. This additional testing process shall be repeated until the rejection rate drops below 5 in 100.
b. Costs of additional inspection required by this paragraph shall be borne by the Contractor.

C. Inspections and testing shall be in conformance with the CBC.

3.4 TOUCHUP

A. Touchup damaged shop-applied protective coating, including cut ends and welds.

B. Use zinc-rich galvanizing paint for prime-coated and galvanized surfaces. Sand or grind damaged zinc coating to bright metal and apply zinc-rich paint, to a minimum DFT of 2 mils, overlapping undamaged area at least 2 inches. Comply with ASTM A 780.

END OF SECTION

SECTION 05 43 00 – SLOTTED CHANNEL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Framing shall be a strut type metal framing system (Strut System).

B. Strut System shall be used:

1. To support mechanical and electrical equipment and devices.
2. For structural applications as applicable.

C. Strut System and components must be supplied from a single approved Manufacturer.

D. This Section supplements Section 05 50 00.

1. Those requirements apply this Section as well except as modified with-in this Section.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Field verification: Verify actual locations of supports.

1.3 SUBMITTALS

A. Data:

1. Specifications and installation instructions for manufactured items.
2. Manufacturer's literature, including engineering data for anchors and data sheets for gate hardware.

B. Shop Drawings:

1. Large scale, dimensioned Shop Drawings of metal fabrications indicating in detail methods of fabrication and assembly, weight, materials, holes, lugs, inserts, finishes and other pertinent data.
2. For components to be embedded in concrete and masonry work, furnish templates supplemented by dimensioned Shop Drawings to trades placing those components in their work. Assist in location of these components where so requested by those trades.

1.4 QUALITY ASSURANCE

A. Manufacturer's qualifications:

1. The manufacturer shall have at least 10 years’ experience in manufacturing Strut Systems.
2. The manufacturer must certify in writing all components supplied have been produced in accordance with an established quality assurance program.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

1. Strut System and components shall be UNISTRUT®, basis o design.
2. Or equal.

2.2 MATERIALS

A. All channel members shall be fabricated conforming to one of the following ASTM specifications:

1. Plain Carbon Steel: A 1011 SS Grade 33.
2. Stainless Steel: A 240 (Type 304).
3. Aluminum: B 221 (Type 6063-T6).

B. All fittings shall be fabricated conforming to one of the following ASTM specifications:

1. Carbon Steel: All carbon steel fittings shall be fabricated from steel that meets/exceeds the physical requirements of ASTM A1011 SS Grade 33 and conforms to one of the following ASTM specifications:

   a. A 575.
   b. A 576.
   c. A 36.
   d. A 635 e. A 1059 f. A 1046.

2. Stainless Steel:

   a. A 240 (Type 304 or Type 316).
   b. A 276 (Type 304 or Type 316).

3. Aluminum:

   a. B 209 (Type 1100F or Type 5052-H32).

2.3 FINISHES

A. Factory painted:

1. Channel

   a. Rust inhibiting thermoset acrylic enamel paint applied by electrodeposition after cleaning and phosphating, and thoroughly baked.

2. Fittings

   a. Polyester powder coat after cleaning and phosphating, and thoroughly baked.

3. Color shall be FHWA Highway Green, Color Tolerance Chart, PR Color No. 4
4. Hardness = 2H

   a. Salt Spray per ASTM B117.

      1) Scribed: Exceed 400 hours.
      2) Unscribed: Exceed 600 hours.

   b. Nominal chalking at 1,000 hours per weatherometer G-23 test.
   c. No checking at 1,000 hours per weatherometer G-23 test.

B. Electro-galvanized per ASTM B 633 Type III SC 1.

C. Pre-galvanized per ASTM A653.

1. Zinc coated by hot-dipped process prior to roll forming at the steel mill.
2. Zinc coating thickness shall be G90 (0.75 mil = 0.45 oz./ sq. ft. surface area).

D. Hot-dipped galvanized per ASTM A123 or A153.

1. Zinc coated after all manufacturing operations are complete.
2. Zinc coating thickness shall be G65 (2.6 mils = 1.50 oz./ sq. ft. surface area).

E. UNISTRUT DEFENDER™ per ASTM A1046 and A1059.

1. Strut coated per A1046 to a mass of 0.45 oz./ sq. ft. surface area.
2. Fittings coated per A1059 to a thickness of 30 microns and/or A1046 to a mass of 0.45 oz./sq. ft. surface area.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions and measurements affecting the work of this Section at site.

B. Correct detrimental conditions before proceeding with installation.

C. Provide other trades with metal items to be embedded in their work. Where necessary, provide templates and instructions for this work.

3.2 INSTALLATION

A. Install in accordance with Section 05 50 00 for:

1. Installation.
2. Field welding.
3. Adjusting and cleaning.
4. Cleanup.
5. Protection.

B. Install plumb, level, and square with adjacent construction.

1. Attach assemblies securely to supports.

a. Verify allowable tolerances.

C. Use Unistrut P1000 to support college logo, see A714.

END OF SECTION

SECTION 05 50 00 - METAL FABRICATIONS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Metal fabrications:

1. Steel thresholds.
2. Steel ladders and ladder safety cages.
3. Elevator hoist way door sill angles,
4. Steel framing and supports for countertops.
5. Steel tube reinforcement for low partitions.
6. Steel framing and supports for mechanical and electrical equipment.
7. Steel Gates.
8. Gratings, frames and covers.
9. Steel bollards.
10. Embedded edge angles in concrete.
11. Steel supports for coiling doors.
12. Steel framing and supports for operable partitions.
13. Supportive framing for sunshade panels.
14. Miscellaneous steel framing, supporting angles, plates, brackets, clips, anchors and bolts for equipment, and other work which is not specifically included in Section 05 12 00, Structural Steel Framing.
15. Miscellaneous fabrications, as indicated on the Drawings.

B. Related Requirements:

1. Division 01 - General Requirements.
2. Section 03 30 00 – Cast-in-Place Concrete.
3. Section 04 22 00: Concrete Unit Masonry.
4. Section 05 05 12: Hot-Dip Galvanizing.
5. Section 05 12 00: Structural Steel Framing.

6. Section 05 52 00: Steel Railings.

1.02 REFERENCES

A. ASTM International (ASTM):

1. ASTM A27 – Standard Specification for Steel Castings, Carbon, for General Application.

2. ASTM A36 – Standard Specification for Carbon Structural Steel.

3. ASTM A47 - Standard Specification for Ferritic Malleable Iron Castings.

4. ASTM A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

5. ASTM A123 - Standard Specification for Zinc (Hot-Dipped Galvanized) Coatings on Iron and Steel Products.

6. ASTM A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

7. ASTM A283 - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates.

8. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength.

9. ASTM A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.

10. ASTM A501 - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.

11. ASTM A563 - Standard Specification for Carbon and Alloy Steel Nuts.

12. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

13. ASTM C1107 - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).

14. ASTM D1187 - Standard Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal.

15. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.

16. ASTM F2329 - Standard Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners.

B. American Welding Society (AWS):

1. AWS D1.1 Structural Welding Code - Steel.

2. AWS D1.3 Structural Welding Code - Sheet Steel.

3. AWS D-19.0 Welding Zinc Coated Steel.

1.03 COORDINATION

A. Coordination between Steel Fabricator and Galvanizer:

1. Prior to fabrication, submit approved fabrication shop drawings to the galvanizer.

2. Notify galvanizer of steel fabrications that exceed the ASTM A385 recommended percentages for carbon, phosphorus, manganese and silicon, so special galvanizing processing techniques are used.

B. Coordinate installation of metal fabrications that are anchored to concrete or masonry, or that receive work specified by other Sections. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry.

C. Field Measurements: Field verify dimensions prior to fabrication.

D. Coordinate selection of shop primers with galvanizing, and with paintings to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and paintings are compatible with one another.

1.04 SUBMITTALS

A. Shop Drawings: Submit Shop Drawings indicating provided materials, dimensions, anchoring detail, and details of termination or connection to adjacent construction. Indicate items that are purchased from a manufacturer and items that are shop fabricated. Indicate component parts requiring Project site fabrication or assembly.

B. Product Data: Submit Product Data for manufactured items. Submit Product Data for primers and finishes.

C. Material Samples: Submit Samples of primers and finishes on fabricated items.

D. Fabricator qualifications per Article “Quality Assurance”.

E. Welding:

1. Welder’s Certificates: Field welders shall be Project certified in accordance with AWS D1.1.

2. Welding Material Certification: Provide certificate that welding material complies with specifications.

F. Research/Evaluation Reports: ICC-ES for post-installed anchors.

1.05 QUALITY ASSURANCE

A. Fabricator Qualifications: Firm with a minimum five year experience in successfully producing metal fabrications similar to that shown on the drawings.

B. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D-1.1– Structural Welding Code – Steel.

2. AWS D1.3 - Structural Welding Code - Sheet Steel.

C. Field applied primers, paintings, sealers and adhesives shall be approved by the OWNER's Office of Environmental Health and Safety (OEHS).

D. Preassemble items in shop to greatest extent possible to minimize field welding. Mark units for reassembly and coordination of installation. Use marking method compatible with galvanizing.

1.06 DELIVERY, STORAGE AND HANDLING

A. Store miscellaneous metal items above grade on platforms, skids, or other required supports.

B. Protect from damage and from corrosion, dirt, grease and other foreign matter.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Structural Steel Shapes: ASTM A36.

B. Rolled Steel Plates: ASTM A36. Plates to be bent or cold-formed shall conform to ASTM A283, Grade C.

C. Round HSS: ASTM A500 Grade B or C.

D. Square and Rectangular HSS: ASTM A500 Grade B or C.

E. Steel Pipe: ASTM A53 Type E or S, Grade B, standard weight (Schedule 40), unless otherwise noted. Black finish.

F. Steel Sheet: ASTM A1008 or ASTM A1011.

G. Steel Bolts: ASTM A307, Grade A, or F3125 with hex steel nuts per ASTM A563 and washers. Galvanized in accordance with ASTM A153 for exterior locations.

H. Steel Bars: Conforming to ASTM A108 or ASTM A575.

I. Concrete Inserts: Threaded or wedge type; galvanized ferrous castings, either malleable iron, ASTM A47, or cast steel, ASTM A27. Provide bolts, washers, and shims, hot-dip galvanized per ASTM A153.

J. Nonshrink, Nonmetallic Grout: Factory-packaged, non-staining, noncorrosive, nongaseous grout complying with ASTM C1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

K. Concrete Materials:

1. Concrete per Section 03 30 00, Cast-in-Place Concrete.

2. Welded wire fabric and reinforcing per section 03 20 00, Concrete Reinforcing.

2.02 FABRICATION

A. General:

1. Preassemble items in the shop to greatest extent possible. Use connections that maintain structural value of joined pieces. Mark units for reassembly and installation.

2. Cut, drill, and punch metals cleanly and accurately. Ease exposed edges to a radius of approximately 1/32 inch, unless otherwise indicated or specified. Remove sharp and rough areas on exposed surfaces. Form exposed work with accurate angles and surfaces and straight edges. Form exposed connections with hairline joints, flush and smooth. Locate joints where least conspicuous.

B. Welding:

1. Weld connections unless otherwise indicated.

2. Weld corners and seams continuously and in accordance with requirements of AWS D1.1 Structural Welding Code. Welds shall be inspected as required in Section 05 12 00: Structural Steel Framing.

3. Grind exposed welds smooth and flush to match and blend with adjoining surfaces.

2.03 PREPARATION FOR GALVANIZING

A. Fabricate to the largest size possible and whenever possible use slip joints to minimize field welding.

B. Fabricate structural steel in accordance with Class I, II, III guidelines as described in AGA's Recommended Details for Galvanized Structures, to facilitate galvanizing process. Corners of gussets, stiffeners, and bracing shall be cropped to allow free flow of zinc during galvanizing process.

C. Remove welding slag, splatter, anti-splatter compounds and burrs prior to delivery for galvanizing.

D. Marking for Identification: Avoid unsuitable marking paints for identification, such as oil based paints and markers and crayon markers. Use water soluble paints or markers acceptable to galvanizer or steel tags wired to the work.

E. Masking: Use masking materials recommended by the American Galvanizers Association (AGA) to produce ungalvanized areas for field welding and at slip critical bolts.

F. Galvanize fabrications per Section 05 5013, Hot-Dip Galvanizing, in accordance with ASTM A123 and ASTM A153.

2.04 SHOP FINISH

A. Metal fabrications shall be provided with a coat of primer, except those indicated to be hot-dip galvanized.

B. Primers:

1. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

2. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.

3. Minimum dry film thickness of primer shall be 2.0 mils.

C. Preparation for Primer Painting: Miscellaneous ferrous metal, except items specified galvanized, shall be thoroughly cleaned and prepared for painting, including removal of shipping oils or protective coatings, mill scale, grease, dirt and rust. Prepare in accordance with SSPC recommendations. Deliver to Project site primed or galvanized as indicated, and ready to receive Project site applied finishes.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine the areas where metal fabrications are to be installed. Notify the OAR in writing of unsatisfactory conditions. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Provide anchorage devices and fasteners as indicated in the drawings and where necessary for securing miscellaneous metal fabrications to in-place construction.

B. Cut, drill, and fit as required for installation of miscellaneous metal fabrications. Set metal fabrication accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

C. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop-welded because of shipping size

limitations. Do not weld, cut, or abrade the surfaces of hot-dip galvanized fabrications intended for bolted or screwed field connections.

D. Alignment: Verify alignment of items with adjacent construction. Coordinate related work.

E. Grout: Follow manufacturer's recommendations for substrate preparation and application.

F. Corrosion Protection: Coat concealed surfaces of metals that will come into contact with grout, concrete, masonry, or wood, with a heavy coat of bituminous paint or zinc chromate primer. Protect dissimilar metals from galvanic corrosion by pressure tapes, coating, or isolators.

3.03 FIELD WELDING

A. Preparation of Weld Area of Galvanized Fabrications: Remove masking from fabrications. Remove remaining zinc coating between one inch and four inches from both sides of members to be welded, by grinding back the zinc coating, burning the zinc away or pushing back the molten zinc from the weld area.

B. Welding: Comply with AWS Code for procedures of manual shielded metal-arch welding, appearance and quality of welds made, methods used in correcting welding work.

1. Weld in accordance to AWS D-1.1.

2. Weld galvanized fabrications in accordance to AWS D-19.0.

C. Remove welding flux immediately. At exposed connections, finish exposed welds and surfaces smooth and blended so that no roughness shows after finishing and contour of welded surfaces matches those adjacent.

D. Upon completion of welding plug vent, drainage and lifting holes of galvanized fabrications with appropriate diameter zinc plugs. Push in about half way by hand, and hammer to a tight fit. With a hand file or an abrasive tool, file away excess material. Repair scratches with a zinc rich coating.

1. Plug railing holes.

2. Plug visible holes of HSS members.

3.04 ADJUSTING AND CLEANING

A. Touch Up Damaged Surfaces:

1. Shop Painted Finishes: Comply with SSPC-PA-1 for touch-up; apply with brush to produce a minimum 2.0 mil dry film thickness.

2. Galvanized Surfaces: Clean field welds, connections and damaged areas. Apply two coats of Carbomastic 15, by Carboline or equal product approved by OWNER’s OEHS. Brush or roll to a 4 to 6 mil thickness.

3.05 CLEAN UP

A. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

3.06 PROTECTION

A. Protect the Work of this section until Substantial Completion.

END OF SECTION

SECTION 05 51 33 - ALUMINUM SHIPS LADDERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Aluminum ships ladders and landings.
2. Aluminum railings attached to ships ladders.
3. Supplementary parts and components, such as inserts, clips, bracing and other miscellaneous supports required for a complete installation.

B. Related requirements:

1. Section 05 50 00 for miscellaneous metal supports.

1.2 SUBMITTALS

A. Shop Drawings: Show dimensioned, materials, methods of fabrication and assembly, finishes, installation and attachment to abutting and supporting construction.
B. Samples: The following finished as specified showing proposed weld quality.

1. Full size Samples of brackets.
2. Corner and coped section.
3. Ships ladder tread.

1.3 QUALITY ASSURANCE

A. Product Qualification: Product design shall comply with OSHA 1910.27 minimum standards for ladders.
B. Welding:

1. Qualify procedures and personnel according to AWS D1.2.
2. Verify that welders to be employed in this work have satisfactorily passed AWS qualification tests.
3. If recertification of welders is required, retesting will be Contractor's responsibility.

C. Fabricator/installer’s qualifications: Firm experienced in producing ladders similar to those indicated for the Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

1.4 WARRANTY

A. Manufacturer shall provide an extended Corrective Period for work of this Section for a period of 5 years commencing on the Certificate of Occupancy date of the product against all the conditions indicated below, and when notified in writing from Owner, manufacturer shall promptly and without inconvenience and cost to Owner correct said deficiencies.

1. Defects in materials and workmanship.
2. Deterioration of material and surface performance below minimum OSHA standards as certified by independent third party testing laboratory. Ordinary wear and tear, unusual abuse or neglect excepted.
3. Within the warranty period, the manufacturer shall, at its option, repair, replace, or refund the purchase price of defective ladder.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. O'Keeffe's, Inc., basis of design.
B. Alaco Ladder Co.
C. Precision Ladders.
D. Or equal.

2.2 PERFORMANCE REQUIREMENTS

A. Provide ships ladders at an incline of 60 degrees, including railings capable of safely withstanding the dead loads of the assemblies, plus the live loads prescribed by Code without exceeding the allowable design working stress of the materials involved, including anchors and connections. Apply each load to produce the maximum stress in each component. Design for a minimum live load of 100 psf.
B. Thermal movements: Provide exterior assemblies with expansion joints spaced so that no distortion or damage occurs when subjected to a surface temperature of plus 180 degrees and a temperature swing of 160 degrees (plus 20 to plus 180 degrees).

1. Make joints as small as possible but sufficiently wide to meet the design criteria.
2. Show joint spacing on Shop Drawings.
3. Space joints equally and symmetrically. Joint locations are subject to relocation at no additional cost to the Owner.

C. Deflection:

1. Limit deflection under uniform load to L/240; L/120 under concentrated load; or 1/4-inch maximum, whichever is more restrictive.
2. Apply each load to produce the maximum stress in each component.

2.3 MATERIALS

A. Aluminum:

1. Extruded tubes: ASTM B 210, B 221, B 234 or B 241.
2. Bars, rods and wire: ASTM B 211.
3. Sheet and plate: ASTM B 209.
4. Structural shapes, rolled and extruded: ASTM B 308.

B. Welding electrodes: As recommended by AWS for the conditions of use and the alloys being welded.
C. Bolts, rivets and other fasteners: The following made of stainless steel.

1. As permitted by the reference standard and CBC.
2. For attachment to concrete and masonry use self-drilling or non-drilling expansion types by Phillips Drill Co., Inc., Rawlplug Co., Inc., Star Expansion Industries, Inc. or equal. Indicate the make, type and capacity of each type of anchor on the Shop Drawings.

2.4 FABRICATION

A. General:

1. Form and fabricate this work to meet installation conditions.
2. Fabricate ladder, in compliance with the approved Shop Drawings, to the dimensions and profiles indicated.

3. Provide complete assembly, including railing systems, struts, clips, brackets, bearing plates, and other components necessary for the support of the ladder and its anchorage to the supporting structure.
4. Weld corners and seams continuously to comply with AWS recommendations and the following:

    a. Use materials, methods and welding sequence that minimize distortion and develop strength and corrosion resistance of base metals.
    b. Obtain fusion without undercut or overlap.
    c. Remove welding flux immediately.
    d. At exposed connections, undercut edges of components to be welded, weld and finish exposed welds and surfaces smooth and blended so that no roughness shows after finishing and contour of welded surface matches those adjacent.
    e. Where welds will be exposed to the elements, weld connections between various pieces continuously to prevent water intrusion in the weld area, or seal welded parts, after weld is ground, with silicone sealant specified in Section 07 92 00.

5. Accurately fit or miter joints with hairline contacts welded.
6. Shear and punch metals cleanly and accurately.
7. Remove sharp and rough edges.
8. Ease exposed edges to a radius of approximately 1/32 inch.
9. Fabricate joints which will be exposed to the weather to exclude water, or provide weep holes where water may accumulate.
10. Close open ends of channel stringers with steel closure plates continuously welded, and ground flush and smooth with parent metal.
11. Fabricate treads so finished walking surfaces slope to drain.

B. Railings:

1. Form simple and compound curves by bending members in jigs to produce uniform curvature for each repetitive configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
2. Interconnect members by butt-welding or welding with internal connectors, at fabricator's option, unless otherwise indicated.
3. At Tee and cross intersections, cope ends of intersecting members to fit contour of tube to which end is joined, and weld all around.
4. Form changes in direction of handrails and rails by bending.
5. Provide welded closures at ends of all handrails.

C. Welding: Weld corners and seams continuously to comply with the following.

1. Comply with AWS Code, unless bolted connections are specifically shown.
2. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
3. Obtain fusion without undercut or overlap.
4. Remove welding flux immediately.
5. At exposed connections, undercut edges of components to be welded, weld and finish exposed welds and surfaces smooth and blended so that no roughness shows after finishing and contour of welded surface matches those adjacent.
6. Make welded joints light-proof and tight. Where joints will be exposed to the elements, at any time including during construction, close welded joint to air and water infiltration either by welding interface completely, or by sealing remaining space with silicone sealant specified in Section 07 92 00.

2.5 FINISH

A. Clear Anodic Finish: AA-M10C22A41 Mechanical finish as fabricated. Architectural Class I, clear coating 0.018 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions and measurements affecting the work of this Section at site.
B. Correct detrimental conditions before proceeding with installation.

3.2 INSTALLATION

A. Isolate aluminum surfaces in contact with dissimilar metals and cementitious materials with tape or paint (minimum 6 mils DFT).
B. Install ships ladders and railings true to line and level, with tight, flush fitting joints.
C. Frame and securely anchor to structure in compliance with the approved Shop Drawings.

END OF SECTION

SECTION 05 52 00 - STEEL RAILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes painted-steel handrails and railings.
B. Related requirements:

1. Section 05 12 00 for structural steel requirements.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Scheduling and sequencing:
B. Preinstallation Conference: Conduct conference at Project site.

1.3 SUBMITTALS

A. Shop Drawings: Large scale, dimensioned, indicating in detail methods of fabrication and assembly, welds, weight, materials, holes, lugs, inserts, fasteners, finishes and other pertinent data.
B. Data: Manufacturer Product Data consisting of the following.

1. Specifications and installation instructions for manufactured items.
2. Manufacturer's literature, including engineering data, for drilled-in anchors and shot pins.

1.4 QUALITY ASSURANCE

A. Fabricator qualifications:

1. Successfully engaged in the manufacture of ornamental work, similar to the work described in this Section and indicated on the Drawings, for a minimum of 5 years.
2. Fabricator qualifications are subject to Architect's review and approval before subcontract is awarded.

B. Welding work qualifications:

1. Qualify welding procedures and welding operators in compliance with AWS "Qualification" requirements for AWS D1.1.
2. Verify that welders to be employed in this work have satisfactorily passed AWS qualification tests.
3. If recertification of welders is required, retesting will be Contractor's responsibility.

C. Mockups:

1. Erect at the Project site, unless otherwise acceptable to the Architect, a mockup of each assembly for the Architect's review and approval.
2. Make mockups complete with all accessories, features required for the final assemblies.
3. Mockup’s size and features are indicated on the Drawings.
4. Make such modifications as necessary to achieve mockups satisfactory to the Architect or remove and construct additional mockup(s).
5. Approved mockups shall serve as the standard for the same work on the building.

6. Remove mockups only after completion and acceptance of final work unless its incorporation in the Work is authorized by the Architect.
7. Protect mockups until their removal.

1.5 HANDLING

A. Protect fabrications with strippable coating or other forms of protection standard with the fabricator for exposed metal surfaces.

1.6 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with railings by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General:

1. Select materials for their surface flatness, smoothness and freedom from blemishes wherever exposed to view in the finished work.
2. Materials shall have been cold-rolled, cold-finished, cold-drawn, extruded, stretcher-leveled and machine cut to the highest commercial standards for flatness, with edges and corners sharp and true to angle or curvature as required.
3. Exposed-to-view surfaces which exhibit pitting, seam marks, roller marks, oil-canning, stains, discolorations or other imperfections will not be acceptable and shall be removed from the job site.

B. Steel:

1. Tubing: ASTM A500/A500M (cold formed) or ASTM A513/A513M, Type 5.
2. Pipe: ASTM A53/A53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.
3. Plates, Shapes, and Bars: ASTM A36/A36M.

C. Welding electrodes and filler metal: Type and alloy recommended by producer of the metal to be welded, as required for color match, strength and compatibility in the fabricated items.
D. Fasteners: Plated steel fasteners complying with ASTM F1941 (ASTM F1941M), Class Fe/Zn 5 for zinc coating.

1. Finish exposed fasteners to match appearance, including color and texture, of railings.

2.2 MISCELLANEOUS MATERIALS

A. Handrail Brackets: Cast iron. Center of handrail to wall, as detailed.
B. Shop Primers: Provide primers that comply with Section 09 96 00 "High-Performance Coatings."
C. Intermediate Coats and Topcoats: By Section 09 96 00 "High-Performance Coatings."
D. Bituminous paint: Cold-applied asphalt mastic complying with SSPC Paint 12, except containing no asbestos fibers.
E. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout, complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.3 FABRICATION

A. Design components to allow for expansion and contraction for a temperature range of 120-degree F, ambient, 180-degree F, material surfaces, without causing buckling, excessive opening of joints, and overstressing of welds and fasteners.
B. Design assemblies to minimize site welding.
C. Form metal work to the required shapes.
D. Welding: Comply with AWS and the metal producer's recommendations.

1. Use welding for joining pieces together, unless otherwise accepted by the Architect on shop drawings.
2. Welds shall be continuous, except where stitch and spot welding are specifically permitted.
3. Make welded joints light-proof and tight. Close welded joint to air and water infiltration by welding interface completely.
4. Maintain proper welding temperature to avoid discoloring adjacent metal components.
5. Clamp parts in jigs during welding to avoid distortion.
6. Undercut metal edges where welds will be ground flush and dressed smooth.
7. Grind welds exposed to view flush, and fill and dress to match adjacent parent metal surfaces so that joint will be invisible in the Work.
8. Welds on or behind surfaces that will be exposed to view shall be done so that finished surface will be free of imperfections such as pits, runs, splatter, cracks, warping, dimpling, depressions or other forms of distortion or discoloration.
9. Remove weld spatter and welding oxides from welded surfaces.

E. Cut components square. Remove burrs from cut edges. Mill joints to a tight, hairline, flush fit. Cope or miter corner joints.
F. Close exposed ends of hollow railing members with prefabricated cap and end fittings of same metal and finish as railings.
G. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch or less.
H. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.

1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers or other means to transfer loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.

I. Unless otherwise shown or accepted on the shop drawings, conceal fasteners in the finish work. Back-up joints with either sleeves or back-up plates.
J. Built-in work: Furnish anchor bolts, inserts, plates and other anchorage devices, and all other items for metalwork to be built into concrete, masonry, or work of other trades, with necessary templates and instructions to facilitate proper placing and installation.
K. Toe Boards: Where indicated, provide toe boards at railings around openings and at edge of open-sided floors and platforms. Fabricate to dimensions and details indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions and measurements affecting the work of this Section at site.
B. Correct detrimental conditions before proceeding with installation.

3.2 PREPARATION

A. Furnish shop drawings, templates, and inserts for work to be embedded in work of other trades.

3.3 INSTALLATION

A. General:

1. Do not install components damaged or defective in any way. Remove and replace members damaged during installation or thereafter, before Final Acceptance.
2. Do not cut, trim or weld parts during erection, where it would damage the finish, decrease the strength, or result in a visual imperfection or a failure in performance of the work.
3. Return components which require alteration to the shop for refabrication, if possible, or for replacement by new parts.
4. Install work with tight joints accurately fitted and aligned.
5. Where cutting is required for proper fitting and jointing, restore finish to eliminate evidence of corrective work.
6. Joints at changes in direction in stainless steel railings shall be shop welded; field joints shall be a minimum of 2 feet from a change in direction and assembled with concealed sleeves or back-up plates and set screws.
7. Install this work with concealed fasteners.
8. Apply a bituminous coating of approximately 30 mils DFT, or other suitable permanent separator, on surfaces of dissimilar metals (except where exposed to view) and metal surfaces in contact with cementitious materials. Where the metals are exposed to view, provide a plastic or neoprene separators between dissimilar metals.
9. Comply with AWS Code for manual shielded metal-arc welding procedures, the appearance and quality of welds made, and the methods used in correcting welding work which must be approved by the Architect in each case.

B. Fastening to in-place construction:

1. Set this work accurately in location, alignment and elevation, plumb, level or sloped to follow ramped conditions, and true to line, measured from established lines and levels.
2. Provide required anchorage devices and fasteners for securing ornamental metals to in-place construction; coordinate the embedment of anchors with the work of Section 03 30 00.

3.4 RAILING CONNECTIONS

A. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article, whether welding is performed in the shop or in the field.

3.5 ANCHORING POSTS

A. Form or core-drill holes not less than 5 inches (125 mm) deep and 3/4 inch (20 mm) larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions.
B. Cover anchorage joint with flange of same metal as post, welded to post after placing anchoring material.
C. Anchor posts to metal surfaces with flanges, angle type, or floor type, as required by conditions, connected to posts and to metal supporting members as follows:

    1. For steel railings, weld flanges to post and bolt to metal supporting surfaces.

3.6 ATTACHING RAILINGS

A. Anchor railing ends to metal surfaces with flanges bolted to metal surfaces and welded to railing ends.
B. Attach handrails to walls with wall brackets. Provide brackets with 1-1/2-inch clearance from inside face of handrail and finished wall surface.

    1. Use type of bracket with predrilled hole for exposed bolt anchorage.
    2. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.

C. Secure wall brackets to building construction as follows:
D. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
E. For hollow masonry anchorage, use toggle bolts.
F. For steel-framed partitions, fasten brackets directly to steel framing or concealed steel reinforcements, using self-tapping screws of size and type required to support structural loads.

3.7 FIELD QUALITY CONTROL

A. Control of corrosion: Prevent galvanic action and other forms of corrosion by isolating metals and other materials from direct contact with incompatible materials.
B. Extent and Testing Methodology: Owner’s Testing agency may randomly select completed railing assemblies for testing that are representative of different railing designs and conditions in the completed Work. Railings will be tested according to ASTM E 894 and ASTM E 935 for compliance with performance requirements.

    1. Remove and replace railings where test results indicate that they do not comply with specified requirements unless they can be repaired in a manner satisfactory to Architect and will comply with specified requirements.
    2. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.8 TOUCHING-UP/CLEANING/PROTECTING

A. Field repair damaged components and finishes when the results are satisfactory to the Architect, otherwise replace with undamaged new components.
B. Restore protective coverings damaged during shipment or installation. Remove protective coverings only when there is no possibility of damage from other work yet to be performed at the same location.

C. Clean and protect exposed surfaces at completion of this work and protect assemblies from damage and stains until final acceptance.

END OF SECTION

SECTION 05 52 13 - PIPE AND TUBE ROOF PROTECTION RAILING SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Permanent roof edge protection.

1. Wall mount guardrails

1.2 RELATED SECTIONS

A. Section 05 50 00 - Metal Fabrications.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Sequencing and scheduling:

B. Scheduling and sequencing: Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not comply with structural performance requirements.

C. Field verification: Verify actual locations of supports.

D. Coordinate fabrication and delivery schedule of handrails with construction progress and sequence to avoid delay of railing installation.

1.4 SUBMITTALS

A. Product Data: Manufacturer's data sheets for products and assemblies specified.

B. Preparation instructions and recommendations.

1. Storage and handling requirements and recommendations.
2. Cleaning methods.

C. Shop Drawings:

1. Indicate profiles, sizes, connections, size and type of fasteners, accessories.
2. Show location of rails and guardrails including plans, details of components and anchor details.
3. Field Verified Measurements: Verify dimensions indicated on Drawings.

D. Verification Samples: For each finish specified, two samples representing actual colors specified.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store and handle materials and products in strict compliance with manufacturer's instructions and recommendations and industry standards.

B. Store materials in manufacturer's original sealed, labeled packaging until ready for installation and in accordance with manufacturer's instructions. Protect finishes on rails and uprights from damage.

1.6 PROJECT CONDITIONS

A. Maintain environmental conditions, temperature, humidity, and ventilation, within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.

B. Field Measurements: Where horizontal rails and uprights are indicated to fit to other construction, check actual dimensions or other construction by accurate field measurements prior to ordering and installation; show recorded measurements on final Shop Drawings.

C. Where field measurements cannot be made without delaying the system fabrication and delivery, obtain guaranteed dimensions in writing by the Contractor and proceed with fabrication of products to not delay fabrication, delivery and installation.

D. Section includes access panels required for access to concealed equipment and assemblies.

E. Related requirements: Division 09 for finish painting access panels, except stainless steel surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis of design: Leading Edge Safety, LLC, which is located at: 1345 Taney St.; North Kansas City, MO 64116; Toll Free Tel: 888-990-2990; Fax: 816-472-0822; Email:request info (sales@leadingedgesafety.net); Web:https://leadingedgesafety.net.

B. Or equal.

2.2 WALL MOUNT GUARDRAIL !BC 50; 50 LBS PER FOOT

A. Product: IBC Wall Mount Guardrail, Powder Coated Steel. Permanent full-perimeter fall protection, allowing direct mounting to interior parapet walls using a dual plate mounting system that assures water-tight installation. Backup plates, target patches, and upright plates creates a compression attachment to prevent water infiltration around mounting studs. Powder coated steel colors available to match Kynar sheet metal or other building components and RAL colors.

1. Standards:

   a. California Building Codes: Meets and exceeds 50 lbs per ft.
   b. Meets and exceeds OHSA Standard 29 CFR 1926.501, 1926.502, 1910.29, Cal-OSHA, 1620,1621, 3209, 3210.
   c. ANSI/ASEE A1264.1-2007.
   d. USACE EM 385-1-1 (21.E.01 a-c).

2. Materials:

   a. Uprights: 1.625 x 0.25-inch steel tube per ASTM A-513-5-08A DOM Grade 1026.
   b. Mounting Bracket: 3/16-inch steel plate per ASTM A36 bracket with pre-punched holes for mounting stud attachment.
   c. Horizontal Rails: 1.625 x 0.065 inch and 1.375 x .065 inch per ASTM A-513 DOM Grade 1020 steel tube adjustable slide rails.

3. Sizes:

   a. Uprights: Custom designed per project to OSHA Standards and CBC code requirements.
   b. Horizontal Rails: 5 ft. on center; 70 to 43 inch, 43 to 29 inch adjustable.
   c. Outside Corner: 20.5 inch on center.
   d. Inside Corner: 12.5 inch on center. Inside Corner.

4. Weight: All weights are approximate.

   a. Uprights: 25 lbs.
   b. Horizontal Rails: 1 lbs per linear ft.
   c. Corners: 2 lbs.

5. Hardware: 3/8-16 inch x 1 inch zinc plated steel. Consult manufacturer for approved structural attachment fasteners.
6. Labels: Applicable safety warnings and manufacturer's contact information.
7. Finish: Powder coated steel or Hot-Dipped Galvanized to ASTM A123.

B. Hardware:

1. Hinges: Concealed spring hinges or concealed continuous piano hinge set to open 175-degree. For fire-resistive units, provide self-closing mechanism.
2. Locking device: Flush, screwdriver-operated cam lock of number required to hold door in flush, smooth plane when closed.

2.3 FABRICATION

A. Fabricate to profiles indicated without exposed cut edges.

B. Provide exterior access panels with weatherproof extruded door gasket.

C. Finishes: As indicated on the Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION AND PREPARATION

A. Inspect and prepare substrates and nailers using the methods recommended by the manufacturer for achieving best result for the substrates under project conditions. Verify that nailers and other structural components of the building are securely fastened and capable of withstanding loads applied by the guardrail system.

B. Do not proceed with installation until substrates and nailers have been prepared using the methods recommended by the manufacturer and deviations from manufacturer's recommended tolerances are corrected. Commencement of installation constitutes acceptance of conditions.

C. If preparation is the responsibility of another installer, notify Architect in writing of deviations from manufacturer's recommended installation tolerances and conditions.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions including the following.

B. Permanent Roof Edge Protection:

1. Set uprights, horizontal rails and corners accurately in location, alignment and elevation, measured from established lines and levels and per installation drawings.
2. Install fasteners as recommended by manufacturer in holes provided on the upright bracket.
3. Inspect final installation and test for capacity in accordance with manufacturer's recommendations.

C. Wall Mount Guardrail shall provide water-tight installation through wall flashings on parapet walls with the use of backup plates, target patches and wall mount brackets. Target patches shall be field fabricated to fit around backup plate mounting studs and provide roof manufacturers recommended seam width around perimeter of target patch. Mounting studs shall be sealed behind target patch with non-curing butyl or manufacturers recommended sealant.

3.3 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 05 73 13 – GLAZED DECORATIVE GLASS RAILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes glass railings (glass, base, cap, and accessories).
B. Related requirements:

1. Division 03 for installation of railing base in concrete slab.
2. Division 05 for all other railings.
3. Division 08 for all other glass and glazing.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Scheduling and sequencing:
B. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver items to Project site in time for installation.
C. Preinstallation Conference: Conduct conference at Project site.

1.3 SUBMITTALS

A. Product Data:

1. Metal railings assembled from standard components.
2. Glass products.
3. Glazing cement and accessories for structural glass railings.
4. Sealant and accessories for structural glass railings.
5. Fasteners.

B. Shop drawings:

1. Large scale, dimensioned Shop Drawings for the work of this Section.
2. Show sizes, location of joints in metal work and glass panels; method of fabrication including connectors and welds.
3. Provide instructions, template or setting diagrams for installation of anchors set by other trades.

C. Samples:

1. Metal samples: 6 inches square for sheets and 12-inch long Samples of each cap, base and other types, profile and finish to be exposed in the Work, showing proposed range of color and texture variations.
2. Glass samples: Samples of glass to be used and finished edges.
3. Assembled Samples of railing systems, made from full-size components, including top rail, handrail, glass panels]and base. Show method of finishing members at intersections. Samples need not be full height.

D. Provide an ESR for the rail assembly.

1.4 HANDLING

A. Protection: For exposed metal surfaces provide strippable coating or other forms of protection standard with the fabricator.
B. Precautions: Prevent damage to glass from condensation, temperature changes, run-off, and other causes.

1.5 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with railings by field measurements before fabrication and indicate measurements on Shop Drawings.

1.6 WARRANTY

A. See Section 08 80 00 for warranty requirements.

PART 2 - PRODUCTS

2.1 GLASS RAILING MANUFACTURERS

A. One of the following, or equal:

1. CR Lawrence, basis of design. ESR-3269.
2. Kinslo Glass.
3. Or equal.

2.2 METALS

A. General:

1. Provide metals selected for their surface flatness, smoothness and freedom from blemishes wherever exposed to view in the finished work.
2. Provide materials cold-rolled, cold-finished, cold-drawn, extruded, stretcher-leveled, and machine cut to the highest commercial standards for flatness, with edges and corners sharp and true to angle or curvature as required.
3. Exposed to view surfaces that exhibit pitting, seam marks, roller marks, stains, oil canning, stains, discolorations or other imperfections will not be acceptable.

B. Aluminum extrusions:

1. ASTM B 221, B 308 or B 210.
2. For base, provide alloy required to safely support the loads to which the railings are subjected.
3. Show alloy type on Shop Drawings.

C. Stainless steel: Grade or type designated below for each form required:

1. Tubing: ASTM A 554, Grade MT 304.
2. Plate and flat bar: ASTM A 666, Type 304.
3. Bars and Shapes: ASTM A276, Type 304.

D. Steel and Iron: Bars: Hot-rolled, carbon steel complying with ASTM A29/A29M, Grade 1010.
E. Structural steel components: ASTM A 36.
F. Welding electrodes and filler metal: Type and alloy recommended by producer of the metal to be welded, as required for color match, strength and compatibility in the fabricated items.
G. Fasteners:

1. Structural bolts for railings: ASTM A 307; where higher strength is r equired, submit bolt specifications with Shop Drawings.
2. All other fasteners shall be stainless steel.

H. Shop primer for steel: As specified in Section 05 50 00.
I. Bituminous paint: SSPC-Paint 12 (cold-applied asphalt mastic).

2.3 GLASS AND GLAZING PRODUCTS, GENERAL

A. Tempered clear float glass, as specified in Section 08 80 00, not less than 1/2-inch thick, with flat ground polished edges with pencil corners where exposed.
B. Glass shall be free from bubbles, smoke vanes, air holes, scratches and other defects.
C. Justify glass thickness by calculations in compliance with ASTM E 1300 for a statistical probability of breakage of one lite per 1000.
D. Glass flatness shall be such that tolerance between installed glass panels will not exceed 3/32-inch.
E. Safety Glazing: Glazing shall comply with 16 CFR 1201, Category II.
F. Safety Glazing Labeling: Permanently mark glass with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction or manufacturer. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
G. Fully Tempered Float Glass: ASTM C1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear), Class 1 and low-iron clear, Quality-Q3.
H. Glazing Cement and Accessories for Structural Glass Railings: Glazing cement, setting blocks, shims, and related accessories as recommended or supplied by railing manufacturer for installing structural glazing in metal base channels.
I. Glazing Gaskets for Glass-Infill Panels: Glazing gaskets and related accessories as recommended or supplied by railing manufacturer for installing glass-infill panels in post-supported railings.

2.4 SEALANTS

A. Sealant and Accessories for Structural Glass Railings: Sealant, gaskets, setting blocks, shims, and related accessories as recommended or supplied by railing manufacturer for installing structural glazing in metal base channels.

2.5 FABRICATION

A. Provide matching alloy (for color) for exposed metal surfaces. Form metal work to the required shapes.

B. Design assemblies to minimize site welding.
C. Comply with AWS for recommended practices in shop welding. Avoid distortion or discoloration of the exposed side. Welds on exposed surfaces shall be continuous.

1. Use only technicians qualified to weld aluminum and stainless steel using TIG equipment.
2. Maintain proper welding temperature to avoid discoloring adjacent metal.
3. Clamp components in jigs during welding to avoid distortion.
4. Clean exposed welded joints of welding flux, and dress on exposed and contact surfaces to be invisible, under normal lighting conditions, from adjacent surfaces.
5. Alligatored, discolored and warped components will be rejected.

D. Joints:

1. Show joint location on the Shop Drawings.
2. Mill metal assemblies jointing tight, hairline, so they fit flush.
3. Cope or miter corner joints.

E. Unless otherwise shown or accepted on the Shop Drawings, conceal all fasteners in the finish work. Backup joints in handrails with sleeves.
F. Finishing metal surfaces:

1. For exposed stainless-steel surfaces: NAAMM No. 4 “Satin” finish.
2. For concealed aluminum surfaces: Mill finish.

PART 3 - EXECUTION

3.1 EXAMINATION/PREPARATION

A. Examine conditions and measurements affecting the work of this Section at site.
B. Correct detrimental conditions before proceeding with installation.

3.2 INSTALLATION

A. General:

1. Do not install damaged and defective components. Remove and replace members that have been damaged during installation or thereafter, before the time of final acceptance.
2. Do not cut, trim or weld parts during erection, in any manner that would damage the finish, decrease the strength, or result in a visual imperfection or a failure in performance of the work.
3. Return components that require alteration to the shop for refabrication, if possible, or for replacement by new parts.
4. Install work with tight joints accurately fitted. Where cutting is required for proper fitting and jointing, restore finish to eliminate evidence of corrective work.
5. Install this work with concealed fasteners.
6. Apply a bituminous coating of approximately 30 mils dry film thickness, or other suitable permanent separator, on surfaces in contact with concrete.
7. Comply with requirements specified above for field welding.

B. Fastening to in-place construction:

1. Set this work accurately in location, alignment and elevation, plumb, level and true, measured from established lines and levels.
2. Provide required anchorage devices and fasteners for securing glass railings to in-place construction; coordinate the embedment of anchors with the work of Section 03 30 00.

C. Glazing:

1. Install glass as specified in Section 08 80 00 and the railing manufacturer's instructions, plumb, level, with joints uniform in width and in the same plane.
2. Attach to base securely as indicated on the approved Shop Drawings.

D. Tolerances: Maximum deviations from theoretical locations shall not exceed 1/8-inch and adjacent glass edges shall not deviate more than 1/16-inch from plumb.

3.3 FIELD QUALITY CONTROL

A. Field repair damaged components and finishes when the results are satisfactory to the Architect, otherwise replace with undamaged new components, to the Architect's satisfaction.

END OF SECTION

SECTION 05 73 16 – CABLE RAILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes cable railings consisting of painted steel main members, and stainless-steel wire ropes and accessories.
B. Related requirements:

1. Division 03 for installation of railing base in concrete.
2. Section 05 50 00 for steel shapes.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Scheduling and sequencing: Schedule installation of cable railings so wall and floor attachments are made only to completed substrates. Do not support assemblies temporarily by any means that do not suit structural performance requirements.

1.3 SUBMITTALS

A. Shop Drawings:

1. Large scale, dimensioned Shop Drawings for the work of this Section.
2. Show elevation of each railing, sizes, location of joints in metal work; method of fabrication including connectors and welds.
3. Provide instructions, template or setting diagrams for installation of anchors set by other trades.

B. Metal Samples:

1. 12-inch-long Samples of each type, profile and finish of components to be exposed in the Work, showing proposed range of color and texture variations.
2. Full size accessories.

1.4 QUALITY ASSURANCE

A. Engineering: Contractor, thru a California-licensed professional engineer, employed by the Contractor, shall be responsible for the engineering, fabrication and installation of the railings, and rails, and their connections to the structure within the physical limitations indicated on the Drawings.

1. Railings shall comply with ASTM E 2353.
2. Obtain approval of Authorities Having Jurisdiction (AHJ) for the railings Shop Drawings and calculations, and pay fees incurred thereby before start of installation.
3. Fasteners and connections.

    a. Fasteners or connections shall not conflict with or require revision of the finish profiles of the railings or the supporting work.
    b. Connections to the structural frame shall not impose eccentric loading or induce twisting or warping.
    c. Connections to the structural frame shall be able to accommodate misalignment of the primary structure within limits allowed by the AISC and ACI tolerances.

1.5 HANDLING

A. Protection: For exposed metal surfaces provide strippable coating or other forms of protection standard with the fabricator.
B. Precaution: Prevent oxidation and stains from condensation, temperature changes, run-off, and other causes that would damage or stain the components.

PART 2 - PRODUCTS

2.1 CABLE RAILING MANUFACTURERS

A. One of the following, or equal:

1. Carl Stahl DecorCable Innovations, Inc.
2. Jakob.
3. Hayn Lines.
4. San Diego Cable Railings.
5. Ultra-Tec Cable Railing System.
6. Or equal.

2.2 METALS

A. General:

1. Provide metals selected for their surface flatness, smoothness and absence of blemishes where exposed to view in the finished work.
2. Provide materials that have been processed to the highest commercial standards.
3. Exposed to view surfaces that exhibit damaged wire ropes, pitting, seam marks, roller marks, stains, discolorations and other imperfections will not be acceptable.

B. Steel components: See Section 05 50 00.
C. Welding electrodes and filler metal: See Section 05 50 00.
D. Fasteners and accessories: Stainless steel finished to a uniform matte surface.
E. Shop primer for steel: As specified in Section 05 50 00.
F. Bituminous paint: SSPC-Paint 12 (cold-applied asphalt mastic).

2.3 FABRICATION

A. Provide matching alloy (for color) for exposed metal surfaces. Form metal work to the required shapes.
B. Design assemblies to minimize site modifications and welding.
C. Comply with AWS for recommended practices in shop welding. Avoid distortion or discoloration of the exposed side. Welds on exposed surfaces shall be continuous.

1. Maintain proper welding temperature to avoid discoloring adjacent metal.
2. Clamp components in jigs during welding to avoid distortion.
3. Clean exposed welded joints of welding flux, and dress on exposed and contact surfaces to be invisible, under normal lighting conditions, from adjacent surfaces.
4. Alligatored, discolored and warped components will be rejected.

D. Joints:

1. Show joint location on the Shop Drawings.
2. Mill metal assemblies jointing hairline-tight, so they fit flush.

3. Cope or miter corner joints.

E. Unless otherwise shown or accepted on the Shop Drawings, conceal all fasteners in the finish work. Back-up joints in handrails with sleeves.

2.4 FINISHING

A. Finishing exposed metal surfaces:

1. Posts and top rails - Steel: Field painted under Section 09 96 00.

PART 3 - EXECUTION

3.1 EXAMINATION/PREPARATION

A. Examine conditions and measurements affecting the work of this Section at site.
B. Correct detrimental conditions before proceeding with installation.

3.2 INSTALLATION

A. General:

1. Do not install damaged and defective components. Remove and replace members that are damaged during installation or thereafter, before the time of final acceptance.
2. See Section 05 50 00 or the installation of the posts and top bars.
3. Install this work with concealed fasteners.
4. Apply a bituminous coating, approximately 30 mils DFT, or other suitable permanent separator on surfaces in contact with cementitious materials.

B. Fastening to in-place construction:

1. Set this work accurately in location, alignment and elevation, plumb, level and true, measured from established lines and levels.
2. Provide required anchorage devices and fasteners for securing railings to in-place construction.

C. Cables: Confirm that the holes thru which the cable will pass are smooth and without sharp edges and burrs that could damage the cables. Do not install frayed cables.

1. Thread cables thru provided holes in supports.
2. Install end fittings and tension cables so they will not deform more than 1/2 inch under a concentrated load of 150 lb. applied at center of span.

D. Tolerances: Maximum deviations from theoretical locations shall not exceed 1/4 inch in plan and 1/16 inch from plumb.

3.3 FIELD QUALITY CONTROL

A. Field repair damaged components and finishes when the results are satisfactory to the Architect, otherwise replace with undamaged new components, to the Architect's satisfaction.

END OF SECTION

DIVISION 06
WOOD AND COMPOSITES

SECTION 06 10 53 - MISCELLANEOUS CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Wood nailers and blockings, and plywood sheathing.
2. Rough hardware.
3. Plywood backboards for electrical and telephone equipment.

B. Related requirements: Painting plywood backboards.

1.2 SUBMITTALS

A. Wood treatment data: Treatment manufacturer’s instructions for proper use of each type of treated material.
B. Pressure treatment:

1. For each type specified, include certification by treating plant stating chemicals and process used, net amount of preservative retained and conformance with applicable standards.
2. For water-borne preservatives, include statement that moisture content of treated materials was reduced to a maximum of 19 percent prior to shipment to project site.
3.

1.3 QUALITY ASSURANCE

A. Fire-retardant wood products shall be manufactured under the independent third party inspection of UL
B. Follow-Up Service and each piece shall bear the UL classified mark indicating the extended ASTM E 84 test
C. Each piece shall be labeled kiln dried after treatment (KDAT).

1.4 HANDLING

A. Procedure: In accordance with AWPA recommendations for storage and protection of pressure-treated wood.
B. Do not store materials in wet or damp areas.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Nailers and blockings:

1. No. 1 or No. 2 grade Douglas fir, S4S, seasoned to moisture content of 19 percent maximum and stamped S-Dry, graded in compliance with WCLIB Grading Rules.
2. If specifications for pressure treatment state the maximum percentages of moisture content at the time of treatment, comply with those requirements in lieu of the above.

B. Plywood:

1. Telephone and electrical equipment backing panels: DOC PS 1, Exposure 1, C-D Plugged, fire-retardant treated, thickness indicated or, if not indicated, not less than 1/2 inch thick.
2. Elsewhere: Softwood plywood APA, Exterior Grade, C-C Plugged.

C. Rough hardware:

1. General: Use hot-dip galvanized (not electro-plated) Type 316 stainless steel fasteners complying with G185 to attach pressure-treated wood.
2. For fastening lumber-to-lumber: Cement-coated or annular threaded nails of sufficient length to penetrate a minimum of 1-1/4-inch into adjoining members, or stove or lag bolts used with washers.
3. For fastening plywood-to-lumber: Ring shank or annular threaded nails; 8d for 1/2-inch plywood and 10d for 3/4-inch plywood.
4. For fastening plywood or lumber to steel: Minimum #10 galvanized full threaded screws driven thru 5/8-inch diameter steel washers.
5. For fastening plywood or lumber to concrete or masonry: Corrosion-resistant drilled expansion type anchors or power-driven anchors by Hilti Fastening Systems, Molly Division of USM Corp., Redhead, or equal, capable of resisting a withdrawal force of 400 lb. each without failure.

2.2 TREATMENT OF LUMBER AND PLYWOOD

A. Preservative treatment by pressure process: AWPA C2 (lumber) and AWPA C9 (plywood), except that lumber not in contact with the ground and continuously protected from liquid water may be treated according to AWPA C31 with inorganic boron (SBX).

1. Kiln-dry material after treatment to maximum moisture content of 19 percent for lumber and 15 percent for plywood.
2. Mark each treated item with treatment quality mark of an inspection agency approved by the American Lumber Standards Committee Board of Review.
3. Treatment of wood nailers used in conjunction with roofing membrane shall be compatible with the roofing bitumen; oil-based preservatives are not acceptable.

B. Application: Treat items indicated on Drawings, and the following:

1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.
3. Wood framing members less than 18 inches above grade.
4. Wood floor plates installed over concrete slabs directly in contact with earth.

2.3 FIRE-RETARDANT TREATED WOOD

A. General: Where fire-retardant-treated materials are indicated, provide materials that comply with performance requirements in AWPA C20 (lumber) and AWPA C27 (plywood). Identify fire-retardant-treated wood with appropriate classification marking of UL, US Testing, Timber Products Inspection, or another testing and inspecting agency acceptable to AHJ.

B. Use treatment for which chemical manufacturer publishes physical properties of treated wood after exposure to elevated temperatures, when tested by a qualified independent testing agency according to ASTM D 5664 for lumber and ASTM D 5516 for plywood**.**

C. Use treatment free of halogens, sulfates, chlorides, arsenic, ammonium phosphate, formaldehyde, urea formaldehyde, and that does not promote corrosion of metal fasteners.

1. Exterior: “Exterior FRX” by Hoover Treated Wood Products (basis of design), FRX FRT Wood by Arch Wood Protection, or equal.
2. Interior: “Pyro-Guard” by Hoover Treated Wood Products, Dricon FRT by Arch Wood Protection, or equal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions and measurements affecting the work of this Section at site.
B. Correct detrimental conditions before proceeding with installation.

3.2 PREPARATION

A. Paint backboard panels before installation as specified in Section 09 90 00.

3.3 INSTALLATION

A. Subdrill holes in pieces where splitting may occur; size holes slightly smaller than diameter of nail.
B. Do not drive nails closer to edge of lumber than 1/4 length.
C. Remove lumber split in nailing and replace with sound members.
D. Make joints accurately and neatly, square, flush and tight.
E. Install wood screws and lag bolts with complete penetration to head. Bore lead holes equal to root diameter of the screw or bolt. Drive flush or recess with nailer face.
F. Pressure-treated wood products: Do not rip or mill treated lumber. End cuts, drilling holes and joining cuts are permitted. Plywood may be cut in any direction.

1. Use pressure-treated wood where required by Code and as specified above.
2. Use fire-treated wood where required for blockings and nailers located in metal-framed walls, partitions and ceilings.

G. Provide nailers and blockings where indicated and required.

1. Template and drill to match anchor bolts in steel members, concrete and masonry.
2. Where materials are applied over flush nailer surfaces, use carriage bolts with heads drawn flush into top of nailer or blockings, or counterbore holes to recess washers and heads of nuts.

3.4 ANCHORAGE

A. Fastening lumber or plywood to lumber:

1. Space nails a maximum of 12 inches o.c. and stagger across face of piece. Locate fastener also within 3 inches of each end of piece.
2. Drive nail heads flush with wood surfaces. Nails shall penetrate adjoining piece a minimum of 1-1/4-inch.

B. Fastening lumber or plywood to concrete or to masonry:

1. Space anchors a maximum of 36 inches o.c. and stagger if lumber is more than 5 inches wide.

2. Make anchor heads flat or countersunk flush with surface, but not countersunk more than 1/3 the thickness of piece to be fastened.
3. Anchor withdrawal resistance shall be a minimum of 400 lb. per anchor, or number of fasteners increased accordingly from that specified. Minimum penetration of 1-1/2-inch into concrete or masonry.

C. Fastening lumber or plywood to steel:

1. Space screws a maximum of 24 inches o.c. and stagger if lumber is more than 5 inches wide.
2. Drive screw heads flush with face of plywood or lumber.
3. Anchor shall penetrate a minimum of 1/4 inch through the steel.
4.

3.5 CLEANUP

A. Comply with the requirements of Division One.
B. Do not bury wood of any type on the jobsite.

END OF SECTION

SECTION 06 16 43 - GYPSUM SHEATHING BOARD

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes gypsum sheathing board on exterior face of exterior walls.
B. Related requirements:

1. Gypsum cover board is specified in Division 07.
2. Gypsum board is specified in Division 09.

1.2 SUBMITTALS

A. Data: Manufacturer Product Data for sheathing and fasteners. Include copies of approval for the assemblies by authorities having jurisdiction where used in fire-rated assemblies.

PART 2 - PRODUCTS

2.1 MANUFACTURER/TYPE

A. As specified below.

2.2 MATERIALS

A. Gypsum sheathing: One of the following of the thickness indicated, or equal complying with ASTM C 1177.

1. G-P Gypsum Products “Dens-Glass Gold” (Standard and Type X) sheathing board complying with ASTM C 1177 (basis of design).
2. National Gypsum “Goldbond E^2 XP.”
3. USG “Securock Glass-Mat Sheathing.”
4. Temple Inland “GreenGlass.”
5. CertainTeed “GlasRoc Sheathing.”

B. Screws: Steel drill screws with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117. Diameter and length to satisfy Code requirement.
C. Gypsum sheathing tape: 3M contractor sheathing tape NO.8086-inch by 3M Co., “Perm-A-Barrier” wall seam tape by WR Grace & CO., “108JTN” by Royston Laboratories, or “Polyken 610” by Polyken Technologies; use only tape approved by the sheathing manufacturers**.**

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine framing to support sheathing board and verify that the contact surface of any framing or furring member does not vary more than 1/4-inch from the plane of adjacent members.
B. Verify that studs, blocking and supporting materials are in place and ready for sheathing attachment prior to starting work.
C. Coordinate the exterior placement of electrical, mechanical and plumbing wall devices, accessories and access panels, wall signage, and other type wall construction with other trades before proceeding with work and during installation.

D. Correct detrimental conditions before proceeding with installation.

3.2 APPLICATION

A. General:

1. Use appropriate length boards to minimize end joints.
2. Place edge joints parallel to, and over framing members. Stagger end joints, if required.

B. Install boards with long edge perpendicular to framing. Butt joints between panels loosely. Do not force panels into place.
C. When fastening the board, proceed from the center towards ends and edges using power screwdriver recommended by the manufacturer to drive screws.
D. Drive fasteners to bear tight against and flush with the surface of the sheathing but do not break the fiberglass mesh.
E. Locate fasteners not closer than 3/8-inch from the edge and the ends of the sheathing panels.

END OF SECTION

SECTION 06 41 16 – PLASTIC-LAMINATE-CLAD ARCHITECTURAL CASEWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Plastic laminate-clad casework. (PLAM-1 and PLAM-2)
2. Hardware for the casework.
3. Structural supports incorporated into wood casework.

B. Factory finishing.

1. Items associated or integral with architectural woodwork, including, but not limited to:

   a. Supports, reinforcement, and like components.
   b. Hardware and accessories.
   c. Concealed steel supports

C. Related requirements:

1. Other Section of Division 06 for wood blocking or grounds inside finished walls or above finished ceilings.
2. Division 23 for plumbing fixtures and fittings installed in countertops.

1.2 REFERENCES

A. Minimum standards for work in this Section shall conform to those listed and referenced in the Woodwork Institute (WI) and North American Architectural Woodwork Standards (NAAWS).

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate placement of backing plates and studs in walls to receive casework with the appropriate trades. Review, and annotate where required, their Shop Drawings before those are submitted to the Architect.
B. Preinstallation Conference: Conduct conference at Project site.

1.4 SUBMITTALS

A. The Drawings are diagrammatic and show required profiles and dimensions. Assembly details are left to the Contractor and shall comply with WI standards provided the profiles and dimensions of the casework remain as indicated.

1. Comply with Woodwork Institute’s (WI) North America Architectural Standards (NAAWS) standards, current edition.
2. Furnish WI Certified Compliance Label on the first page of Shop Drawings.

3. Submit large scale, dimensioned, Shop Drawings showing location of each item of casework, dimensioned plans and elevations, large-scale details, attachment devices, finishes, and finish hardware type and location.

    a. Include hardware list, identifying each item by manufacturer, catalog number, size, finish and intended use. Include catalog cut sheets.
    b. Indicate method of seismic construction by WI-Seismic Test Codes Number.
    c. Coordinate Shop Drawings with the work of related trades which is a part of, or will be incorporated with the architectural woodwork, such as plumbing, electrical, and electronic equipment, along with adjacent and abutting materials to which this work is to be secured. Obtain the approval of the millwork Shop Drawings by these related trades (as evidenced by their stamp and signature thereon) before submitting Shop Drawings to the Architect.

B. Closeout:

1. Deliver all documentation required herein, including but not limited to:

    a. WI Certificates of Compliance.
    b. “As built” shop drawings reflecting all changes made during the project

2. Deliver a minimum of 4 keys for each lock to the District Representative. Label with individual tags indicating lock location(s).

1.5 QUALITY ASSURANCE

A. Manufacturer qualifications:

1. Firm (woodwork manufacturer) with not less than 5 years of production experience similar to this Project, whose qualifications indicate the ability to comply with the requirements of this Section.
2. The woodwork manufacturer must have at least one project in the past 5 years where the value of the woodwork was within 20 percent of the cost of woodwork for this Project.

B. Installer qualifications:

1. Manufacturer of casework, or
2. Firm licensed by WI under their "Certified Compliance Program," or
3. Firm specializing in custom millwork with 5 years’ experience in installation of custom millwork similar to that required for this Project.

C. Mockup:

1. Before starting production work, assemble a mockup of a base cabinet with one drawer and one door, and a countertop, for the Architect's review and approval. Mockup shall be complete with hardware and finished as specified.
2. Mockup must be located at the Project site.
3. Finish the mockup as intended for the finish work.
4. Approved mockup will be used as a standard for the Work.
5. Approved mockup may be used for the Project upon approval of Architect.

D. Requirements of regulatory agencies: Provide evidence of compliance with Code for architectural woodwork.

1. Particle board, MDF, and hardwood plywood used in this project must comply with California Air Resource Board standards for formaldehyde emissions.

E. Single source responsibility: A single manufacturer shall produce and install the work of this Section.
F. Certified compliance:

1. Before delivery to the jobsite the woodwork supplier shall provide a WI “Certified Compliance” Certificate indicating the millwork products being supplied and Certifying that these products meet the requirements of the Grade or Grades specified.
2. Each piece of paneling shall bear a WI Certified Compliance Label.
3. At completion of installation the woodwork installer shall provide a WI Certified Compliance Certificate indicating the products installed and certifying that the installation of these products meets the requirements of the NAAWS Grade specified.
4. Fees charged by the WI for their Certified Compliance program are the responsibility of the Contractor and shall be included in the bid.

1.6 HANDLING

A. Procedure: In accordance with NAAWS "Recommended Care and Storage of Architectural Woodwork"
B. Delivery:

1. Deliver materials to Project site in protective wrappings clearly labeled with identification of manufacturer, item name, and specific installation location.
2. Deliver millwork only when the area of operation is enclosed, all plaster and concrete work dry, and the area broom clean.

C. Storage:

1. Store in a clean storage area, well ventilated and protected from direct sunlight, excessive heat, rain or moisture, in which the relative humidity is between 45 percent and 65 percent at 60 to 90-degree F, and Equilibrium Moisture Content conditions between 8 percent and 12 percent.
2. The air conditioning or heating system shall be on and functioning and the architectural millwork shall be acclimated to these conditions for 72 hours prior to installation.
3. Do not subject casework to abnormal heat, extreme dryness, humid conditions, sudden changes in temperature, or direct sunlight.
4. Store cabinets carefully and set or store on a level floor. Protect the exposed finished portions from bumping, scratching, staining and other damage.

D. Handling: Handle with clean hands, use care not to slide one item over the other, and when primed or sealed, properly re-stack when dry.

PART 2 - PRODUCTS

2.1 COMPONENTS

A. Lumber:

1. In accordance with the NAAWS Grade specified for the product being fabricated. Moisture content shall be 6 percent to 12 percent for boards up to 2-inch nominal thickness and shall not exceed 19 percent for thicker pieces.
2. Lumber shall be Birch or Poplar.

B. Veneer:

1. In accordance with the NAAWS requirements for its use and grade(s) specified.
2. Veneer shall be any close-grained hardwood suitable to receive an opaque finish.

C. Core: MDF meeting the requirements of NAAWS.
D. Veneer core plywood: Classic Core by Columbia Forest Products, or equal void less veneer hardwood plywood.
E. Hardboard: AHA A135.4.
F. Plastic laminate:

1. Complying with the requirements of the NAAWS for its intended use.
2. Colors and textures indicated or selected by the Architect.
3. Where edge is exposed in the Work, provide color core laminate.

G. Cabinet liner: Type CLS.
H. Edgeband: PVC.
I. Adhesives: Type I.
J. Finish hardware:

1. Hinges:

a. Grade 1 (institutional), or Grade 2, concealed (European style) with 3-way independent adjustment.
b. Self-closing, 170-degree opening, except 90-degree where door opens against a wall, or otherwise limited to 90-degree.

2. Drawer slides: WI-approved, self-closing metal runners with ball-bearing rollers, full extension type, side mounted.

a. Pencil drawers: 50 lb rated.
b. General purpose drawers: 75 lb rated.
c. General purpose drawers more than 24-inch wide or 6-inch deep: 100 lb rated.
d. File drawers: 100 lb rated.
e. Lateral file drawers more than 24 inches wide: 150 lb rated.
f. Drawer guides: full extension NAAWS-approved.

3. Drawer Pulls: DP3/AM Series -Antimicrobial 4-inch tab drawer pull.

a. Finish: Matte black.

4. Shelf supports for adjustable shelves in wall-hung cabinets and the upper half of tall cabinets: Designed to prevent shelves from sliding forward in a seismic event.
5. Bored hole shelf support systems and metal shelf ladders have both been determined to provide satisfactory support.
6. Drawer and Cabinet Locks: Equal to National Cabinet Lock.

a. Cabinet Doors: C8173, C8174, or C8175.
b. Drawers: C8177, C8178 or C8179.
c. Provide a minimum of 4 keys per lock.

7. Keying:

a. Key locks inside one room alike. Furnish 3 keys for each lock keyed separately, and 2 keys for each lock in keyed alike groups. Master keys shall be tagged and delivered to the Inspector of Record (IOR). Locks and keys shall be stamped with coded set number / direct digit.

b. Cabinet locks shall be master-keyed and keyed alike. Backside of cabinet lock bolts (on visible side following installation) and change keys shall be stamped with manufacturer's code, either direct digit or coded series. Change keys shall also be stamped with set numbers direct digit.
c. Master keys shall be National GM2.

8. Elbow catches: Equal to Ives 2A.
9. Grommets in casework: Plastic, of the color selected by the Architect, with flip-top of appropriate size for wire management, by Doug Mockett & Co., Hardware Concepts, Inc., Wood Technology, Inc., Blanton & Moore, or Metcor Manufacturing Co.
10. Shelf standards: Knape & Vogt 255 series recessed steel pilaster standards with 256 series steel shelf supports or approved equal.
11. Wire manager: Plastic, of the color selected by the Architect, Doug Mockett & Co., Inc. WM-2A, Blanton & Moore WMC-4000 Series, or equal. Provide at each computer station.
12. Bolts: Surface type BBW No. 97-B6, Quality B6 or Trimco No. 4856-6.
13. Provide seismic restraints for open shelf supports.
14. Card Holders for Drawers: Corbin No. 1913-1/4H or Garcy No. 853.
15. Hanger Rods: 1-1/16 inches minimum diameter metal tubing, aluminum or stainless steel clad, KV660; heavy wall steel tubing KV770.
16. Hanger Rod Flanges: KV757, or flanges KV734, KV735; Ronther Reiss R44-55; or equal.
17. Casework door silencers: Provide at tops and bottoms of all doors.

K. Rough hardware:

1. Wood screws, nails and anchors: As selected by the fabricator provided that they result in permanent connections.
2. Toothed steel or lead expansion bolt devices for drilled-in-place anchors. Furnish inserts and anchors, as required, to be set into concrete work for anchorage.

2.2 FABRICATION

A. Casework:

1. NAAWS Custom Grade.
2. Countertops: Premium Grade.
3. Exposed interior surfaces: Low pressure melamine overlay.
4. Semi-exposed surfaces: Cabinet liner.
5. Doors, drawer fronts, and false fronts: Flush overlay.

a. Edgeband at doors, drawer fronts, and false fronts: 3mm PVC.

B. Drawers: Comply with the requirements of the NAAWS for the Grade specified.
C. Plastic laminated countertops:

1. Laminate:

a. Manufacturer: See Finish Schedule.
b. Pattern: See Finish Schedule

2. Core material: MDF.
3. Back splashes: As detailed.
4. Front edges: As detailed.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify the adequacy and proper location of any required backing or support framing.
B. Verify that mechanical, electrical, plumbing, and other building components affecting work in this Section are in place and ready.
C. Examine conditions and measurements affecting the work of this Section at site.
D. Correct detrimental conditions before proceeding with installation.

3.2 PREPARATION

A. Condition woodwork to average prevailing humidity conditions in installation areas prior to installing.

3.3 INSTALLATION GENERAL

A. Comply with requirements of WI, and Code for seismic attachment and bracing.
B. Install work plumb, level, true and straight with no distortions, to a tolerance of 1/8-inch in 8 feet from plumb and level.
C. Shim using concealed shims.
D. Scribe and cut work to fit adjoining work and refinish cut surfaces or repair damaged finish at cuts.
E. At gypsum board construction, anchor through wall surface to backing plates and studs. Indicate location of required concealed backing on casework shop drawings.
F. Furnish fillers, closures and trim as required for a complete installation. Scribe in place where required.

3.4 CASEWORK

A. Comply with WI's Architectural Woodwork Standards for custom installation unless otherwise detailed.
B. Install in a manner consistent with the specified quality grade, plumb, level, true and straight with no distortions.
C. Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
D. Install cabinets with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
E. Secure to ground, stripping and blocking with countersunk, concealed fasteners and blind nailing as required for a satisfactory installation. Scribe and cut for accurate fit to adjacent finished surfaces.

3.5 COUNTERTOPS

A. Comply with WI's Architectural Woodwork Standards for custom installation unless otherwise detailed.
B. Anchor securely to base units and other support systems as indicated. Fasten joints in tops with draw-bolt type fasteners let into underside of top.
C. Install countertops with ends as detailed.

D. Verify opening requirements and make cutouts for sinks, fittings, service fixtures, and equipment.
E. Scribe laminated plastic tops to walls and other adjacent items.

F. Fill gaps between solid surface tops and walls and other adjacent items with color matched sealant.

3.6 FIELD QUALITY CONTROL

A. Field touchup shall be the responsibility of the installer and shall include filling in of nail holes, refinishing of raw surfaces resulting from job fitting, repair of job inflicted scratches and mars, and final cleanup of the finished surfaces.
B. Protecting:

1. Do not use the top of casework for storage.
2. Do not store materials adjacent to woodwork unless it is protected against damage and staining.
3. When painting or touching-up surfaces contiguous to woodwork, mask it with non-staining Kraft paper and tape.

C. Replace work damaged beyond satisfactory field repair, as determined by the Architect, with satisfactory millwork.
D. Before inspection for Substantial Completion, remove protective covering and clean interior and exterior surfaces using procedures and materials recommended by manufacturer.

END OF SECTION

SECTION 06 42 00 – WOOD PANELING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Wood paneling. (WD-1)
2. Wood trim and other decorative components of the paneling.
3. Clips and other hardware to attach paneling to concealed supports.

B. Related requirements: Division 06 for exterior and interior finish carpentry and for interior architectural woodwork.

1.2 DEFINITION

A. “Paneling” as defined in this Section includes wood trim and other decorative components at the perimeter and in the field of the paneling.

1.3 REFERENCES

A. Architectural Woodwork Institute, and the Architectural Woodwork Manufacturers of Canada (WI.) North American Architectural Woodwork Standards (NAAWS).

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Indicate on Shop Drawings the exact location and type of concealed supports required to attach paneling to walls. Verify with affected trades that the supports are provided in accordance with the approved Shop Drawings before wall finish material is installed.

1.5 SUBMITTALS

A. Procedure: In accordance with the NAAWS.
B. Data: Manufacturer Product Data for adhesives, finishing system, and for clips.
C. Shop Drawings:

1. Comply with NAAWS.
2. The Drawings are diagrammatic and show required profiles and dimensions. Submit large scale, dimensioned, Shop Drawings showing paneling layout on each plane, plans and elevations, large-scale details, finishes, and attachment devices types and locations.

D. Samples:

1. Paneling:

a. Sample panels approximately 24 inches square, complete with trim, showing proposed variations in grain and color of the veneer for paneling with a transparent finish. Include at least one face-veneer seam and finish as specified.
b. Same size panels, complete with trim, with an opaque finish.

2. Clips: Full size Samples by 6 inches long.
3. Veneer: Leaves representative of and selected from flitch showing species, cuts, finishes, textures and patterns to be used.
4. Approved Samples will serve as Architect’s control Samples.

E. Product Data:

1. Evidence of no added Formaldehyde panel products.

F. Closeout: Instructions on maintenance and touching-up finish.

1.6 QUALITY ASSURANCE

A. General: Work shall be in accordance with NAAWS for the grade or grades specified.
B. Manufacturer/installer qualifications:

1. Firm licensed by WI under their "Certified Compliance Program," and/or
2. Firm with not less than 10 years of production experience similar to this Project, whose qualifications indicate the ability to comply with the requirements of this Section.
3. Firm must have at least one project in the past 5 years where the value of the woodwork was within 20 percent of the cost of woodwork for this Project.

C. Single source responsibility: A single manufacturer shall produce and install the work of this Section.
D. Special design requirements: Sequence-matched wood veneers and wood doors with face veneers that are sequence-matched with woodwork and transparent-finished wood doors and adjacent decorated trim and ornaments that are required to be of same species as woodwork.
E. Quality standard: Unless otherwise indicated, comply with AWS standards for “Premium” grade for paneling to receive a transparent finish and “Custom” grade for paneling to receive an opaque finish.
F. Requirements of regulatory agencies: Provide evidence of compliance with Code for wood paneling.

1. Formaldehyde emissions: Particle board and MDF used for the Project must comply with California Air Resource Board standards for formaldehyde emissions.
2. Fire-test-response characteristics: Provide materials and products with fire-test-response characteristics complying with Class I or A, as determined by testing identical products per test method indicated by UL, ITS, or another testing and inspecting agency acceptable to AHJ. Identify with appropriate markings of applicable testing and inspecting agency in the form of separable paper label or, where required by AHJ, imprint back of panels.

G. Mockups:

1. Before starting production work, assemble mockup consisting of 4 panels (minimum) of each type, with one corner for Architect’s review.
2. Finish the mockups as intended for the finish work.
3. Repeat mockups when the first ones are unsatisfactory.
4. Approved mockups will be used as a standard for the Work and may remain as part of the Work when protected.

1.7 HANDLING

A. Procedure: In accordance with AWS standards.
B. Delivery:

1. Deliver paneling to Project site in protective wrappings clearly labeled with identification of manufacturer, item name, panel number corresponding to the numerical sequence of the Shop Drawings, and specific installation location.
2. Deliver paneling only when the area of operation is enclosed and broom clean, and cementitious work is dry.

C. Storage:

1. Store materials in a clean, well-ventilated storage area protected from direct sunlight, excessive heat, rain and moisture; in which relative humidity is between 45 and 65 percent at 60 to 90 degrees F. and equilibrium.
2. The air conditioning or heating system shall be on and functioning and the wood paneling shall be acclimated to these conditions for 72 hours prior to installation.
3. Do not subject paneling to abnormal heat, extreme dryness, humid conditions, sudden changes in temperature, or direct sunlight.

4. Store paneling carefully and set or store on a level floor. Protect the exposed finished portions from bumping, scratching, staining and other damage.

D. Handling: Handle with clean hands, taking care not to slide one item over the other; when primed or sealed, properly re-stack when dry.

E. Fire-retardant-treated wood: Handle, store, and install fire-retardant-treated wood to comply with chemical treatment manufacturer's written instructions, including those for adhesives used to install woodwork.

1.8 PROJECT CONDITIONS

A. Acclimation: Condition materials to moisture content between 8 percent and 12 percent.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Provide materials that comply with NAAWS for quality grade specified, unless otherwise indicated.

B. Panel core products: In compliance with section 500 of the standard.

C. Wood trim and other decorative components of the paneling: From solid wood matching face veneer for transparent finished panels; MDF or close-grained solid hardwood for opaque finish.

D. Exposed surfaces, including edges:

1. Wood species and cut: As indicated in Interior Finish Materials Schedule on Drawings.
2. Finish: As indicated and matching Architect Control Sample.

E. Concealed surfaces: Hardwood veneer compatible with face.

2.2 HARDWARE AND ACCESSORIES

A. Panel clips: Extruded aluminum 2-piece Kingclips by Brooklyn Hardware Manufacturing, or equal by Orange Aluminum or Monarch Metal Fabrication.

B. Anchors:

1. Select material, type, size, and finish required for each substrate for secure anchorage.
2. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance.

2.3 FINISHES

A. Wood fillers, sealers, stains and finish coating systems (stains and dyes), used with compliant stains and bases by one of the following manufacturers:

1. Minwax.
2. RJ McGlennon Co., Inc.
3. Sikkens.
4. Sherwin Williams.
5. WD Lockwood.

2.4 WOOD PANELING

A. General:

1. Match Architect’s Control Sample. In preparation for finish, clean woodwork.
2. Comply with AWS section 500, grade specified, and these Specifications.
3. Finish woodwork at the mill, smoothly dressed. Sand, using same sequence and grade of abrasive used in the Architect’s Control Sample to achieve the same finish. Clean woodwork thoroughly with a tack cloth.

4. Produce surfaces free from open joints, hammer and machine marks, structural defects and surface blemishes.

B. Veneer, meeting requirements of the NAAWS for the Grades specified above: Match approved Samples and mockups.

2.5 SHOP FINISHING

A. General: Finish wood paneling at fabrication shop. Defer only final touchup, cleaning, and polishing until after installation.
B. Grade: Provide finish of same grade as items to be finished.
C. Preparation for finishing: Comply with referenced AWS Quality Standard for sanding, filling, sealing concealed surfaces, and similar preparations for finishing paneling.
D. Transparent finish:

1. Grade: Premium.
2. AWS Finish System: TBD
3. Sheen: TBD.

E. Backpriming: Backprime paneling on surfaces that will be concealed with one coat of wood primer or clear varnish.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions and measurements affecting the work of this Section at site.
B. Correct detrimental conditions before proceeding with installation.

3.2 PREPARATION

A. Condition paneling to average prevailing humidity conditions in installation areas prior to installing.

3.3 INSTALLATION

A. Comply with NAAWS standards requirements for Grade of the items being installed.
B. Attach continuous clips securely to back of panels.
C. Anchor the supporting clips through wall surface to backing plates and studs. Indicate location of required concealed backing on paneling Shop Drawings.
D. Install paneling plumb, level, true and straight with parallel, uniform joints, to a tolerance of 1/8-inch in 10 feet from plumb and level; lipping is not allowed; use concealed shims.

3.4 FIELD QUALITY CONTROL

A. General: Field touchup is the responsibility of the installer and shall include filling in of nail holes, refinishing of raw surfaces resulting from job fitting, repair of job inflicted scratches and mars, and final cleanup of the finished surfaces.
B. Protecting: When painting or touching-up surfaces contiguous to woodwork, mask it with non-staining Kraft paper and tape.

1. Replace millwork damaged beyond satisfactory field repair with satisfactory woodwork, as determined by the Architect.
2. During final cleaning, remove protective covering and clean interior and exterior surfaces using procedures and materials recommended by manufacturer.

3.5 ADJUSTING AND CLEANING

A. Repair damaged and defective paneling, where possible, to eliminate functional and visual defects; where not possible to repair, replace paneling. Adjust joinery for uniform appearance.
B. Clean surfaces on exposed and semi-exposed surfaces.

END OF SECTION

DIVISION 07

THERMAL & MOISTURE PROTECTION

SECTION 07 16 16 - CEMENTITIOUS WATERPROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes cementitious, crystalline waterproofing applied to:

1. Interior walls and floor of elevator pits and other pits below lowest building floor slab.
2. Exterior curbs; from behind cement plaster to 6-inches below finish floor (below grade).

B. Related requirements: All other waterproofing systems.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Scheduling and sequencing: Comply with waterproofing manufacturer's recommendations for sequencing construction operations after waterproofing applications to avoid conditions detrimental to performance of waterproofing application.

B. Preinstallation meeting:

1. Prior to start of installation arrange a pre-installation meeting between the product manufacturer authorized representative, the Contractor, the Architect, and the installer to review Project conditions, the Drawings, Specifications and the manufacturer's data.
2. If more than one trade will be responsible for the successful performance of the work of this Section, these trades shall attend the meeting.
3. Record meeting minutes and distribute copy to all concerned, and the Architect, within 7 days after the meeting.

1.3 SUBMITTALS

A. Data: Waterproofing manufacturer Product Data for proposed products, and their installation method.

B. Shop Drawings: Detail waterproofing construction joints, crack treatment, corners, and penetrations in waterproofed surfaces.

C. Warranty: Sample copies of warranty for assembly to be furnished under this Section, clearly defining terms, conditions, and time periods for the warranty.

D. Letter of acceptance: From the manufacturer to verify its acceptance of the applicator and acceptance of substrates as satisfactory to receive this work.

E. Test reports: Submit complete test reports from approved, independent testing laboratories certifying that waterproofing system conforms to specified performance characteristics and testing requirements.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Manufacturer shall be ISO 9001 registered, and shall have no less than 10 years’ experience in manufacturing the cementitious crystalline waterproofing materials for the required work.

B. Installer qualifications: Qualified firm authorized, approved, or licensed to install products specified and eligible to receive warranty specified, with at least 3 years experience in work of the type required by this Section.

C. Source quality: Obtain proprietary crystalline waterproofing products from a single manufacturer.

1.5 HANDLING

A. Deliver and store packaged waterproofing materials to project site in original, undamaged containers, with manufacturer's labels and seals intact.
B. Do not use materials past the manufacturer's recommended shelf life.

1.6 PROJECT CONDITIONS

A. Provide ventilation, heaters, humidifiers and water sprays as required to reach and maintain the surface and air temperatures, and humidity within the limits specified for the installation of the waterproofing materials.
B. Apply waterproofing only when air and concrete temperatures are above 40 degrees F. Do not apply to frost-covered surfaces.
C. For interior application, Provide sufficient light to properly perform this work.
D. For exterior application, shade the work areas from direct sunlight during installation, as needed to prevent rapid evaporation caused by excessive heat or wind.

1.7 SPECIAL WARRANTY

A. Warrant waterproofing against water penetration thru waterproofed surfaces for 5 years after Substantial Completion.
B. Make repairs required during this period, to restore integrity of the waterproofing, at no cost to the Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS/SYSTEMS

A. Waterproofing materials: One of the following.

1. "Xypex Concentrate", "Xypex Modified", and "Xypex Patch'n Plug" by Xypex Chemical Corp. (basis of design).
2. "Planiseal 88" by Mapei.
3. "Hey'Di K-11" by Euclid Chemical.
4. "Permaquik Super 200" by Tremco.
5. "Kóester NB 1" by Kóester American Corp.
6. "Aquafin-IC" by Aquafin Building Product Systems.

2.2 PERFORMANCE REQUIREMENTS

A. Provide waterproofing that prevents the passage of water thru waterproofed surfaces.
B. Testing Requirements: Crystalline waterproofing system shall be tested in accordance with the following standards and conditions, and the testing results shall meet or exceed the specified performance requirements.

1. Independent Laboratory: Testing shall be performed by an independent laboratory meeting the requirements of ASTM E 329 and certified by the United States Bureau of Standards. Testing laboratory shall obtain all concrete samples and waterproofing product samples.

C. Permeability: Independent testing shall be performed according to U.S. Army Corps of Engineers CRD C48 "Permeability of Concrete".

1. Concrete samples (treated and untreated) shall have design strength of 2000 psi and thickness of 2 inches. No admixtures permitted.
2. Coatings shall have maximum thickness of 0.05 inch per coat with up to 2 coats permitted.
3. Samples shall be pressure tested to 175 psi (405 foot head of water.)

4. Treated samples, after crystalline growth has occurred, shall exhibit no measurable leakage.

D. Chemical Resistance: Independent testing shall be performed according to ASTM C 267 “Chemical Resistance of Mortars” and ASTM C 39 “Compressive Strength of Cylindrical Concrete Specimens”.

1. Concrete samples (treated and untreated) shall have design strength of 4000 psi. No admixtures permitted.
2. Coatings shall have maximum thickness of 0.05 inches per coat with up to 2 coats permitted.
3. Untreated and treated specimens shall be immersed for a minimum of 84 days in following chemical solutions: hydrochloric acid (3.5pH), brake fluid, transformer oil, ethylene glycol, toluene, caustic soda.
4. Treated specimens shall exhibit no detrimental effects after exposure, and shall have a minimum of 14 percent increase in compressive strength versus untreated control specimens.

E. Potable Water Approval: Independent testing shall be performed according to NSF Standard 61 and approval for use of waterproofing material on structures holding potable water shall be evidenced by NSF certification.

2.3 MATERIALS

A. Waterproof coating materials:

1. Walls: Xypex Concentrate and Modified.
2. Floors (Contractor’s option): Xypex Concentrate DS-1 or DS-2 (dry shake).

B. Curing agent (Contractor option in lieu of water curing): Xypex Gamma Cure.
C. Water: Potable and fresh.
D. Alternate to Xypex coatings for new cast-in-place concrete: Xypex Admix C-500 (accelerated set time), C-1000 (standard set time), or C-2000 (extended set time), or Aquafin IC Admixture.

1. Dose at 2 to 3 percent by weight of Portland cement in the mix.
2. Add admixture to the concrete when batching in accordance with its manufacturers recommendations.

2.4 MIXES

A. In accordance with the manufacturer’s recommendations.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions affecting the work of this Section at site.
B. Correct detrimental conditions before proceeding with installation.

3.2 APPLICATION - GENERAL

A. Install the waterproofing in a uniform thickness, reasonably free of trowel marks, over entire areas to be waterproofed. Comply with the waterproofing manufacturer's installation instructions.

3.3 NEWLY PLACED HORIZONTAL CONCRETE SURFACE

A. Comply with manufacturer's instructions, including Product Data, technical bulletins, catalog installation instructions, and product carton instructions. When in conflict, the most stringent provision applies.
B. Newly placed concrete must be free of bleed water and be able to support the weight of a power trowel. Apply a rough wood float or broom finish.
C. Immediately after floating the surface, apply one-half of the dry shake material evenly by a hand or mechanical spreader at rate recommended by manufacturer.
D. As soon as the dry shake material absorbs moisture from the base slab, finish the concrete surface and incorporate the dry shake material into surface during the finishing process.

3.4 PREPARATION OF CURED CONCRETE

A. Prepare surfaces to be treated in accordance with waterproofing manufacturer's instructions.
B. Horizontal surfaces shall have a rough wood float or broom finish. Coordinate this requirements with the concrete finisher.
C. Clean laitance, curing compounds, excess form oil, dirt film, paint, coatings or other foreign matter harmful to the performance of waterproofing from surfaces of cured concrete to be treated.
D. Prepare cured surfaces if necessary to provide open capillary surface to provide tooth and suction for treatment; use acid etching, sandblasting, waterblasting, or other methods.
E. Defects: Rout out defects, such as cracks, faulty construction joints, honeycombing, form tie holes, and other defects to sound concrete, and repair.

1. Chip defective areas into a U-shaped slot one inch wide and minimum one inch deep.
2. Clean slot, wet, saturate with water and remove surface water.
3. Apply specified slurry coat to slot at rate recommended by manufacturer.
4. Allow slurry coat to reach initial set.
5. Fill cavity with specified dry pack repair compound.
6. Compress tightly into cavity using pneumatic packer or hammer and blocks.

F. Rock Pockets, Honeycombing, and Other Defective Concrete:

1. Rout out defective areas to sound concrete.
2. Remove loose material and saturate with water.
3. Remove surface water and apply specified slurry coat.
4. After slurry coat has set, but while still green, fill cavity to surface with specified patching compound.

G. Coves: At right-angle intersections cove the joint for smooth transition of waterproofed surface.

1. Apply specified slurry coat to slot at rate recommended by manufacturer.
2. Fill and form surfaces using specified dry pack repair compound or waterproofing material in mortar consistency while slurry coat is still green, but after slurry coat has reached initial set.
3. Trowel into a cove shape.

H. Construction Joints: Apply sealing strips at each construction joint by filling grooves coinciding with construction joint.

1. If grooves have not been preformed, at least 3/4 inch wide and minimum one inch deep, saw cut and chip grooves to that dimension.
2. Fill and form surfaces using specified dry pack repair compound.
3. Compact tightly using pneumatic packer or hammer and block.

I. Expansion Joints: Treat as indicated on drawings.

3.5 INSTALLATION ON CURED CONCRETE

A. Comply with manufacturer's instructions, including Product Data, technical bulletins, catalog installation instructions, and product carton instructions.
B. Mix materials in accordance with manufacturer's instructions.
C. Wet concrete surfaces and saturate with clean water to ensure migration of crystalline chemicals into concrete; remove free surface water before application of waterproofing treatment.
D. Exposed Surface Application: Apply waterproofing uniformly with semi-stiff bristle brush or spray under conditions and application rate recommended by manufacturer.

1. Apply second coat while first coat is still green, but after reaching initial set.
2. Use light pre-watering between coats when rapid drying conditions occur.

E. Sandwich (Topping) Slab Application: Place topping material while waterproofing application is still green, but after reaching initial set.

1. Use light pre-watering between coats when rapid drying conditions occur.

F. Curing: Cure exposed waterproofing treatment using a mist fog spray of clean water after coating has hardened sufficiently not to be damaged by spray; do not use plastic sheeting laid directly on waterproofing; air circulation is required.

1. If water curing is not possible, follow manufacturer's recommendations for curing using chemical curing agent approved by manufacturer.
2. Avoid coating damage with spray operation.
3. Spray treated surface 3 times a day for 2 to 3 days.
4. In hot climates, spray treated surfaces at intervals recommended by waterproofing manufacturer.
5. During curing period, protect treated surfaces from rainfall, ambient temperature below freezing, and puddling of water.
6. Provide supplementary air circulation as recommended by waterproofing manufacturer.
7. Concrete Structures to Hold Liquids: Cure waterproofed concrete surfaces for 3 days and allow coating to set for 12 days before filing with liquid; for hot corrosive liquids allow to set for additional 6 days before filling.

3.6 FIELD QUALITY CONTROL

A. Manufacturer's Field Services: Provide manufacturer's field service consisting of product use recommendations and periodic site visit for inspection of product installation in accordance with manufacturer's instruction.
B. Do not cover waterproofed surfaces with other construction until they have been observed by manufacturer's field representative and Architect/Engineer.
C. Flood test areas that are capable of holding water after end of curing period.

1. Plug or dam drains.
2. Fill structures intended to hold liquids with water to within 1/2 inch from top of waterproofed vertical surfaces.
3. Test slabs by constructing temporary dams where necessary, at least 2 inches high, and filling with 2 inches of water.
4. Let water stand for 24 hours.
5. Repair leaks and retest until no leaks are observed.

3.7 CLEANING AND PROTECTING

A. Clean spillage and overspray from adjacent surfaces using appropriate cleaning agents and procedures.
B. Protect installed product from damage during construction; do not allow traffic on unprotected waterproofed surfaces.
C. Do not backfill against waterproofed surfaces for at least 36 hours after installation; use moist backfill material when backfilling occurs less than 7 days after installation.
D. Do not apply paint or other coatings for at least 21 days; before applying coatings neutralize waterproofed surface as recommended by waterproofing manufacturer.
E. Touch-up, repair or replace damaged products before Substantial Completion.

3.8 SCHEDULE:

A. Provide waterproofing of concrete substrates, using surface application, in the following locations:

1. Dry side of elevator pits, sump pits, and exterior edge of slabs, behind cement plaster to 6-inches below finished grade.

END OF SECTION

SECTION 07 18 13 - PEDESTRIAN TRAFFIC COATINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Provide a complete troweled waterproof neoprene composition traffic bearing deck surfacing coating system where indicated on Drawings.

1.2 RELATED SECTIONS

A. Section 03 30 00 – Cast-in-Place Concrete.
B. Section 07 62 00 – Sheet Metal Flashing & Trim.
C. Section 07 92 00 – Joint Sealers.

1.3 PREINSTALLATION MEETINGS

A. Convene a pre-application meeting before the start of application of coating system. Require attendance of parties directly affecting work of this section, including Architect, Consultant, General contractor, applicator, and authorized representative of the coating system manufacturer and interfacing trades. Review the following:

1. Drawings and specifications affecting work of this section.
2. Protection of adjacent surfaces.
3. Surface preparation and substrate conditions.
4. Application.
5. Field quality control.
6. Protection of coating system.
7. Repair of coating system.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer’s product data sheets on each product and system to be used including:

1. Preparation instructions and recommendations.
2. Storage and handling requirements.
3. Installation methods.
4. Maintenance requirements.

B. Shop Drawings:

1. Show locations and extent of each traffic coating on plans/elevations with detail callouts.
2. Include details for treating substrate joints and cracks, flashings, deck penetrations, tie-ins with adjoining constructions, and other termination conditions.
3. Manufacturer's approval shall be clearly noted on the drawings.

C. Selection Samples: For each system specified, provide two sets of samples showing color, texture, thickness and surfacing.
D. Manufacturer Certification: Signed by manufacturer certifying that the system complies with requirements specified in "Materials Performance Requirements" Article.

1. Submit evidence of compliance with performance requirements.

E. Material Test Reports: Indicating test results certify compliance with “Materials Performance Requirements” below.

F. Statement of installer qualifications see Quality Assurance article below.

1.5 QUALITY ASSURANCE

A. All materials used in the traffic coating systems shall be manufactured and provided by a single manufacturer to ensure compatibility and proper bonding.
B. Use adequate numbers of skilled workmen thoroughly trained and experienced in the necessary crafts and completely familiar with the specified requirements and methods needed for proper performance of the work of this section.
C. Contractor shall have a minimum of five (5) years' experience installing pedestrian traffic coatings of this type which is required for this project and who is acceptable to the manufacturer.

1. Applicator shall designate a single individual as project foreman who shall be on site at all times during installation.
2. Contractor must show and have QCA Qualified Contractor/Applicator paperwork from the manufacturer of the coating system, as required to obtain a long-term jobsite specific warranty.

1.6 DELIVERY, STORAGE & HANDLING

A. Delivery: Materials shall be delivered to the job site in sealed, undamaged containers. Each container shall be clearly marked with manufacturer's label showing type of material, color, and lot number.
B. Storage: Store all materials in a clean, dry place with a temperature range in accordance with manufacturer's instructions.
C. Handling: Handle products carefully to avoid damage to the containers. Read all labels and Material Safety Data Sheets prior to use.

1.7 PROJECT SITE CONDITIONS

A. Maintain environmental conditions (temperature and weather) within the limits recommended by the manufacturer.
B. Concrete shall be tested for moisture before applying cementitious coating. Water vapor transmission upwards through concrete may result in loosening of cementitious coating or improper curing of materials. If moisture emissions exceed 5 pounds per 1,000 square feet contact the manufacturer before application.
C. Schedule coating work to avoid rain and excessive dust and airborne contaminates. Protect work areas from moisture and excessive airborne contaminates during coating application.
D. Before any work is started, the applicator shall examine all surfaces for any deficiencies. Should any deficiencies exist, the architect, owner or general contractor shall be notified in writing and any corrections necessary shall be made.

1.8 WARRANTY

A. Upon completion of the work in this section provide a written warranty.
B. Manufacturer Warranty: Manufacturer shall supply the Owner with a material against defect of materials for a period of 5 years for each specific system. To obtain project specific warranty the coating system applicator must be a Qualified Contractor/ Applicator and apply for warranty.
C. Installer Warranty: Contractor shall supply the Owner with a separate 2 year workmanship warranty. If any work related to the waterproofing and flashing is found to be within the contractor's warranty term, defective or otherwise not in accordance with the contract documents, the Contractor shall repair defect at no cost to the Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Basis of design is Weatherwear by Dex O Tex Weatherwear as manufactured by Crossfield Products Corp. in Rancho Dominguez, California.
B. Or equal.

2.2 SYSTEM

A. The trowel applied waterproof neoprene composition traffic bearing roof deck surfacing system shall be composed of a slip-sheet, waterproof membrane, traffic surfacing and finish coats, and shall conform to the following standards:

1. Traffic deck binder and all rubber emulsions shall be compounded with neoprene liquid and shall have a minimum neoprene solids content of 35% when tested by the dry cup method.
2. Aggregate for traffic surface coating shall be suitably graded, fine trap-rock passing a #20 mesh sieve and retained on a #40 mesh sieve.
3. Slip-Sheet shall consist of an asphalt-saturated glass fiber matting weighing not less than 20 lbs. per 100 square feet and no more than 30 lbs. per 100 square feet and contain no rag or organic fibers.
4. Fabric used as reinforcement for waterproof flashing shall be 7-1/2 oz. woven polypropylene fabric.
5. Fabric used as reinforcement for waterproof membrane on horizontal surfaces shall be a minimum 1 oz. per square foot non-directional glass fiber matting.
6. Final Finish dressing shall be a single component, water-phase acrylic latex emulsion material, pigmented and of a consistency suitable for roller application.

2.3 PROPERTIES

A. Colors: As indicated, or if not otherwise indicated, as selected by Architect from manufacturer's standard colors.

1. Physical Properties: Provide a waterproof deck covering system that meets or exceeds the listed minimum physical property requirements when tested according to the referenced standard test methods in parentheses.

a. Weight: 2.5 lbs. per sq. ft.
b. Accelerated Weathering (Atlas Twin-Arc Weatherometer) (ASTM G23): No cracking, blistering, delamination, chalking, crazing or color change under 5X magnification.
c. Cycles, Wet/Dry 2000 hours: Dry: 1450 F, 120 mins. Wet: 600 F, 18 mins
d. Accelerated Aging (Procedure D & E - 6 cycles) (ASTM D756): No cracking, blistering, delamination, chalking, crazing or color change.
e. Freeze-Thaw (ASTM C97): No breakage or weight loss > 1.0%
f. Abrasion (1,000 revolutions, 1,000 gr. No. 80 TP load aluminum oxide grit) (ASTM D1242): 4.3% Thickness Reduction
g. Percolation (ICC standard): Complies to ICC Test Method for this Standard
h. Water Absorption (ASTM D570): 6.09% No warping or cracking.
i. Wind Uplift (ICC Factory Mutual 1-52): Qualifying Wind Velocity with Safety Factor of 3. Wind Velocity 131 MPH.
j. Flammability (ASTM E108, UL 790, NFPA 256):

1)	Intermittent Flame Exposure	Class A.
2)	Spread of Flame	Class A.
3)	Burning Brand	Class A.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions.

1. Inspect all surfaces to receive the pedestrian traffic system. Verify that surfaces are free of ridges and sharp projections, dry, clean, and free of contaminates that would prevent coating system from properly adhering to the surface.
2. That the concrete was finished by a power or hand steel trowel followed by soft hair broom to obtain light texture or "sidewalk" finish.
3. Test for moisture according to ASTM D 4263.
4. Test for moisture content by method recommended in writing by traffic-coating manufacturer.
5. Verify that substrates have a minimum 1% slope.
6. Before starting work, report in writing to the owner any unsatisfactory conditions.

3.2 PREPARATION

A. Substrate: Perform preparation and cleaning procedures according to waterproof deck covering manufacturer's instructions for particular substrate conditions involved, and as specified. Provide clean, dry and neutral substrate for application of waterproof deck covering.
B. Materials: Mix aqueous emulsions and aggregate when required as per manufacturer's instructions. Prepare materials according to waterproof deck covering system manufacturer's instructions.

3.3 TERMINATIONS AND PENETRATIONS

A. Prepare vertical and horizontal surfaces at terminations and penetrations through traffic coatings and at expansion joints, drains, and sleeves according to ASTM C 1127 and manufacturer's written instructions.
B. Provide sealant cants at penetrations and at reinforced and nonreinforced, deck-to-wall butt joints.
C. Terminate edges of deck-to-deck expansion joints with preparatory base-coat strip.
D. Install sheet flashings at deck-to-wall expansion and dynamic joints, and bond to deck and wall substrates according to manufacturer's written recommendations.

3.4 JOINT AND CRACK TREATMENT

A. Prepare, treat, rout, and fill joints and cracks in substrates according to ASTM C 1127 and manufacturer's written recommendations. Before coating surfaces, remove dust and dirt from joints and cracks according to ASTM D 4258

1. Cracks and Cold Joints: Visible hairline cracks (less than 1/16-inch in width) in concrete and cold joints shall be cleaned, primed as required and treated with thoroughly mixed FC7500/FC7960 base coat material a minimum distance of 2-inches on each side of crack to yield a total thickness of 30 dry mils. Large cracks (greater than 1/16-inches in width) shall be routed and sealed with 70991 sealant. Sealant shall be applied to inside area of crack only, not applied to deck surface. Detail sealed cracks with thoroughly mixed FC7500/FC7960 base coat material a distance of 2-inches on each side of crack to yield a total thickness of 30 dry mils.
2. Comply with recommendations in ASTM C 1193 for joint-sealant installation.

B. Apply reinforcing strip in traffic-coating system where recommended in writing by traffic- coating manufacturer.

3.5 APPLICATION

A. General: Apply each component of waterproof neoprene composition traffic bearing roof deck surfacing system according to manufacturer's directions to produce a uniform monolithic surface of thickness indicated.
B. Prepare and prime the sheet metal or alternate flashing. Inspect all transitions and terminations for proper waterproof seal that the installation of the flashing is in accordance with the recommended application methods.
C. Apply slip-sheet over properly prepared substrate. Overlap seams a minimum of 2 inches. Apply latex bonding coat when required.
D. Apply reinforced membrane at all vertical junctures. Embed polypropylene fabric into neoprene membrane liquid.
E. Apply aqueous neoprene rubber waterproof membrane solution with glass fabric reinforcement to entire area to be coated. Overlap all seams a minimum of 2 inches.
F. Trowel apply two coats of neoprene and aggregate composition traffic surfacing over all surfaces previously covered with waterproof membrane. Sand surface to remove trowel marks or small surface imperfections.
G. Trowel apply two smoothing coats of neoprene and fine aggregate composition to achieve smooth, filled surface. Sand to remove trowel marks or small surface imperfections.
H. Roller apply two coats of final finish dressing to a uniform finish.
I. Apply clear sealer as recommended by the manufacturer.
J. Finished neoprene composition traffic-bearing roof deck surfacing shall be a nominal 3/16 inch thick, smooth and uniform in color and texture.

3.6 FIELD QUALITY CONTROL

A. Verify coatings and other materials are as specified.
B. Verify coverages and finish of the system as work progresses.
C. Manufacturer’s technical representative shall be present at beginning of the work, and provide technical assistance and guidance for surface preparation and application of coating systems.

3.7 PROTECTION AND CLEAN-UP

A. Cure waterproof neoprene composition traffic bearing roof deck surfacing materials according to manufacturer's directions, taking care to prevent contamination during application stages and before completing curing process. Close application area for a minimum of 24 hours.
B. Installation areas must be kept free from traffic and other trades during the application procedure and cure time.
C. Protect finished surfaces of coating system from damage during construction.
D. Touch-up, repair or replace damaged coating system after substantial completion.

3.8 MAINTENANCE

A. Contractor shall provide to owner, maintenance, and cleaning instructions for the floor system upon completion of work. Owner is required to clean and maintain the surfaces to maintain manufacturer’s warranty.

END OF SECTION

SECTION 07 21 00 - THERMAL BUILDING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes thermal insulation at locations specified below in and the following:

1. Safing insulation at edges of slabs and elsewhere as indicated.
2. Thermal insulation (board form) on the exterior face of exterior walls.
3. Thermal insulation (board form) on the exterior face of walls below grade.
4. Thermal insulation (batts) between studs in exterior walls.
5. Thermal insulation (batts) in soffits where indicated.

B. Insulation location: As a minimum, provide thermal insulation for the building envelope, as defined below

1. Building envelope (all exterior walls but excluding roof insulation specified elsewhere, at parapets and openings in walls, including louvers (where no blank-off panels occur), vision glass and doors).
2. Exterior soffits of air-conditioned spaces.

C. Perimeter fire-containment systems: Where indicated for gaps between the perimeter edge of fire-resistance-rated floor assemblies and non-fire-resistance-rated exterior curtain walls, provide a perimeter fire-containment system with the fire-test-response characteristics indicated, as determined by testing identical systems per UL 2079 or another testing and inspecting agency acceptable to authorities having jurisdiction.

D. Related requirements:

1. Division 03 & 07 for roof insulation.
2. Other Section of Division 07 for firestopping, including fire safing insulation.
3. Other Section of Division 07 for insulation in roof hatch and vents.
4. Division 09 for acoustical insulation.
5. Division 22 for pipe and duct insulation.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Sequencing: Sequence and coordinate application of insulation with related work to comply with the following.

1. Provide temporary enclosures to prevent deterioration of insulation exposed to unfavorable environmental conditions.
2. After its application, avoid unnecessary exposure of insulation to damage during construction operations.
3. Do not begin application of insulation under steel deck until clips, hangers, supports, sleeves, and other items penetrating insulation are in place.
4. Defer installing ducts, piping, and other items that would interfere with the application of insulation until insulation installation is completed.
5. Do not install enclosing or concealing construction until after insulation is installed, inspected, tested, and corrections are made to provide an uninterrupted thermal barrier.

B. Pre-installation meeting:

1.3 SUBMITTALS

A. Data: Manufacturer Product Data for materials specified.
B. Shop Drawings:

1. Show each type of insulation, indicating type and manufacturer, location, extent, material, insulating value, and method of attachment.
2. Submit color-coded floor plans supplemented by elevations showing the location of each type of insulation. Identify material, manufacturer, thickness, R value, and method of fastening where applicable.

C. Samples:

1. 24 inches square Samples of each type of insulation.
2. Full size impaling pins.
3. Twelve inches long Samples of tape.

1.4 HANDLING

A. Packaging: In unopened containers and packages with labels bearing producer(s) name and source of product, date of manufacture, with UL classification on package, and R value.
B. Storage:

1. Keep insulation protected while stored; keep dry during and after installation.
2. Outdoors, store off ground on pallets, protected with breathing type covers.
3. Insulation shall be dry when installed.
4. Remove insulation that becomes wet or damp immediately from the job site.

1.5 ENVIRONMENTAL REQUIREMENTS

A. Install insulation in dry weather, unless building is enclosed and watertight.
B. If insulation will be exposed to the elements after installation, cover with waterproof membrane each day; do not enclose wet insulation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Fiber glass batt insulation: One of the following, or equal.

1. Owens Corning.
2. CertainTeed.
3. Knauf Insulation.
4. Johns Manville.

B. Mineral wool insulation: One of the following, or equal.

1. Thermafiber (basis of design).
2. Rockwool Group.
3. Partek Insulations, Inc.
4. Rock Wool Manufacturing Co.
5. Fibrex Insulation, Inc.
6. Industrial Insulation Group, LLC.

C. Polyiso board insulation for use on above grade walls: One of the following Non-ODP, Low GWP and formaldehyde-free, complying with ASTM C578, Type XV..

1. Glass-Fiber-Mat Faced: ASTM C1289, glass-fiber-mat faced, Type II, Class 2, Grade 2 (20 psi).

a. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

2. Manufacturers:

a. Enverge CI foil faced by Firestone.
b. Hunter Xci CG by Hunter Panels
c. EnergyShield CGF Pro by Atlas.

D. Polystyrene board insulation for use on below grade walls: One of the following.

1. Foamular 150 by Owens Corning
2. ThermaDRain Insulated Drainage Board.
3. Insulfoam a Carlisle Co.
4. Or equal rigid insulation that also serve as a protection/drainage board.

2.2 PERFORMANCE/DESIGN CRITERIA

A. Some exterior envelope elements are based on the "Rain Screen Principle". This requires construction behind cladding to act as an air/water barrier to prevent passage of moisture laden air and diffusion of water vapor inside the building. To ensure continuity of air/waterr barrier within construction specified herein and with adjacent barrier construction is a responsibility of this Section.

B. Comply with these Specifications for thermal resistance, and to the Drawings for maximum or minimum thickness of insulation required.

1. Provide the thermal resistance (R value) indicated to limit building thermal gains and losses.
2. Select appropriate products from list of materials to provide (a) the specified thermal value for the building envelope, (b) compatibility when incorporated into finished system while ensuring substrate conditions as well as their ability to adhere components permanently, where applicable, in rigid manner, and (c) maintain flexibility where required in finished work.
3. Provide insulation materials and their facings that do not support fungal growth when tested in accordance with ASTM C1338.

2.3 THERMAL INSULATION

A. Thermal resistance (“R” value): Minimum of 19, except as noted.

B. In curtain wall:

1. Mineral fiber complying with ASTM C 612; non-combustible when tested in compliance with ASTM E 136, fire resistant when tested in compliance with ASTM E 84 and E 119, 8 pcf, dark gray color, foil-faced.
2. Fire hazard classification:

a. Flame spread: 25 maximum.
b. Fuel contributed: 5.
c. Smoke developed: 5.

3. Acceptable product: Thermafiber “FSP Curtainwall Insulation,” “FBX Curtain Wall Insulation” by Fibrex, “Pyro-Fiber Curtain Wall Insulation” by Johns-Manville, or “Paroc CW” by Partek Insulations, Inc.

C. Under floor slabs-on-grade: Extruded-polystyrene drainage panels, ASTM C 578 (Type VI) with a compressive strength of 40 psi, “Styrofoam Highload 40” by Dow Chemical Co. or Owens Corning “Foamular 400.”

D. On soffits exposed to view (not concealed by a suspended ceiling): CertaPro Commercial Board by CertainTeed Corp. with a white kraft-scrim-foil (ASJ) facing adhered to the fiber glass board.

E. Sprayed foam sealant: Fire-rated polyurethane foam insulation meeting ASTM E 84, one- or 2-component, foamed-in-place, polyurethane foam sealant, 1.5 to 2.0 pcf density; flame spread index of 25 or less according to ASTM E 162; with primer and noncorrosive substrate cleaner recommended by foam sealant manufacturer.

1. Dow.
2. Tiger Foam Insulation.
3. Fomo Products, Inc., or equal.

F. Mineral wool semi-rigid (board) insulation: Thermafiber “RainBarrier 30 or 45,” semi-rigid boards, water-repellent, or equal with the following characteristics:

1. ASTM C 665 Non-corrosive, Type I, III.
2. ASTM C 612 RainBarrier 30 Type IA.
3. ASTM C 612 RainBarrier 45 Type IA, IB, IVA.
4. ASTM E 136 Rated Non-combustible per NFPA Standard 220.
5. ASTM E 96 Unfaced, 50 Perms as tested.
6. ASTM E 84 Flame Spread 0, Smoke Developed 0.
7. ASTM C 1104 Absorbs 0.03% by volume.
8. ASTM C 356 Linear Shrinkage <2% 1200º F.

G. At all other locations:

1. Type: Glass fiber or mineral wool batt or blanket insulation complying with ASTM C 665, Type III, Class A, flame spread (FSK) 25 or less, formaldehyde-free by Johns Manville, Knauf, or equal.
2. Width: Batt width shall match the stud spacing and be sized for a friction-fit to be self-supporting.

2.4 INSTALLATION MATERIALS

A. Impaling pins and clips: Cemco 1500 Series, Tactoo Insul-Hangers Series T by AGM Industries, Inc. or equal by Eckel Industries, Inc., of appropriate length required for insulation thickness used.

B. Clips at slab perimeter: 22-gage galvanized steel closure angle at underside of slabs if gap is larger than 4 inches from slab edge to mineral wool insulation plane.

C. Strip impalement clips at slab perimeter: Thermafiber “Insulation Hangers,” or equal acceptable to AHJ, fabricated from galvanized sheet in rolls with punch out insulation securement arrows.

D. Insulation supports for between rafters insulation: 13-gage steel, IS16 and IS24 (depending on wood framing spacing) by Silver Metal Products, Inc., Southeastern Wire, Moore Products, or equal.

E. Adhesive used with impaling pins: Made, or approved by the clip manufacturer. Do not use "peel and press" hangers with self-adhesive back.

1. Where insulation is installed under concrete-filled steel deck, "Drop/Deck Nails" of the required length by Cemco may be used through the steel deck before concrete fill is cast.

F. Staples, zinc-coated wires and other devices for fastening insulation: As recommended by the insulation manufacturer.
G. Insulation tape:

1. Polyethylene Adhesive Tape: “Scotch brand No. 483” by 3M.
2. Foil Vapor Barrier Tape:

a. Pressure sensitive aluminum foil tape, 2 mils thick, 3-inch wide, “Scotch brand No. 425" by 3M.
b. “Dead Soft Aluminum Foil Tape” by Hanson Ltd.
c. “FSK Copolymer” by Compac Corp.
d. “General Purpose FSK Facing Tape” by Venture Tape.
e. Or equal FSK-faced cold weather tape.

PART 3 - EXECUTION

3.1 EXAMINATION/PREPARATION

A. Examine conditions and measurements affecting the work of this Section at site.
B. Correct detrimental conditions before proceeding with installation.
C. Before installing insulation in stud walls, thoroughly vacuum space clean of dust and debris. Also clean spandrel cavities in the same manner.

3.2 INSTALLATION

A. Install insulation where shown and specified. Cut to fit irregular spaces, butt edges into firm contact with each other and adjoining surfaces.

1. Hand pack around pipes, ducts, conduits, electrical boxes, and other penetrations as required to thoroughly fill all voids and spaces between framing members and to form a continuous fire, thermal barrier.
2. Do not compress insulation more than 10 percent.
3. Where door and window frames occur in insulated assemblies, cut additional strips of insulation and hand-pack in and around the frames or use foam insulation to fill all voids.
4. Insulate boxed headers and studs in exterior walls.
5. Use foam insulation for small spaces that are difficult to insulate otherwise. Fill space completely and trim insulation flush with face of wall when cured.
6. Comply with the National Electrical Code (NEC) for installation in proximity to light fixtures. Do not install insulation closer than recommended by NEC.
7. Where in-wall electrical conduit is parallel to the wall, slit the insulation halfway to bury the conduit in it. Where the conduit is perpendicular to the wall, do not oversize the penetration; tape the conduit to prevent heat leakage.
8. Install foil-faced insulation with foil facing the building interior.

B. Batt insulation in stud walls:

1. Install wall insulation with aluminum foil facing interior of the building, with a friction fit to studs, short joints closely butted, and with joints square, straight without warp or twist.
2. Cut and fit insulation to closely fit intersecting or penetrating surfaces.
3. Leave no voids in completed installation.
4. Provide insulation to meet the overall thermal resistance requirements of the exterior wall enclosure.

C. Rigid insulation – under radiant floor heating system:

1. Where more than one layer of insulation is required to achieve the thermal resistance specified, apply adhesive in ribbons 6 inches apart to insulation in accordance with the adhesive manufacturer's instructions so when in place, the boards are firmly adhered to each other. Adhere the bottom boards to a clean, dry substrate in the same manner. Stagger joints between boards.
2. Protect board until the radiant system is installed and has been successfully tested. Prohibit non-essential foot traffic from exposed boards.

D. Attach insulation to solid surfaces as follows:

1. Where required, install insulation fasteners before fireproofing.
2. Provide insulation fasteners at typical spacing specified, or equivalent area for panels of a different size and for any cut panel sizes, except not less than 2 fasteners for any single piece.
3. Lay out panels for minimum of joints, and with any single piece not less than 24 inches wide or less than 48 inches long, unless otherwise approved.
4. Offset intermediate end joints in adjacent panels not less than 48 inches.
5. For 48-inch wide units follow insulation manufacturer's instructions. Provide a minimum of 8 fasteners. Space edge fasteners no more than 3-inch from edges.
6. For 24-inch wide units, comply with the above, except use no less than 6 fasteners.
7. Secure each metal clip base in full bed of adhesive as recommended by their manufacturer.
8. Do not install panels until clip adhesive is fully set.
9. Cut panels in straight lines using tools which minimize fraying. Neatly and carefully precut small slots through panels to facilitate placing insulation over fasteners.
10. Install panels fully bearing against substrates, and neatly and tightly fitted at joints and around surfaces of penetrations.
11. Install fastener caps firmly against panel faces and without compressing insulation, and turn clip prongs or steps flat against caps.

E. Between rafters, support insulation with insulation supports spaced at 16 inches o.c. maximum.
F. After installation is complete and before concealing, seal joints between insulation, between insulation and intersecting or penetrating surfaces and between insulation and perimeter surfaces with 4-inch wide vapor-proof aluminum colored tape applied on the aluminum foil facing side. Seal fastener punctures with aluminum colored vapor-proof mastic or use tape used for sealing joints.
G. Cut safing insulation slightly oversized and compress in the space to be fireproofed so that no void remains. At edge of slabs, impale securely on metal clips spaced at 12 inches o.c. maximum, and attach the clips securely to the slab**.**

3.3 FIELD QUALITY CONTROL

A. Prior to closing-in of insulated assemblies, or prior to Substantial Completion for insulation that will remain exposed in the building, refit, reinstall and/or replace wet, damaged and displaced insulation.

END OF SECTION

SECTION 07 26 16 - BELOW GRADE VAPOR RETARDER

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes aggregate bed and vapor retarder (VR) under building concrete slabs-on-grade.
B. Related requirements:

1.2 ADMINISTRATIVE REQUIREMENTS

A. Scheduling and sequencing: Schedule and sequence installation of VR so it will stay exposed to construction traffic for as short a time as possible to avoid damage.

1.3 SUBMITTALS

A. Data:

1. Manufacturer Product Data, specifications, typical installation details and other data necessary to demonstrate vapor retarder compliance with the specified requirements.
2. Summary of test results, ASTM E 1745.

B. Samples: 24-inch square Samples of vapor retarder with a taped joint at third point.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Vapor retarder: By Reef Industries, Inc., or equal by one of the following complying with ASTM E 1745 Class A, and the values given below.

1. Fortifiber Corp.
2. WR Meadows.
3. Raven Industries.
4. Stego Industries, LLC.
5. Or equal.

2.2 PERFORMANCE REQUIREMENTS

A. Vapor retarder:

1. Material: 7-ply laminate, combining 4 layers of high-density polyethylene and 3 high-strength non-woven cord grid.
2. Weight: 82 lb/1,000 square feet when tested in accordance with ASTM D 3776.
3. Puncture propagation Tear: 55 lb when tested in accordance with ASTM D 2582.
4. Permeance (Perm): 0.019 grains/hr-sq ft-in Hg when tested in accordance with ASTM E 96.
5. Drop dart: 2300 g, when tested in accordance with ASTM D 1709.
6. Tensile strength: 275 lb/5,464 psi when tested in accordance with ASTM D 882, 3-inch-wide specimen.
7. Puncture strength: 72 lb when tested in accordance with ASTM D 4833.
8. Classification: Class A, when tested in accordance with ASTM E 1745.

9. Usable temperature range: Minus 45 to 170 degrees F.

2.3 MATERIALS

A. Vapor retarder: “Griffolyn Type 105”
B. Sealing material: Mastic, adhesive or pressure-sensitive adhesive tape recommended by the vapor retarder manufacturer.

1. VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Repair tape: Self-adhesive tape recommended by vapor retarder manufacturer to repair holes in membrane by jobsite activities.

1. VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. Pipe boots: Of sizes indicated, compatible with vapor retarder and adhesive materials.

E. Stone aggregates (base course): Washed, evenly graded mixture of gravel conforming to the following gradation.

Sieve size	Percent passing
3/4-inch	90 to 100
No. 4	0 to 10
No. 100	0 to 3

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions affecting the work of this Section at the site.
B. Verify below-grade work and items penetrating moisture retarder are complete.
C. Verify that subgrade is level and compacted to 95 percent maximum density, determined in compliance with ASTM D 1557.
D. Correct detrimental conditions before proceeding with installation.

3.2 AGGREGATE BEDDING

A. Cover subgrade with a minimum 4-inch layer of stone aggregate.
B. Work to fill voids; vibrate to compact and leave with finished surfaces reasonably uniform at established grade.

3.3 VAPOR RETARDER

A. Cover aggregate bed with the vapor retarder.
B. Comply with ASTM E 1643 and the following:

1. Layout to minimize running and side joints with long dimension parallel with the direction of the pour.
2. Spread sheeting over undamaged vapor retarder, smooth and even; lap edge and end joints 6 inches; turn-up perimeters against concrete walls/footings to top of future slab and tape continuously to clean, dry concrete so that neither the tape nor the vapor barrier is visible when the slab is cast.

3. Offset intermediate end joints in adjacent sheets 4 feet minimum.
4. Seal laps and perimeters using continuous beads or strips of sealing material applied to bottom layer or tape. When using sealing material, apply top layer and press sufficiently to assure complete contact.

C. Penetrations:

1. Cut sheeting to fit closely and neatly.
2. Slip sheeting over penetrations where possible, otherwise slit from penetration hole to nearest edge.
3. Seal pipe penetrations with prefabricated boots made from vapor retarder and seal tight with tape to the vapor retarder.
4. Seal edges continuously around penetrations.
5. For smaller penetrations, repair slits with 12-inch wide strips of sheeting set centered on slit and sealed on each side.

D. Cuts and accidental tears: Repair with tape, or if too large, with patches of the vapor retarder continuously taped.

END OF SECTION

SECTION 07 27 26 - FLUID-APPLIED AIR BARRIER SYSTEM

PART 1 - GENERAL

1.1 SUMMARY:

A. Work of this Section includes window and door flashing, air and water-resistive barrier membrane system, and accessory materials for application to exterior building envelope, except where doors and windows occur.

B. Related requirements:

1. Section 03 30 00 – Cast-in Place Concrete.
2. Section 06 16 00 – Gypsum Board Sheathing.
3. Section 07 60 00 – Flashing and Sheet Metalwork.
4. Section 07 92 00 – Joint Sealers.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Pre-installation conference: Prior to beginning installation of air and water-resistive barrier system, hold a pre-installation conference to review work to be accomplished.

1. Contractor, Architect, installer, membrane system manufacturer's representative, and other trades who have materials penetrating membrane system or finishes covering membrane system shall be present.
2. Contractor shall notify participants at least 7 days prior to time for conference.
3. Contractor shall record minutes of meeting and distribute to attending parties.
4. Agenda: As a minimum discuss the following.

    a. Surface preparation.
    b. Substrate condition and pretreatment.
    c. Minimum curing period.
    d. Special details and sheet flashing.
    e. Sequence of construction, responsibilities, and schedule for subsequent operations.
    f. Installation procedures.
    g. Inspection procedures.
    h. Protection and repair procedures.
    i. Review and approval of all glazing applications.

1.3 SUBMITTALS

A. Data: Manufacturer’s Product Data including membrane and accessory material types, technical and test data, composition, descriptions and properties, installation instructions and substrate preparation requirements.

B. Shop Drawings: Provide manufacturer’s Installation Guideline Illustrations.

C. ASTM E 2357 Compliance: If applicable, submit certification from an approved independent testing laboratory as well as the Air Barrier Association of America (ABAA).

1.4 QUALITY ASSURANCE:

A. Manufacturer qualifications: Firm with a minimum of 5 years experience in the production and sales of air and water-resistive barrier system.
B. Installer qualifications: The installer shall demonstrate qualifications to perform the work of this section by submitting the following.

1. Verification that installer has been trained by and is approved to perform work specified by the air and water-resistive barrier system manufacturer.
2. Firm experienced in applying similar materials on projects of similar size and complexity.
3. Evidence of proper equipment and trained field personnel to successfully complete the Project.

C. Inspection and testing: Cooperate and coordinate with the Owner's inspection and testing agency. Do not cover installed products or assemblies until they have been inspected, tested and approved.
D. Sole source: Obtain materials from a single manufacturer.
E. Regulations: Provide products which comply with state and local regulations controlling use of volatile organic compounds (VOC).
F. Sourcing: Components used shall be sourced from one manufacturer, including sheet membrane, water- resistive vapor permeable air barrier sealants, primers, mastics, and adhesives.

1.5 HANDLING:

A. Deliver materials and products in labeled packages. Store and handle in strict compliance with manufacturer's instructions and recommendations. Protect from damage, weather, excessive temperatures and construction operations. Remove damaged material from site and dispose of in accordance with applicable regulations.
B. Protect air and water-resistive barrier components from freezing and extreme heat. Store materials at temperatures of 40 degrees Fahrenheit to 100 degrees Fahrenheit.
C. Sequence deliveries to avoid delays, and to minimize on-site storage.

1.6 PROJECT CONDITIONS:

A. Weather conditions: Perform work only when existing and forecasted weather conditions are within the limits established by the manufacturer of the materials used.

1. Apply at surface and ambient temperatures recommended by the manufacturer.
2. Proceed with installation only when the substrate construction and preparation work are complete and in condition to receive the membrane system.

B. Exposure limitations: Schedule work to ensure that air and water-resistive barrier system is covered and protected from UV exposure within 180 days of installation. If air and water-resistive barrier membrane system cannot be covered within 180 days after installation, apply temporary UV protection as recommended by membrane manufacturer.

1.7 WARRANTY

A. Manufacturer's warranty requirements: Submit manufacturer's written warranty stating that installed air and water-resistive barrier materials are watertight, free from defects in material and workmanship, and agreeing to replace defective materials and components.
B. Warranty period: 5 years from Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Performance requirements: Comply with the specified performance requirements and characteristics specified.
B. Performance description:

1. Elastomeric, acrylic, water-resistive vapor permeable air barrier membrane system shall be constructed to perform as a continuous air barrier, and as a liquid water drainage plane flashed to discharge to the exterior any incidental condensation or water penetration.
2. Membrane system shall accommodate movements of building materials by providing expansion and control joints as required, with accessory air sealant materials at such locations, changes in substrate, perimeter conditions and penetrations.
3. Joints and seals shall be securely installed in or on the joint for its entire length so as not to dislodge, loosen or otherwise impair its ability to resist positive and negative pressure from wind, stack effect and mechanical ventilation.
4. System shall be capable of withstanding positive and negative combined wind, stack and HVAC pressures on the envelope without damage or displacement.
5. System shall be installed in an airtight and flexible manner, allowing for relative movement of substrate due to building movement caused by wind, thermal and moisture variations.

C. Intent is to bridge and seal the following air leakage pathways and gaps:

1. Connections of the walls to the roof air barrier.
2. Connections of the walls to the foundations.
3. Seismic and expansion joints.
4. Openings and penetrations of window and door frames, store front, curtain wall.
5. Piping, conduit, duct and similar penetrations.
6. Masonry ties, screws, bolts and similar penetrations.
7. All other air leakage pathways in the building envelope.

D. Water-resistive vapor permeable air barrier membrane system to be applied to the minimum uniform thickness specified and as utilized in the referenced Standard Test Methods.

2.2 MANUFACTURER:

A. Basis-of-Design Manufacturer: Sika Corporation, 201 Polito Avenue, Lyndhurst NJ 07071. Toll Free 800-933-SIKA (7452), www.sikausa.com or equal.

2.3 FLUID-APPLIED MEMBRANE AIR BARRIERS

A. Air Barrier Membrane: Sikagard® 530 Liquid Applied Acrylic Vapor Permeable Air Barrier by Sika Corp, a low VOC one component elastomeric acrylic membrane that may be trowel, brush, roller or spray applied. Membrane shall have the following physical properties:

1. Color: Yellow.
2. Air permeability: less than 0.004 CFM/ft2 @ 1.57 lbs/ft2 to ASTM E 2178, passes ABAA.
3. Tested to ASTM E 2357 for Air Leakage of Air Barrier Assemblies, passes ABAA.
4. Water vapor permeance (21 mil dry thickness): 11 perms to ASTM E 96 Method B.
5. Nominal wet film thickness: 40 mils.
6. Recycled Content by weight: 25%.
7. VOC: <50g/l.
8. Fastener Sealability: Pass to ASTM D 1970.
9. Water Resistance: Pass to AATCC 127.
10. Exposure: May be exposed for up to 6 months
11. Fire Performance: Flamespread Index of 20, Smoke Developed Index of 25 and Class A rating per ASTM E 84.

2.4 SELF-ADHERING MEMBRANE SEAM TAPE

A. Self-Adhering Membrane Seam Tape: SikaMultiSeal® 515 Self-Adhered Transition Seam Tape by Sika Corp, a self-adhering polyester-backed, synthetic butyl rubber based adhesive membrane for wall construction, specifically designed to be water resistant. Use for all window jambs, headers, door openings, inside and outside corners, joint treatment and other transitions shall be Membrane shall have the following physical properties:

1. Membrane Thickness: 0.0394 inches (40 mils).
2. Low temperature flexibility: -30 degrees F.
3. Elongation: 500% to ASTM D 412-modifed.
4. LIQUID SEAM AND PENETRATION SEALANTS

B. Liquid Seam Sealant: Sikaflex® 11FC by Sika Corp, a polyurethane, elastomeric sealing compound having the following physical properties:

1. Compatible with air barrier, roofing and waterproofing membranes and substrate.
2. Set Time: 1 hour @ 72 degrees, 40% RH.
3. VOC < 50 g/l.
4. Elongation:600% to ASTM D 412.
5. Joint Movement 12.5%+/- ASTM C 719.
6. Seals construction joints.

C. Penetration Sealant: Sikaflex® 11FC by Sika Corp, a polyurethane, elastomeric sealing compound having the following physical properties (other Sikaflex sealants may apply):

1. Compatible with air barrier, roofing and waterproofing membranes and substrate.
2. Set Time: 1 hour @ 72 degrees, 40% RH.
3. VOC < 50 g/l.
4. Elongation:600% to ASTM D 412.
5. Joint Movement 12.5%+/- ASTM C 719.
6. Seals construction joints.

2.5 PRIMER AND SURFACE CONDITIONER

A. Primer: Sikagard 510® Transition Seam Tape Primer for self-adhering transition and flashing membrane at all temperatures, a high tack adhesive primer, quick setting having the following physical properties:

1. Color: White,
2. Solids by weight: 37%,
3. Drying time (initial set): 30 minutes.

B. Surface Conditioner: Sikagard® 530 or 535 Liquid Air Barrier Membrane for self-adhering transition and flashing membrane at temperatures above 40 degrees F, having the following physical properties:

1. Color: Yellow.
2. Solids by weight: 64%,
3. Application Rate: 160 sq.ft/gallon to a uniform wet film thickness of 10 mils.
4. Drying time (initial set): 60 minutes.
5. SELF-ADHERED THRU WALL FLASHING

C. Self-Adhering Thru-Wall Flashing: Sika® MultiSeal® Plus by Sika Corporation, an ethylene propylene copolymer adhesive with a UV resistant TPO membrane facer for cavity wall construction. Specifically designed to be water resistant and used as a thru-wall flashing membrane:

1. Thickness (Membrane): 0.032 inches (32 mils).
2. Elongation (ASTM D412): 600%.
3. Membrane Tensile Strength (ASTM D412): 3500 PSI.
4. Measured Flow (ASTM D5147): PASS.
5. Low Temperature Flexibility -22F (CGSB 37-GP-56M): PASS.
6. Water Vapor Permance (ASTM E96): Impermeable.
7. Adhesion to Concrete (ASTM D903): 6.0 lbf/in.
8. Adhesion to DensGlass Gold (ASTM D903): 6.0 lbf/in.
9. Moisture Absorption (ASTM D570): PASS (<1g absorption).

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Verify that surfaces and conditions are ready to accept the Work of this section. Correct discrepancies.
B. Substrates to receive the work of this Section must be sound, dry, clean, and free of grease, dirt, excess mortar or other contaminants. Fill voids, gaps, and spalled areas in substrate to create an even plane. Fill masonry head joints fully and tool.
C. Where curing materials are used they must be clear resin based without oil, wax or pigments.
D. Condition materials to room temperature prior to application to facilitate extrusion and handling.

E. Do not proceed with application of air barrier membrane when rain is expected within 24 hours.

F. Condition materials to ambient temperature prior to application to facilitate handling.

3.2 SURFACE PREPARATION

A. Ensure preparatory Work is complete prior to applying primary air barrier membrane.

B. Mechanical fasteners used to secure sheathing boards or penetrate sheathing boards shall be set flush with sheathing and fastened into solid backing.

C. Mechanical penetrations such piping, conduit and vents shall be secured solid and fastened into solid backing.

3.3 INSTALLATION

A. Joint Treatment: Seal joints 1/4 inch and less between panels of sheathing (exterior grade gypsum, faced gypsum sheathing, plywood, OSB or cementitious panels) with liquid seam sealant. Fill joint between sheathing with approved liquid seam sealant ensuring contact with all edges of sheathing board.

B. Gaps and Voids: Seal gaps and voids or irregular joints greater than 1/4 inch between panels of exterior grade gypsum, faced gypsum sheathing, plywood, OSB or cementitious panels with a strip of self-adhering transition membrane lapped a minimum of 3 inches on both sides of the joint. Prepare and prime surfaces as appropriate to achieve surface adhesion and allow to dry prior to placement of self-adhering transition membrane. Align and position self-adhering transition membrane, remove protective film and press firmly into place. Ensure minimum 2 inches overlap at all end and side laps.

C. Outside Corners: Seal outside corners with a strip of self-adhering transition membrane extending a minimum of 3 inches on either side of the corner detail. Prepare and prime surfaces as appropriate to achieve surface adhesion and allow to dry prior to placement of self-adhering transition membrane. Align and position self-adhering transition membrane, remove protective film and press firmly into place. Ensure minimum 2 inches overlap at all end and side laps of membrane. Roll all laps and membrane with a counter top roller to ensure seal.

D. Inside Corners: Seal inside corners with a liberal bead of seam sealant (3/8 inch x 3/8 inch).

E. Crack Treatment for Masonry and Concrete: Seal cracks 1/4 inch and less in masonry and concrete with liquid seam sealant applied over the crack. Fill joint between sheathing with approved liquid seam sealant ensuring contact with all edges of sheathing board. Seal cracks and voids in masonry and concrete greater than 1/4 inch with a strip of self- adhering transition membrane lapped a minimum of 3 inches on both sides of the joint. Prepare and/or prime surfaces as appropriate to achieve surface adhesion and allow to dry prior to placement of self-adhering transition membrane. Align and position self-adhering transition membrane, remove protective film and press firmly into place. Ensure minimum 2 inches overlap at all end and side laps of membrane. Roll all laps and membrane with a counter top roller to ensure seal.

F. Transition Areas: Tie-in to structural beams, columns, floor slabs and intermittent floors, parapet curbs, foundation walls, roofing systems and at the interface of dissimilar materials as indicated in drawings with self-adhering transition membrane

1. Prime surfaces as per manufacturers' instructions and as appropriate to achieve surface adhesion and allow to dry prior to placement of self-adhering transition membrane.
2. Align and position self-adhering transition membrane, remove protective film and press firmly into place. Provide minimum 3 inch lap to all substrates.
3. Ensure minimum 2 inch overlap at all end and side laps of membrane. Roll all laps and membrane with a counter top roller to ensure seal.

G. Thru-Wall Flashing:

1. All surfaces must be dry and frost-free, as well as clean of oil, dust and excess mortar. Strike masonry joints flush.

2. Concrete surfaces must be smooth and without large voids, spalled areas or sharp protrusions. Concrete must be cured a minimum of 14 days and must be dry.
3. May be installed direct to concrete or Dens Glass Gold without the aid of primers or other surface conditioners.
4. Applications to wood require the use of a primer.
5. Verify priming requirements before the start of each project.
6. Cut the desired length, remove the release paper, position into place and apply positive pressure using a roller. Use care to avoid blisters or wrinkles.
7. Overlap all joints by 2 inches.
8. Keep flashing sheet back about 1/2 inch from outside face of wall or veneer.
9. At all laps, seams, penetrations, and along top edges of membrane apply a continuous feathered bead of sealant as termination seal. Form end dams as required with same sealant.
10. Apply under dry conditions when air and surface temperatures are above 25 degrees F.
11. Top or leading edge of flashing sheet should be sealed with a sealant to limit rainwater from migrating behind the membrane

H. Primary Air Barrier: Apply by brush, roller, spray or flat trowel a complete and continuous unbroken film of liquid vapor permeable air and rain barrier membrane.

1. For temperatures above 40 degrees F and rising, apply one component acrylic water-resistive vapor permeable air barrier membrane at a rate of 40 sq.ft/gallon to a uniform wet film thickness of 40 mils.
2. Spray apply or brush around all projections and penetrations ensuring a complete and continuous air barrier membrane.
3. Allow air barrier membrane to dry as per manufacturers recommendations prior to placement of cladding materials.
4. Subject to porosity of substrate, recommend to back roll spray applications.

3.4 APPLICATION OF PENETRATION SEALANT

A. Seal membrane terminations, heads of mechanical fasteners, masonry tie fasteners, around penetrations, duct work, electrical and other apparatus extending through the primary vapor permeable air and rain barrier membrane and around the perimeter edge of membrane terminations at window and door frames with specified penetration sealant.

B. Seal the leading edge of membrane terminations and reverse laps.

3.5 FIELD QUALITY CONTROL

A. Make notification when sections of work are complete to allow review prior to covering water-resistive vapor permeable air barrier system.

B. Cooperate with Owner’s independent testing agency, which will observe substrate and membrane installation prior to placement of cladding systems and provide written documentation of observations.

3.6 PROTECTION

A. Do not inhibit damp substrates from drying out. Drying time will vary depending on interior and exterior temperature, and interior and exterior relative humidity. Do not expose the backside of the substrate to moisture or rain.

B. Cap and protect exposed back-up walls against wet weather conditions during and after application of membrane. Protect uncured air barrier Work against wet weather conditions for a

minimum of 24 hours. Protect air barrier membrane from damage and inclement weather during the construction phase.

END OF SECTION

SECTION 07 42 13 - PREFORMED WALL PANELS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes preformed aluminum wall panels, their support system, special shapes, and all other panels elements for the building.
B. Related requirements:

1. Division 05 for cold-formed steel framing supporting panels.
2. Division 07 for the following:

a. Other flashing.
b. Sealants.

1.2 SYSTEM DESCRIPTION

A. General: Single-skin exposed fastener metal wall panel applied as the exterior component of an a framed wall system.

1.3 SUBMITTALS

A. Shop Drawings: Dimensioned Shop Drawings for the panel systems, including design and detailing of panel support framing elements and their attachment to the structural frame. Coordinate Drawings and their submittal with other adjacent exterior wall components.

1. Show in detail the panel layout on each plane, support framing system, panel attachment members, jointing, dimensions, sizes and locations of cut-outs, relation to work of other trades, and other pertinent data and information.
2. Indicate and dimension adjoining, abutting and penetrating work, to be performed by other trades.
3. Number each panel to correspond to the markings shown on the fabrication/shop drawings. Mark the identification number on the back of each panel.

B. Samples:

1. Prior to fabrication, submit preliminary Samples panels showing corners, special shapes, or other conditions, all finished as specified.
2. Samples will serve as the control for limiting acceptable range of appearance.

C. Data:

1. Manufacturer Product Data sheet or equivalent printed literature indicating product information for panel anchorages, setting accessories and other related materials.
2. Data shall substantiate that the materials comply with the specified requirements.

D. Manufacturer instructions: Manufacturer instructions for care, repair and replacement procedures, and Samples showing repaired panels.

1.4 QUALITY ASSURANCE

A. Fabricator/installer qualifications:

1. Single firm with a minimum of 5 years successful experience in the fabrication and erection of panel systems of similar sizes, shapes and finishes required for this Project,

and which has ample production facilities to produce, furnish and supply the panels as required for installation without delay to the Work.

2. Firm must be regularly engaged in the engineering, fabrication, finishing and installation, of similar work.

1.5 HANDLING

A. Delivery:

1. After fabrication, protect panels with strippable plastic film.
2. Deliver panels to ensure that there will be no damage or staining.
3. Deliver other materials, except bulk materials, in manufacturer's unopened containers with name, brand, type, grade and color fully indicated thereon. Store bulk materials as required to avoid any deleterious effects of weather, soiling or contamination.
4. Delivered items shall be properly boxed or crated. Mark containers with installation location, fabrication/piece numbers, shop drawings reference, etc., as applicable.

B. Storage:

1. Store above grade on suitable surfaces using polyethylene film to separate panels from supporting or protecting members.
2. Protect from weather, soiling and damage of every kind.
3. Crate panels to prevent accumulation of moisture between panels.

1.6 SPECIAL WARRANTIES

A. Warrant that wall panels and their support system elements will meet the specified performance criteria specified and will be free from defects in materials and workmanship for 2 years after Substantial Completion, except where longer warranties are specified below.

1. Certify in writing that installed work is in accordance with the Contract Documents and authorized alterations and/or additions thereto and that, should defect develop during the warranty period due to improper workmanship or materials installed as a part of this Section, such defects will upon written request, be repaired or replaced at no additional cost to the Owner.
2. If exploratory work is required to determine the cause of the defects, the cost of such work shall be borne by the Contractor when his work is found to be at fault.

B. Further warrant the Owner in writing that wall panels will not evidence delamination of any type for 10 years after Substantial Completion.

C. Warrant finish against fading, chalking, peeling, cracking, checking, chipping, or erosion to base metal of the exterior panel finish for 10 years after Substantial completion.

D. Defective materials and workmanship are hereby defined to include evidence of abnormal deterioration or aging or weathering or work, structural failure of components resulting from exposure to normal load and forces, sealant failures, deterioration or discoloration of finishes in excess of normal weathering and aging, delamination, and failure to fulfill other specified performance requirements.

E. The warranty, the enforcement or lack of enforcement thereof, shall not deprive the Owner of other actions, rights or remedies available to him. Warranty shall be in form approved by Owner.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Panel design: Design panels to meet or exceed the following structural and weather resistance requirements, as demonstrated by engineering calculations. Loads used in design shall be those prescribed by Code.

1. Structural requirements:

a. Perpendicular to the plane of the wall, net deflection of framing members shall not exceed L/175 times span, or 3/4-inch, whichever is less. Span is defined as the distance between anchor centerline. For cantilevers, span is defined as twice the distance between anchor centerline and end of cantilever.
b. Perpendicular to the plane of a soffit, net deflection of framing members shall not exceed L/600 times span under dead load support of panels. Span is defined as the distance between anchor centerlines.
c. In the plane of the wall, deflection of horizontal framing members shall not exceed L/360 or 1/8-inch, whichever is less. This includes horizontal rail sag due to dead load.
d. At connection points of framing members to anchors, combined movement of anchor relative to building structure, and framing member relative to anchor, shall not exceed 1/16-inch in any direction.
e. Stresses shall not exceed the allowable values established by the specifications listed in reference standards. In no case shall allowable values exceed the yield stress. Where permitted by Code, a 1/3 increase in allowable stress for wind or seismic load is generally acceptable, but not in combination with any reduction applied to combined loads.
f. Limit deflection of metal panels to L/120 of the span or 1/4 inch, whichever is less when tested in accordance with ASTM E 330 at specified design pressure. Measure deflection relative to the horizontal and vertical support members with the allowable deflection being determined by the lesser dimension.
g. At 150 percent of the design pressure loads for metal members supporting panels the net permanent deflection of framing members shall not exceed 1/1000 times span. There shall be no failure or gross permanent distortion of framing members, anchors, or connections. At connection points of framing members to anchors, combined movement of anchor relative to building structure, and framing member relative to anchor, shall not exceed 1/16-inch set after load is removed.
h. Vibration harmonics, wind whistles, noises caused by thermal movement, thermal movement transmitted to other building elements, loosening, weakening, or fracturing of attachments or components of system are not permitted in the installed work.
i. Design system so individual panel can be removed without removing or disrupting adjacent panels or materials.

2. Weather requirements:

a. Design wind loads shall be as indicated acting normal to the plane of the wall.
b. Wall panels shall be designed for a maximum deflection of L/180 under load.
c. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1) Temperature Change (Range): 120 deg F ambient; 180 deg F, material surfaces.

2.2 MANUFACTURER

A. Basis of Design: Morin Matrix Series Perforated Metal Wall Panels by Morin; a Kingspan Group Company. (MX-1 and MX-2).

B. Or equal.

2.3 MATERIALS

A. Aluminum Panels:

1. Coil Stock meeting ASTM B209; Alloy and temper as required for forming operations.
2. Thickness: 0.050 inch.
3. Panel Width: 12 inches.
4. Profile: MX-1. And MX-2.
5. Panel thickness: 1-1/2 inch thick.
6. Panel joint: Tongue and groove interlock joint.
7. Texture: Perforated.

a. Perforation Pattern; 3/16 inch holes: 33 percent open area - 5/16 inch hole spacing.

B. Flashing and trim: Fabricated in the same material, gage, finish, and color as the panels.

2.4 ACCESSORIES

A. Fasteners: 1/4 x 20 fasteners (per calculations).

1. Exposed fasteners shall be Bi-Flex with oversized washer per calculations bonded neoprene and stainless-steel washers coated to match the exterior panel color.

2.5 FABRICATION

A. Panel system components shall be fabricated in the factory for field-assembly to the greatest extent possible, under controlled environment in fabricator's plant in conformance with accepted shop drawings and calculations so tolerances, as stated herein, are not exceeded. Field fabrication of panels is not permitted.
B. Fabrication tolerances:

1. Panel bow: Maximum 0.2 percent of width or length, whichever is greater.
2. Width or length: Plus 0.064 to 48-inch; Plus 0.032 to 144 inch.
3. Thickness: Plus 0.008-inch
4. Squareness: 0.1875-inch difference between diagonals.
5. Camber: 0.062 inch maximum.
6. Radius of exterior bent corners: 1/16-inch maximum.

2.6 FINISHING

A. Exterior Finish: Fluropon PVDF, Mica color coat, full 70% Kynar® 500/Hylar 5000®
B. Interior Finish: Primer Coat Material: Match exterior finish.
C. Color: See Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine structure that will support the metal panel support system. Verify elevation, tolerances, offset lines, and other conditions that would affect the satisfactory installation and performance of the panels.
B. Correct unsuitable conditions before proceeding with erection.

3.2 PREPARATION

A. Examine surfaces and supports to receive panels. Make they are secure and properly aligned.

3.3 INSTALLATION

A. Install panels and panel support members in compliance with the approved shop drawings, calculations, and fabricator's published instructions.
B. Install panels so that in their final location and position joints are uniform, perfectly aligned, with flush joints, and panels are not twisted out of plane.
C. Adjust work to conform to the following tolerances (maximum variations):

1. Face width of joints: Plus 1/32 inch.
2. Joint taper: 1/100-inch/foot length, with a maximum length of tapering in one direction of 6 feet.
3. Jog in alignment of edge: Plus 1/16 inch.
4. Rough opening dimension: Plus 1/16-inch at head, Plus 1/16 inch at sill, and Plus 1/16 inch at jamb.
5. Deviation from plumb, 1/16 inch maximum per one story height and a maximum of 1/8 inch in a 45 feet run.
6. Deviation from horizontal: 1/8 inch maximum in a 30 feet run.

3.4 CLEANING AND PROTECTING

A. Leave protective film on panels in place as long as possible where doing so will not produce discoloration or other undesirable visual defects.
B. Remove protective film when, and in the manner, recommended by panel manufacturer’s instructions.
C. Clean panels in accordance with their manufacturers' published recommendations.
D. Protect panels from damage. Repair or replace damaged panels to Architect's satisfaction.

3.5 ACCEPTANCE

A. Each panel will be subject to the Architect's approval or rejection.
B. Panel or panels may be rejected after installation.
C. Carefully remove rejected panels and replace with new panels without delay and without cost to the Owner.
D. Remove panel or panels damaged in the removal of defective or rejected panels, and replace with new panels.

END OF SECTION

SECTION 07 42 19 – COMPOSITE METAL PANELS

PART 1 - GENERAL

1.1 SUMMARY

A. Work of this section includes provision of the following:

1. Aluminum Composite Material (ACM) Panel System (MT-2).
2. Fastening system.
3. Sub-girt system.
4. Engineering by Sub-Contractor.

1.2 RELATED REQUIREMENTS

A. Section 05 41 00 – Cold-Formed Steel Framing.
B. Section 06 16 43 – Gypsum Sheathing Board.
C. Section 07 05 42 – Thermally Improved Cladding Support Systems
D. Section 07 21 00 – Thermal Building Insulation.
E. Section 07 27 26 – Fluid-Applied Air Barrier System.
F. Section 07 62 00 – Flashing and Sheet Metalwork.
G. Section 07 92 00 – Joint Sealers.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Convene pre-installation meeting prior to beginning work of this Section and on-site installation, with Contractor, Consultant, Panel Fabricator, Panel Installer, and ACM Manufacturer to:

1. Verify project requirements.
2. Review installation and substrate conditions.
3. Co-ordination with other building sub-trades.
4. Review installation method and warranty requirements.
5. Review field quality control procedures.

B. Coordination: Coordinate ACM panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.
C. Panel Fabricator’s representative shall also provide frequent inspection visits during the work of this Section to assure quality and competence of panel installation.

1.4 SUBMITTALS

A. Product Data:

1. Submit ACM Manufacturer's printed product literature, specifications, and datasheet.

B. Shop drawings

1. Submit dimensioned shop drawings, signed, and sealed by the Panel Fabricator’s Engineer.
2. Indicate layout, profiles and product components including anchorage, accessories, finish colors and textures.

3. Include details showing thickness and dimensions of the various system parts, fastening and anchoring methods, locations of joints and gaskets and location and configuration of movement joints. Show edge conditions, joints, corners, panel profiles, supports, anchorages, trim, flashings, closures, and special details.
4. Submit anticipated distortion measured in a diagonal line drawn from each corner.

C. Samples

1. Submit duplicates of ACM Manufacturer's standard sized samples of composite panel in specified thickness, finishes, and selected colors. Allow for review at panel fabrication facility of clips, anchors, supports, fasteners, closures, and other panel accessories for assembly approval.

D. ACM Manufacturer & Panel Fabricator's Instructions

1. Submit installation instructions
2. Submit special handling criteria and cleaning procedures.

E. Shop drawing submittals shall bear the seal of a professional engineer registered in the State of California.

F. Submit delegated design professional engineer's design notes and calculations upon request of the Architect.

G. Schedules from Panel Fabricator's Engineer:

1. Provide requisite Engineering Schedules to Consultant (CRP - Coordinating Registered Professional).

H. Manufacturer assurance submittals

1. Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.
2. Certificates: submit certificates signed by ACM Manufacturer certifying that composite wall panels comply with specified performance characteristics and physical properties.

1.5 QUALITY ASSURANCE

A. .ACM Manufacturer

1. Company specializing in manufacturing composite panel products specified by this Section.
2. Able to document minimum 20 years' experience in such manufacturing.

B. Panel Fabricator

1. Company specializing in designing, engineering, and fabricating wall panels of this Section.
2. Able to document minimum 10 years experience. Submit project contact information. Owner, General Contractor, Architect names and phone numbers including project addresses.
3. Approved Panel Fabricator: Keith Panel Systems Co. Ltd., www.keithpanel.com.

C. Panel Installer

1. Company specializing in installing work of this Section.

2. Able to document minimum 5 years experience. Submit project contact information. Owner, General Contractor, Architect names and phone numbers including project addresses.
3. Trained and authorized by Panel Fabricator as qualified to perform work of this Section.
4. Approved Panel Installer

    a. Pacific Erectors Inc., https://www.pacificerectors.com/

D. Retain a professional engineer, registered in the state of the Work, to provide structural engineering for fabrication and erection of the Work of this Section.
E. Building Code and Contract Document requirements including, but not limited to, the following:

1. Seal and signature to shop drawings and design submittals requiring structural engineering.
2. Field review of installed components.

1.6 MOCK-UPS

A. Construct mock-ups if necessary, in accordance with Division 01 Requirements.
B. Cost of mock-up(s) are separate from Sub-trade Contract Price and are to be submitted to Contractor for review and approval by Owner.
C. Construct mock-ups in locations as directed by Architect:

1. Provide mock-up for evaluation of surface finishes and workmanship.
2. Construct mock-up indicating relationship between wall panels, air spaces, air/vapour retarder membrane, windows, and doors.
3. Remove and replace units which are not accepted.
4. Do not proceed with remaining work until workmanship, color, and finish are reviewed by consultant.
5. Refinish mock-up area as required to produce acceptable work.
6. When accepted, mock-up will demonstrate minimum standard of quality required for this work.

    a. Approved mock-up may remain as part of finished work.

1.7 DELIVERY, STORAGE AND HANDLING

A. Deliver components, aluminum composite material panels, and other manufactured items so as not to be damaged or deformed. Package aluminum composite material panels for protection during transportation and handling.
B. Unload, store, and erect aluminum composite material panels in a manner to prevent bending, warping, twisting, and surface damage.
C. Stack aluminum composite material panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store aluminum composite material panels to ensure dryness, with positive slope for drainage of water. Do not store aluminum composite material panels in contact with other materials that might cause staining, denting, or other surface damage.
D. Retain strippable protective covering on aluminum composite material panels during installation.

1.8 WASTE MANAGEMENT AND DISPOSAL

A. Separate waste materials for recycling and disposal in accordance with Division 01 Requirements.

1.9 WARRANTY

A. Workmanship Warranty

1. Installer agrees to repair or replace components of the panel system that fail in workmanship within specified warranty period. Failures include all items in relation to the following:

a. Structural failures.
b. Rainscreen performance failures.

2. Warranty Period: One year from date of Substantial Completion.

B. Aluminum Composite Material (ACM) Warranty

1. ACM Manufacturer's standard warranty in which Manufacturer agrees to repair finish or replace aluminum composite material panels that show evidence of deterioration Deterioration of finish includes, but is not limited to, color fade, chalking, cracking, peeling of factory-applied finishes within specified warranty period under the following criteria:

a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
b. Chalking in excess of a No.8 rating when tested according to ASTM D 4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. An ICC-ES Evaluation Report is required, this systems report is ESR-1185.
B. Factory-formed and assembled, site installed, aluminum composite material wall panels fabricated from two metal facings bonded to a solid mineral core; formed into profile for installation method indicated.
C. Attachment components including perimeter frame, tracks and clips to be extruded aluminum
D. Panel perimeter frame shall consist of factory-installed hidden dry rubber gaskets that reduces moisture entry into the Rainscreen cavity and minimizes noise from movement.
E. System shall be of pressure-equalized Rainscreen design as tested per AAMA 508. Lag time between the cavity and cyclic wind pressure (5 PSF to 25 PSF) shall not exceed 0.08 seconds. The maximum differential between the cavity pressure and the external wind pressure shall not exceed 8%
F. Wall panel system shall be designed for positive drainage of water leakage and condensation to exterior of wall panel system, including gutter system and hidden lashing at each horizontal joint.

2.2 PERFORMANCE/DESIGN CRITERIA

A. Structural Performance: Provide aluminum composite material panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E 330:

1. Wind Loads: As indicated on Drawings.
2. Other Design Loads: As indicated on Drawings.
3. Deflection Limits: For wind loads, no greater than 1/100 for frame elements and 1/60 for panel materials.

B. Seismic Performance

1. Aluminum composite material wall panels shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

C. Air Infiltration

1. When tested according to ASTM E 283, air leakage of not more than 0.02 cfm/sq. ft. (0.1 L/s per sq. m) at a test-pressure difference of 6.24 lbs/sq. ft. (300 Pa).

D. Water Penetration under Static Pressure

1. When tested according to ASTM E 331, no water penetration under static pressure differential of 20% of inward acting design load at a test-pressure difference of 12 lbs/sq. ft. (600 Pa).

E. Water Penetration under Dynamic Pressure

1. Tested according to AAMA 501.1:
2. No evidence of water penetration through fixed glazing and framing areas when tested at dynamic pressure equal to 20 percent of positive wind-load design pressure, but not less than 12 lbs/sq. ft. (600 Pa).
3. Water leakage does not include water controlled by flashing and gutters, or water that is drained to exterior.

F. Pressure Equalized Rainscreen

1. Tested to AAMA 508-07

a. The panel Fabricator must provide an official test report from an independent testing agency that graphs the performance of the panel system when subject to the AAMA 508-07 test criteria
b. Lag time between the cavity and cyclic wind pressure (5 PSF to 25 PSF) shall not exceed 0.08 seconds. The maximum differential between the cavity pressure and the external wind pressure shall not exceed 8%. For example, at 25 PSF External Wind Pressure, the cavity pressure should not fall below 23 PSF.

G. Thermal Movements

1. Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

a. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

H. Fire Performance

1. For Combustible Construction permitted

a. Tested to ASTM E 84
b. Max. Flame Spread 25, Max. Smoke Developed 450

2. For Non-Combustible Construction

a. Panels shall meet requirements of the Intermediate Scale Multi Story Fire Evaluation

1) USA: NFPA 285
2) Canada: CAN/ULC-S134

2.3 COMPOSITE METAL PANEL SYSTEM MATERIALS

1. Aluminum Composite Material (ACM): aluminum sheets thermally bonded in continuous process, under tension, to fire rated core with no glues or adhesives between dissimilar materials, and as follows:

a. Basis of Design

1) 3A Composites USA Inc.; Alucobond

b. 4mm Total Composite Thickness
c. Aluminum face sheets:

1) Thickness: 0.51 mm.
2) Alloy: AA 5005.
3) Factory Finish: coil coated with fluoropolymer paint to AAMA 620 and AAMA 2605.

d. Fire rated core in accordance to CAN/ULC S-134 in Canada and NFPA 285 in the United States
e. Bond Integrity

1) When tested, in accordance with ASTM D1781 (simulating resistance to panel delamination), there shall not be an adhesive failure of the bond between the core and the skin or a cohesive failure of the core itself according to the following values:

a) Bond Strength: 1160 psi to ASTM C297/C297M.
b) Peel Strength: 100 N mm/mm minimum to ASTM D1781.
c) No degradation in bond performance after 8 hours of submersion in boiling water and after 21 days of immersion in water at 21 degrees C.

2. Panel System for MT-2:

a. Basis of Design

1) KPS System A by Keith Panel Systems
2) KPS System A Plus by Keith Panel Systems for curved panels

b. Attachment assembly components

1) Perimeter frame, tracks and clips to be formed of aluminum extrusions

a) Alloy AA 6063
b) Color: Exposed: best match to panel color, Unexposed: mill finish

2.4 SYSTEM BACK-UP MATERIALS

A. Fasteners: corrosion resistant; standard Leland

B. Thermally broken façade substructure (if required by jurisdiction):

1. Attributes:

a. Non-combustible
b. Meet requirements of ASHRAE 90.1 for project location
c. Adjustable to permit façade alignment to meet installation tolerances.
d. Suitable for rear ventilated Rainscreen façade design.

C. Acceptable product:

1. KPS ThermaSmart Clip 3.0 by Keith Panel Systems Co. Ltd.

D. Girts and sub-girts as detailed: custom manufactured z-girts, Galvalume steel to ASTM A792/A792M, 18 Ga. (1.2 mm) thickness, profiles as indicated, AZM 150 coating.
E. Isolation Tape: ACM Manufacturers standard material for separating dissimilar metals from direct contact.

2.5 ACCESSORIES

A. System Sealants: Panel system to be dry-joint Rainscreen with no reliance on surface applied sealants.
B. Gaskets: Santoprene or EPDM as recommended by Panel Fabricator.
C. Flashings: Fabricate flashing from 0.040-inches minimum thickness aluminum sheet. Where exposed to view, finish to match adjacent panels. Provide lap strip under flashing at abutted conditions; with lapped surfaces sealed with a full-bed of non-hardening sealant.

2.6 FINISH

A. Prefinished sheet with factory applied coating to AAMA 2605, Polyvinylidene Fluoride (PVDF) or Fluoroethylene Vinyl Ether (FEVE).

1. Color: Alucobond Steel City Silver Mica Cool PVDF-2 Gloss level 20.
2. Coating thickness: two coat system not less than 30 micrometres (1.2 mils).

2.7 FABRICATION

A. Panels and components shall comply with details as indicated on drawings and as indicated in reviewed shop drawings.
B. Panel system shall be shop fabricated – field fabrication or assembly not acceptable.
C. Components shall match quality and installation of accepted mock-up specified above.
D. Drill 0.25 inch drainage weep holes every 16 inches on center along length of horizontally oriented bottom end frames located at base of panelized wall areas.
E. Tolerances:

1. Panel bow shall not exceed 0.8% of panel overall dimension in width or length.
2. Panel dimensions shall allow for field adjustment and thermal movement.
3. Panel lines, breaks and curves shall be sharp, smooth and free of warps or buckles.
4. Panel shall be visually flat.
5. Panel surfaces shall be free of scratches or marks caused during fabrication.

2.8 INSULATION

A. Insulation: as specified in Section 07 21 00 Thermal Building Insulation.

PART 3 - EXECUTION

3.1 ACM MANUFACTURER'S INSTRUCTIONS

A. Compliance: comply with ACM Manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 PREPARATION

A. Obtain dimensions from job site.
B. Ensure all structural support is aligned and condition is acceptable.
C. Building surfaces shall be smooth, clean and dry, and free from defects detrimental to the installation of the system. Notify Contractor of conditions not acceptable for installation of system.
D. Inspect wall system and components before installation and verify that there is no shipping damage.
E. Do not install damaged panels; repair or replace as required for smooth and consistent finished appearance.

3.3 INSTALLATION

A. Install composite panels in accordance with ACM Manufacturer's written instructions and shop drawings.
B. Ensure continuity of building envelope air barrier and vapour retarder systems.
C. Erect panels plumb, level and true.
D. Do not install component parts that are observed to be defective, including warped, bowed, dented, scraped and broken members.
E. Adjust assembly to secure panels safely to wall while allowing for expansion and contraction of components.
F. Do not cut, trim, weld, or braze component parts during erection in manner which would damage finish, decrease strength, or result in visual imperfection or failure in performance.
G. Return component parts which require alteration to shop for fabrication, if possible, or for replacement with new parts.
H. Ensure panels aligned vertically and horizontally.
I. Separate dissimilar metals: use appropriate gaskets and tapes to minimize corrosive or electrolytic action between metals.
J. Install flashings to divert all moisture and condensation to exterior. Trim and flash around doors, louvers, and windows. Use only membrane flashing supported by insulation per architectural details.
K. Site Tolerances:

1. Variation from plane or location shown on shop drawings: 0.4 inches over 33-foot length to maximum of 0.79 inches over 328 feet.
2. Deviation of vertical and horizontal members: 0.12 inches over 28-feet run.
3. Offset between two adjacent members abutted end-to-end, in line: maximum 0.03 inch from true alignment

L. Touch-Up Painting: Inspect completed wall system and apply matching touch-up paint as needed to correct minor paint flaws.

3.4 FIELD QUALITY CONTROL

A. Panel Fabricator's Field Services:

1. Panel Fabricator to provide field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with Panel Fabricator's instructions.

3.5 CLEANING

A. Clean in accordance with ACM Manufacturer's instructions.
B. Remove and replace panels damaged beyond repair as direct result of panel installation.
C. Repair panels with minor damage.
D. Remove protective film from finish panels immediately once installation is complete or as otherwise directed by consultant.
E. Provide additional protection required after installation to protect assembly and finishes during construction.
F. Weep holes and drainage channels shall be unobstructed and free of dirt and sealants.
G. Upon final acceptance of installation, remove surplus and protective materials, excess materials, rubbish, tools and equipment from site.
H. General Contractor to leave panels clean and free of debris and residue. Where required, clean exposed panel surfaces using non-abrasive detergent and clean water in accordance with ACM Manufacturer's instructions.

END OF SECTION

SECTION 07 54 19 - PVC ROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Vapor Control Layer.
2. Adhesive for Cover Board and Insulation.
3. Tapered and Flat Polyisocyanurate (ISO) Rigid Insulation.
4. Approved Gypsum Roof Cover board.
5. Water Based Adhesive for membrane attachment.
6. Glass Fiber Reinforced 80 mils PVC Roof Membrane.
7. Low VOC Contact Adhesive for Flashings.
8. 60 mils Glass Fiber Reinforced PVC Flashing Membrane.
9. Other Metal Flashings.
10. Sealants.
11. 60 mils Glass Fiber Reinforced PVC Membrane For Roof Logo.

B. Related requirements:

1. Section 06 10 53 for miscellaneous carpentry.
2. Section 07 62 00 for other sheet metal flashings.
3. Section 07 21 00 for insulation.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Scheduling and sequencing:

1. Sequence work to avoid traffic by equipment or personnel over completed roofing. Where such access is inevitable, provide necessary protection and/or barriers to segregate the work area and to prevent damage to adjacent areas.
2. Do not store materials on completed membrane surfaces. Where storage or traffic is unavoidable provide plywood, additional protection boards or similar protection to prevent damage to the membrane. Notify the membrane manufacturer that traffic or storage is anticipated.
3. All conduit, utilities boxes, inserts, penetrations and drains shall be in place, grouted where required and permanently fixed to the substrate before the insulation and membrane are installed.

B. Pre-installation meeting:

1. Prior to start of installation arrange a pre-installation meeting between the waterproofing manufacturer authorized representative, the Contractor, the Architect, and the installer of to review Project conditions, the Drawings, Specifications and the waterproofing manufacturer data.
2. If more than one trade will be responsible for the successful performance of the work of this Section, these trades shall attend the meeting.
3. Identify areas of concern and remedial measures.
4. Record meeting minutes and distribute PDF copy to all concerned, including the Architect, within 48 hours after the meeting.

1.3 SUBMITTALS

A. Product data:

1. Roofing system: Describe each material, and include installation instructions.
2. Insulation: Written approval by the insulation manufacturer for use and performance of the product in the proposed system.

B. Shop drawings:

1. Show outline of roof and its respective size.
2. Show roof topography, identify slopes and gradients.
3. Provide large scale details of roof drains, each flashing component, penetrations and terminations, and locations of stone ballast and walking pads.

C. Samples: Samples of each material to be used in the roof system including each component manufacturer's literature.

1. Make roof membrane Samples a minimum of 24 inches square with one welded joint.
2. Make flashing Samples a minimum of 6 inches long.
3. Bagged roof ballast of sufficient quantity to demonstrate average sizes, colors and textures.

D. Copy of the ASTM Certification for the named flashing product showing Type II Class I fiberglass reinforced membranes.

E. Warranty:

1. Roofing membrane manufacturer warranty form.
2. Roofer warranty form.

1.4 QUALITY ASSURANCE

A. Unreinforced or polyester reinforced membrane base flashings are prohibited.

B. Acceptance:

1. Technical acceptance from roofing membrane manufacturer of the roofing system.
2. Certifications by producers of roofing and insulating materials that materials supplied comply with requirements of the identified ASTM and industry standards.
3. Certification that system specifications meet all identified code and insurance requirements.

C. Roofer qualifications:

1. Roofing system shall be applied only by a firm authorized in writing, by the roofing membrane manufacturer, to apply roof membrane specified.
2. Upon completion of installation, and delivery to roofing membrane manufacturer by the Contractor of a certification that work was done in accordance with Specifications and roofing membrane manufacturer requirements, an inspection shall be made by a technical representative of roofing membrane manufacturer to observe the roof system.
3. Work pertaining to the installation of roofing membrane and flashings shall only be completed by applicator personnel trained and authorized by roofing membrane manufacturer in those procedures.

D. Code requirements: Submit evidence that the proposed roof system will meet Code requirements and has been tested and approved or listed by the following testing organizations.

1. FM (Factory Mutual Research Corp.) FM I-90 wind uplift resistance.
2. UL (Underwriters Laboratories, Inc.) Class A membrane.

E. Base flashings and penetrations must have a minimum 8-inch height above the finished roof assembly. Care must be taken to ensure this is possible when installing equipment pads and making allowances for associated crickets.

1.5 REGULATORY REQUIREMENTS

A. These requirements are minimum standards. Do not start roofing work without written documentation of the system's compliance, as required in the "Submittals" section of this specification.
B. Field and Flashing membranes shall conform to ASTM D4434 (latest version), "Standard for Polyvinyl Chloride Sheet Roofing". Classification: Type II Grade I.
C. Roofing System shall meet Factory Mutual Research Corporation (FM) - Norwood, MA: Class 1-90 when completed.
D. Roofing System shall have a Underwriters Laboratories, Inc. - Northbrook, IL Class A assembly rating.

1.6 HANDLING

A. Delivery: In original unopened containers or wrappings.
B. Storage:
    1. Handle materials to prevent damage. Place materials on pallets and fully protected from moisture.
    2. Store membrane rolls lying down on pallets, and fully protected from moisture with clean canvas tarpaulins. Unvented polyethylene tarpaulins are unacceptable.
    3. Store adhesives above 40-degree F.
    4. Store flammable materials in a cool, dry area away from sparks and open flames.
    5. Load materials on the rooftop in such a manner to eliminate risk of deck overload due to concentrated weight.
    6. Remove damaged materials from the job site and replace at no cost to the Owner.

1.7 JOB CONDITIONS

A. Install materials when environmental conditions are within range acceptable to the roofing membrane manufacturer.
B. Install only materials as much of new roofing as can be made weathertight each day, including all flashing and detail work.
C. Surfaces to receive insulation, membrane, and flashings shall be dry. Should surface moisture occur, provide the necessary equipment to dry surface prior to application.
D. Install uninterrupted waterstops at the end of each day’s work, and completely remove them before proceeding with the next day’s work.
E. Prior to and during application of insulation and roofing membrane, remove dirt, debris and dust from surfaces either by vacuuming, sweeping or blowing with compressed air and/or similar methods.
F. Conduct fastener pullout tests in accordance with industry standards to help verify condition of deck/substrate and to confirm expected pullout values.

1.8 SEQUENCING

1.9 Arrange work sequence to avoid use of newly constructed roofing as a walking surface or for equipment movement and storage. Where such access is absolutely required, provide all necessary protection and barriers to segregate the work area and to prevent damage to adjacent areas. Provide a substantial protection layer consisting of plywood over Sarnafelt or plywood over insulation board for all roof areas that receive concentrated rooftop traffic during construction.

1.10 SPECIAL WARRANTIES

A. Special warranties: The manufacturer and the roofer, as noted below, shall repair defects within the warranty period at no cost to the Owner. If work related to roofing, flashing, or metal is found to be within the roofer and/or manufacturer warranty term, defective or otherwise not in accordance with the Contract Documents, the roofer and/or manufacturer, as specified below, shall repair defect(s) at no cost to the Owner.

1. Defects are defined as follows:

    a. Failure of the roof and flashings to remain weathertight during the warranty period.
    b. Discoloration of the roof membrane other than caused by normal aging; uneven discoloration will be deemed a defect.
    c. Lack of adhesion to substrate, such as evidenced by bubbles (trapped air) under the roof membrane.

2. Manufacturer warranty: Provide a “No Dollar Limit” non-prorated warranty that does not exclude ponding or standing water or contain time limits for standing water. No additional fees or roofing manufacturer inspections will be required to maintain the warranty. The System Warranty includes membrane, insulation, coverboard and attachment components of the roofing system provided by the Manufacturer.
3. Roofer’s warranty: Roofer shall supply the Owner with a separate 2-year workmanship warranty. The installer's warranty obligation shall run directly to the Owner, and a copy shall be sent to the manufacturer.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Provide roofing membrane that prevents the passage of water in the building.

2.2 MEMBRANE SYSTEM

A. Basis of design: Sika Sarnafil 80 mils thick G410 fiberglass reinforced membrane with a lacquer coating. Membrane shall conform to ASTM D 4434, "Standard for Polyvinyl Chloride Sheet Roofing" Classification: Type II, Grade I.
B. Other acceptable manufacturers:

1. Elvaloy alloyed PVC membranes: Seaman Corp. “Fibertite.
2. PVC membrane: Durolast.
3. Or equal.
4. No "Private Label" or third party membrane manufacturers are approved alternates.

C. Color: T24 compliant White.

2.3 FLASHING MATERIALS

A. Flashing Membranes - Sika Sarnafil G410-15 (Basis Of Design) 60 mils thickness with fiberglass reinforcement. Color to match field sheet.
B. As supplied by roofing membrane manufacturer.
C. Flashing materials shall be same material as roofing membrane, except that the metal portion of the flashing shall be Type 316 stainless steel.

2.4 ADHESIVES

A. Surface Conditioner 150: Concrete primer for G476SA membranes.
B. Water-based adhesive for membrane attachment to cover board substrate.

C. Low rise foam adhesive for insulation and cover board attachments.
D. Adhesives must be acceptable to the roof membrane manufacturer for the conditions of use.

1. PVC surfaces: Sarnacol 2121 VOC-compliant adhesive for vertical concrete and steel deck surfaces.
2. Gypsum underlayment board and insulation adhesive: OlyBond 500 by Olympic Manufacturing Group, or equal polyurethane foam adhesive acceptable to the roofing manufacturer.
3. Stabond Adhesive.: Low VOC reactivating-type adhesive used to attach membrane to flashing substrate.

2.5 INSULATION

A. Uniform Thickness complying with ASTM C1289 Type II, Class 1 Grade 2. Provide 2.7-inch maximum thickness.
B. Polyisocyanurate 20 psi compressive strength 4 feet x 4 feet boards.
C. R30 Long-Term Thermal Resistance (LTTR)
D. Provide one or more layers where overall thickness exceeds 2.7-inch.
E. Sarnatherm tapered system and tapered crickets.
F. Tapered rigid Polyisocyanurate foam Sarnatherm complying with ASTM C1289 Type II, Class 1 Grade 2, 20 psi compressive strength and ¼ inch per foot slope. Cricket valleys slope should be maximized are not expected to achieve the major ¼ inch per foot slope.

2.6 COVER BOARD

A. Cover Board (Basis Of Design): 1/2 in. Dens Deck Prime manufactured by Georgia-Pacific, 1/2 in. Fiberglass Mat Faced Gypsum Roof Board. Or equal.
B. Provide only fire-tested, Fiberglass Mat Faced Gypsum Roof Board with EONIC™ Technology for improved moisture resistance.

1. Tested to exceed ASTM C473 with only 1-gram maximum surface moisture absorption and 5% total moisture absorption by weight.
2. Acceptable Product: GP Gypsum, Dens Deck Prime ® Roof Boards.
3. Thickness: 1/2 inch.
4. Width: 4 feet.
5. Length: 8 feet
6. Surfacing: Primed Fiberglass Mat.
7. Flexural Strength, Parallel (ASTM C473): 40 lbf, minimum.
8. Permeance (ASTM E96): Greater than 30 perms.
9. Compressive Strength (Applicable Sections of ASTM C472): Nominal 900 pounds per square inch.
10. Flame Spread/ Smoke Development (ASTM E84): Not more than 0 Flame Spread, 0 Smoke Development
11. Combustibility (ASTM E136): Noncombustible
12. Fire resistance rating (UL 790 and ASTM E108): Class A
13. Mold Resistance (ASTM D3273): Scored a 10

2.7 VAPOR CONTROL LAYER

A. Vapor Retarder SA 31 Primer WB: A polymer emulsion-based primer designed to improve the adhesion of Sarnavap Self Adhered Vapor Control Layers.
B. Vapor Retarder SA 31: A 31 mil self-adhesive vapor barrier that can also serve as temporary roof protection. Vapor Retarder SA 31 is available in rolls 44.9 in. x 133.8 ft. Consult Product Data Sheet for additional information.

2.8 COMPONENTS

A. Sarnaclad PVC Laminated Metal
B. Sarnareglet - A heavy-duty, extruded aluminum flashing termination reglet used at walls and large curbs.
C. Universal PVC Prefabricated stack - A prefabricated vent pipe flashing made from 0.060-inch thickness PVC.
D. Prefabricated Corners - Prefabricated outside and inside flashing corners made of 0.060-inch-thick PVC.
E. Sarnacircles "G": Circular 0.060-inch thick G410 membrane patches welded at T-joints formed
F. by overlapping thicker membranes.

2.9 ATTACHMENT COMPONENTS

A. Membrane Adhesives: Sarnacol 2121 Adhesive, a water-based adhesive used to attach the membrane to horizontal or near-horizontal substrates. Consult Product Data Sheets for additional information.
B. Flashing Adhesive: Stabond U148A Adhesive, a low VOC reactivating-type adhesive used to attach membrane to flashing substrate.
C. Peelstop: An extruded aluminum, low profile bar used with certain fasteners to attach to the roof deck or to walls/curbs at terminations, penetrations and at incline changes of the substrate.
D. Insulation Board Adhesive: Sarnacol 2163/Sarnacol AD/OM Adhesive, a one step low-rise polyurethane foam used to attach insulation to approved compatible substrates. Adhesive is applied with a gravity fed applicator or by hand with a dual component caulk gun in bands 12 in. on center. Additional adhesive may be required for rougher surfaces. Consult Product Data Sheets for additional information. Application rates as recommended by the membrane manufacturer.
E. Sarnafasteners:

    1. #15, heavy-duty, corrosion-resistant fastener used with Sarnastop termination bar for secondary perimeter attachment to steel or wood substrates
    2. #12, fastener used with Sarnaplates to attach boards to steel or wood roof decks for 20 year warranty systems.

F. Sarnaplate: Used with various Sarnafasteners to attach insulation boards to roof deck. Sarnaplate is a 3 inch square or round, 26 gauge stamping of SAE 1010 steel with an AZ 55 Galvalume coating.

2.10 WALKWAY PROTECTION

A. Sarnatred V: Polyester reinforced, 0.096 inch, weldable membrane with surface embossment. Used as a protection layer. Sarnatred is supplied in rolls of 39.3 inches wide and 50 feet long.

2.11 SEALANTS

A. Multi-Purpose Sealant (for termination details). Sika 1A or approved equal.
B. Approved two-component urethane adhesive sealant.
C. Depending on substrates, the following sealants are options for temporary overnight tie-ins:

    1. Spray-applied, water-resistant urethane foam.
    2. Mechanical attachment with rigid bars and compressed sealant.

2.12 MISCELLANEOUS FASTENERS AND ANCHORS

A. Provide only post-galvanized steel, aluminum or stainless-steel fasteners. Take precautions to avoid galvanic corrosion. Install expansion type fasteners with stainless steel pins for the attachment of metal to masonry. The minimum embedment for all concrete fasteners and

anchors is 1¼ inch and for all miscellaneous wood fasteners and anchors used for flashings 1 inch.

2.13 EQUIPMENT PLATFORM WATERPROOFING

A. Sikalastic RoofPro 641 by Sika Corporation - provide fully reinforced waterproofing membrane RoofPro 641 20 system 80 mils wft. Galvanized Sheet metal covers may be used but are not required with this system.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Manufacturer’s inspections:

1. Request the manufacturer's presence before start of this work to verify substrate acceptability, and as required thereafter to review installation procedures and completed work, and to issue warranty specified.
2. Unsatisfactory conditions disclosed by the manufacturer visits to the site shall be documented, and promptly and satisfactorily repaired and the areas re-inspected by the manufacturer before work starts or resumes in affected areas.

B. Examine substrates, conditions and surfaces to/under which materials will be applied/installed to receive materials.
C. Inspect deck for defects that will adversely affect the quality of work.
D. Conduct fastener or adhesion pullout tests in accordance with industry standards to help verify condition of deck/substrate and to confirm expected pullout or adhesion values.
E. Correct detrimental conditions before proceeding with installation.

3.2 PREPARATION

A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's instructions. Remove sharp projections.
B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Ensure that drains are functioning normally prior to starting this work. Remove roof-drain plugs when no work is taking place or when rain is forecast.
C. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at the end of the workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.
D. Coordinate the installation so that each roofed area is made watertight at the end of each day.

3.3 SUBSTRATE PREPARATION

A. Vapor retarder SA 31 primer WB application at concrete decks:

1. Shake well before use. Minimum application temperature is 41 deg F. Application rates will vary according to substrate. Apply with a brush roller or spray to a clean dry substrate at an average rate of 1 gallon per 100 square feet for porous surfaces and ½ gallon per 100 square feet for non porous surfaces.

B. Vapor control layer (VCL) installation at concrete decks:

1. Verify the substrate is completely dry and the surface has a smooth finish and is free of voids, sharp protrusions, loose aggregate, spalled areas, laitance and form release agents. In the event of rain, allow the concrete to dry before primer is applied.
2. Apply VCL Membrane from low point to high point, in a shingle fashion, so laps will shed water. Overlap all edges at least 21/2 inches. Stagger end laps. Place membrane carefully to avoid wrinkles and fish-mouths. Immediately after installation, roll with a weighted foam covered

3.4 WOOD NAILERS

A. Install continuous treated wood nailers, of same thickness as insulation height, at the perimeter of the entire roof and around roof projections and penetrations.
B. Anchor nailers to resist a minimum force of 300 lb./linear foot in any direction.
C. Provide a 1/2-inch space between nailer lengths.
D. Individual nailer lengths shall not be less than 3-foot long.
E. Space fasteners at 12-inch o.c. Stagger fasteners 1/3 the nailer width and install within 6-inch of each end.
F. Nailer attachment shall meet this requirement and current FM Loss Prevention Data Sheet 1-49.

3.5 INSULATION & COVER BOARD INSTALLATION

A. Mechanically-attach insulation with approved fasteners to the decks as recommended by roofing membrane manufacturer and in compliance with FM for fastening rates and patterns.
B. Install tapered insulation around drains creating a drain sump.
C. Do not install more insulation board than can be covered with membrane by the end of the day or the onset of inclement weather.
D. Use at least 2 layers of insulation when the total thickness exceeds 2.5-inch. Stagger joints at least 12-inch between layers.
E. Attach insulation as recommended by the insulation manufacturer, FM and roofing membrane manufacturer instructions, and so that insulation boards rest evenly on the substrate. Install each insulation board tightly against the adjacent boards on all sides.
F. Install cover board over the insulation with tight, flush joints, in accordance with the roof membrane manufacturer’s instructions. Break joints between the insulation and the cover board.

3.6 ROOFING MEMBRANE

A. Install roof membrane over clean, dry substrate in accordance with its manufacturer’s instructions.
B. Hot air-weld seams continuously.
C. Install walkway pads in the pattern indicated over the completed roof membrane. Adhere fully to roof membrane as recommended by the membrane manufacturer or lay loose when acceptable for the product selected.

3.7 FLASHINGS

A. Install concurrently with roof membrane as the work progresses, in accordance with the roofing membrane manufacturer instructions, to seal all edges and penetrations.

3.8 WALKWAY INSTALLATION

A. Verify the lap welds to be covered are continuous and the membrane is clean and dry before installing Sarnatred. Apply a continuous coat of Stabond U148A adhesive to the deck sheet and the back of the Sarnatred and press Sarnatred into place with a water-filled, foam-covered lawn roller. Hot-air weld the overlaps and the perimeter. Do not apply adhesive to the seam area.

3.9 EQUIPMENT PLATFORM WATERPROOFING

A. Prepare the equipment platform to receive the Sikalastic EP Primer
B. Apply Sikalastic EP Primer at 200-250 ft2/gallon and allow to cure (typically 8-12 hours).
C. Apply the base coat of RoofPro 641 resin within 72 hours of EP Primer application, if this time is exceeded clean and re-apply EP Primer to the cured primer.
D. Apply 50 mils base coat of RoofPro 641 resin with a roller and immediately saturate the Reemat Premium into the wet RoofPro 641 resin and backroll to ensure complete embedment. Allow the 641 resin to cure 12-18 hours. Apply the 30 mils RoofPro 641 top coat over the cured base coat and allow to cure fully (typically 24 hours) before applying roof top equipment to the platform.

3.10 LOGO INSTALLATION

A. Verify the lap welds to be covered are continuous and the membrane is clean and dry before installing logo. Apply a continuous coat of Stabond U148A adhesive to the deck sheet and the back of the logo membrane and press logo membrane into place with a water-filled, foam-covered lawn roller. Hot-air weld the overlaps and the perimeter. Do not apply adhesive to the seam area.

3.11 TEMPORARY CUT-OFF

A. Construct all temporary waterstops to provide a 100% watertight seal. Maintain the stagger of insulation joints by installing partial panels of insulation. Carry the new membrane into the waterstop. Seal the waterstop to the deck and/or substrate so that water will not be allowed to travel under the new or existing roofing. Seal the edge of the membrane in a continuous heavy application of sealant. Cut out all contaminated membrane before resuming work.

3.12 COMPLETION

A. Correct all punch-list items to the satisfaction of the Owner's Representative and Manufacturer prior to demobilization.

3.13 FIELD QUALITY CONTROL

A. Seams:

1. Check welded seams for continuity daily where directed by roofing membrane manufacturer’s representative. Take one inch wide cross-section samples of welded seams at least three times a day. Correct welds display failure from shearing of the membrane prior to separation of the weld. Each test cut shall be patched by the Applicator at no extra cost to the Owner.
2. Correct welds displaying failure from shearing of membrane prior to separation of weld. Patch each test cut.

B. Interim and Final Inspections - Upon completion of the installation and the delivery to Manufacturer by the Applicator of a certification that all work has been done in strict accordance with the contract specifications and Manufacturer's requirements, a warranty inspection shall be made by the manufacturers Specialist Technical Representative no personnel with a sales role/function within the company shall be permitted to inspect contractors work. Water test all drains to confirm they are functioning properly after roofing work is completed.

1. Note defects and non-compliance with Specifications and itemize roofing membrane manufacturer’s recommendations in a punch list.
2. These items must be corrected immediately to the satisfaction of the Architect and roofing membrane manufacturer prior to demobilization.

3.14 DEMONSTRATION

A. Provide maintenance documents and personal instruction to the Owner for the following:

1. Access restrictions and precautions.
2. Avoiding mechanical damage.
3. Potential contaminants and rectification.
4. Cleaning.
5. Emergency repairs.

END OF SECTION

SECTION 07 62 00 - FLASHINGS AND SHEET METALWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Gravel stops.
2. Gutters, conductor heads and downspouts.
3. Copings.
4. Prefabricated counterflashing assemblies.
5. Flashing collars for roof screen supports.
6. Air intake louver.
7. Storefronts and curtain wall sill pans and dams.
8. All other flashings and sheet metal items shown or required to make the building weathertight and not specified in other Sections.

B. Related requirements:

1. Section 07 42 13 for flashing related to metal wall panels.
2. Section 07 72 33 for roof hatch.
3. Division 08 for flashings in connection with window wall and skylights, and counterflashings at perimeter of skylights.
4. Division 23 for mechanical sheet metal work, and flashings and collars for mechanical and electrical work, except as specified herein for roof drains.

C. Definitions:

1. In general, flashings visible by the public shall be prefinished aluminum.
2. All other flashings shall be stainless steel.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Scheduling and sequencing:
B. Pre-installation meeting:

1. Prior to starting installation, arrange a pre-installation meeting between trades responsible for flashings and trades whose systems interface with flashings.
2. Attendees shall also include, but are not necessarily limited to the following:

    a. Contractor.
    b. Architect.
    c. Project roofing and waterproofing consultant.
    d. Roofing material manufacturer’s technical representative.
    e. Representatives of waterproofing, fenestration, exterior building envelope, weatherproofing and exterior cladding systems.

3. Those present shall review the Drawings and Specifications, and typical flashing details.
4. Identify areas of concern and proposed remedial measures. Take photographs of the areas of concerns, before and after remedial measures are taken.
5. Record meeting minutes and distribute PDF copy to all concerned, including the Architect, within 48 hours of the meeting.

1.3 SUBMITTALS

A. Data: Manufacturer Product Data, specifications, installation instructions and general recommendations for installation of prefabricated assemblies.

B. Shop Drawings:

1. Show typical and atypical details, including, but not limited to sheet metal components as well as all transitional and interface flashings between the various roofing, waterproofing and exterior building envelope weatherproofing assemblies, such as wall cladding and fenestration. Include material weight, methods of joining and attachment, and relationship with adjacent materials and supports of all sheet metal assemblies.
2. Detail interface with adjacent materials. For interface between flashings with different profiles and conditions difficult to illustrate in 2-dimension, furnish isometric drawings. Key sheet metal components, transitional and interface flashings, and associated materials to the Drawings, and show typical locations and profiles.

C. Samples: Assembled Samples of the following at least 6 inches long, except as otherwise specified. Mount on plywood and include all components to be installed under this Section for each Sample.

1. Complete coping, including inside and outside corner condition, with legs at least 12 inches long; include typical moving and non-moving joints. Inside and outside corners must be fully soldered; sealant joints at those locations are unacceptable.
2. Gravel stop and/or roof termination.
3. Scupper.
4. Gutter including holding strap.
5. Conductor head and downspout.
6. Counterflashing with receiver.
7. Rain bonnet.

1.4 QUALITY ASSURANCE

A. Design criteria and performance requirements: Fabricate and install the work of this Section to withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failing, rattling, leaking, excessive oil-canning, and fastener disengagement.

1. Thermal movements:

a. Provide sheet metal flashing and trim that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects.
b. Provide clips that resist rotation and avoid shear stress as a result of sheet metal and trim thermal movements.
c. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
d. Temperature change (range) of 120-degree F ambient; 180-degree F, material surfaces.

2. Water infiltration: Provide sheet metalwork and flashings that do not allow water infiltration to building interior, and to damage materials, such as insulation, in exterior walls.

1.5 HANDLING

A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage. Store sheet metal flashing and trim materials away from uncured concrete and masonry.
B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to the extent necessary for the period of sheet metal flashing and trim installation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General: Sheet metal flashing and trim assemblies, including cleats, anchors, and fasteners, shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.
B. Sheet Metal Standard for Flashing and Trim: Comply with NRCA's "The NRCA Roofing Manual: Architectural Metal Flashing, Condensation and Air Leakage Control, and Reroofing" and SMACNA's "Architectural Sheet Metal Manual" (for gravity loading only) requirements for dimensions and profiles shown unless more stringent requirements are indicated.
C. SPRI Wind Design Standard: Manufacture and install copings tested in accordance with ANSI/SPRI/FM 4435/ES-1 and capable of resisting the following design pressure:

1. Design Pressure: As indicated on Drawings.

2.2 MATERIALS

A. Sheet steel: Commercial quality carbon steel sheets complying with ASTM A 653, lock-forming grade, galvanized with a G90 zinc coating, 24-gage (0.025 inch) minimum unless otherwise indicated, known commercially as "Satincoat", or "Galvanneal." Steel sheet thicknesses specified are base metal thicknesses prior to galvanizing.
B. Increase gage of galvanized sheet steel for larger sheet applications, such as gutters, curbs, etc.

1. Sheet lead for roof drains: 4 lb./square-foot, ASTM B 29 desilverized pig lead.

C. Stainless steel at concealed locations only: ASTM A240/A240M, Type 304, dead soft, fully annealed; with smooth, flat surface.

1. Finish: ASTM A480/A480M, No. 2D (dull, cold rolled).

a. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
b. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.

1) Run grain of directional finishes with long dimension of each piece.
2) When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

D. Aluminum:

1. Sheet aluminum: ASTM B 209, alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required; with smooth, flat surface. (0 .03 inch thick.)

2. Aluminum extrusions: ASTM B 229.

    a. Clear Anodic Finish, Coil Coated at concealed locations only: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

3. Exposed Coil-Coated Finish:

    a. Metallic Fluoropolymer: AAMA 2605. Three-coat fluoropolymer finish with suspended metallic flakes containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions. Match coating on metal in Section 07 42 13.

4. Color: Match Architect's sample As indicted on Drawings.
5. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of 0.5 mil.

E. Nails:

1. For attaching sheet steel to wood: Large flat head "stronghold" type roofing nails with barbed point, formed of hot-dip galvanized steel of sufficient length to penetrate a minimum of one-inch into the wood nailer.
2. For attaching sheet steel to concrete: 1-1/4-inch by 8d hot-dip galvanized hardened steel nails with lead washers.

F. Hot dip galvanized self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads.

1. Fasteners for flashing and trim: Blind fasteners or self-drilling screws, gasketed with hex washer head.
2. Blind fasteners: High-strength aluminum or stainless-steel rivets.

G. Solder and flux:

1. Galvanized sheet metal: 50-50 lead/tin solder complying with ASTM B 32, used with a non-corrosive flux.
2. Lead: ASTM B 32, Grade Sn50, 50 percent tin and 50 percent lead.
3. Copper: ASTM B 32, Grade Sn50, 50 percent tin and 50 percent lead.
4. Lead-coated copper: ASTM B 32, Grade Sn60, 60 percent tin and 40 percent lead.
5. Stainless steel: ASTM B 32, Grade Sn60, with an acid flux of type recommended by stainless-steel sheet manufacturer.

H. Sealing tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealing tape with release-paper backing.

1. Provide permanently elastic, nonsag, non-toxic, non-staining tape.
2. Tremco 440, Schnee-Morehead, Inc. SM5700, or equal.

I. Expansion-joint sealant: For hooked-type expansion joints, which must be free to move, provide non-setting, non-hardening, non-migrating, heavy-bodied polyisobutylene sealant.

J. Bituminous coating:

1. Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat.
2. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

K. Insect screens: 14 by 18 mesh, 0.063-inch diameter aluminum wire crimped screen material.

L. Slip sheet: Red Rosin Building paper, minimum 12 lb./100 square feet by W.R. Meadows or equal.

1. Size: 36 inches by 150 feet.

2.3 UNDERLAYMENT MATERIALS

A. Felt: ASTM D226/D226M, Type II (No. 30), asphalt-saturated organic felt; nonperforated.
B. Source Limitations: Obtain underlayment from single source from single manufacturer.
C. Slip sheet: Red Rosin Building paper, minimum 12 lb./100 square feet by W.R. Meadows or equal.

1. Size: 36 inches by 150 feet.

2.4 FLEXIBLE FLASHING

A. Flexible flashing materials installed under, or interface with sheet metal. Protect flexible flashing materials from UV exposure; do not leave uncovered in excess of the material manufacturer's published exposure limits.
B. Self-adhering waterproofing membrane materials shall be either manufactured by the Air and Water Barrier material manufacturer as part of their system or approved for use as being compatible with the Air and Water Barrier system specified in Section 07 27 26.

1. General: For use in high temperature environments (temperatures in excess of 225 degrees F.), provide flashing rated by the flexible flashing manufacturer as "high temperature resistant" and suitable for its intended use and application.
2. For use on exterior walls, where neither metal flashing, air and water barrier, or high-temperature flashings occur:

a. Perm-A-Barrier by GCP Applied Technologies.
b. Window and Door Flashing by Carlisle Coatings & Waterproofing.
c. Fast Flash by Protecto Wrap Co.
d. Sealtight Air-Shield by WR Meadows, Inc.
e. Seam Seal Tape by SafSeal Innovations.
f. TW Moisture Wrap by Tamko Waterproofing.
g. Or equal.

3. For use under copings and other sheet metal assemblies: Self-adhering (peel and stick) flexible high-temperature resistant, self-adhering waterproofing flashings by one of the following, and shall include primers, sealants and mastics, liquid membrane and accessories required for complete systems.

a. WIP 300HT-by Carlisle Coatings & Waterproofing.
b. PW 100/40 HT by Protecto Wrap Co.
c. Grace Ultra by GCP Applied Technologies.
d. Or equal.

2.5 PREFABRICATED ASSEMBLIES

A. Counterflashing assemblies: Formed of 24-gage galvanized sheet steel of the profiles shown on the Drawings, complete with factory-formed internal and external corners, and end closures by one of the following.

1. Basis of design is for Fry Reglet Corp. Type ST (stucco), CO (concrete), SM (surface mounted).]
2. Keystone Flashing Co.
3. CF Cheney Flashing Co.
4. MM Systems Corp.
5. Or equal.

B. Strainer units for conductor heads: Removable beehive design fabricated from 0.062-inch diameter galvanized steel wire or wire mesh with openings not more than 1/2-inch.
C. Prefabricated expansion gutter joints: “Expansion Joint” by Wilco, or “T-Pren Expansion Joint” by Matthew Hebden.
D. Sheet metal curbs:

1. Of the sizes and profiles indicated, by Thybar Corp., Pate Co. or Custom Curb, Inc., with an 18-gage galvanized steel shell and base plate fully welded, factory installed insulation, and continuous wood nailer.
2. Reinforce curb as required to safely support the equipment thereon.

2.6 FABRICATION

A. General:

1. Shop fabricate flashings and sheet metal work to comply with profiles and sizes indicated on the Drawings and standard Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA) detail plates of the "Architectural Sheet Metal Manual" as follows, unless otherwise indicated.

    a. Gravel stops and roof edging: Figure 2-5C.
    b. Laps: J2.
    c. Copings: Figure 3-4A. Miter and solder inside and outside corners continuously to make watertight; the use of sealant for that purpose is unacceptable.
    d. Gutter: Style A. Butt expansion joint Figure 1-7.
    e. Downspout: Figure 1-32A round; Figure 1-32B rectangular.
    f. Downspout hanger: Figure 1-35 to match shape of gutters.
    g. Scupper and conductor head: Figure 1-27A.

2. Form sheet metal on bending brake with straight, sharp edges. Shape, trim, and hand seam sheet metal on bench; keep job site forming to a minimum.
3. Comply with metal producers' recommendations for tinning, soldering, and cleaning flux from metal.
4. Fabricate with joints and corners accurately machined, filed and fitted, and rigidly framed together and connected.

B. Galvanized Sheet Metal flashing: See Section 09 90 00.
C. Fabricate in as long length as possible to minimize field joints.
D. Prefabricate intersections, including counterflashings, with mitered, riveted joints. Make corners and intersections with legs a minimum of 24-inch long extending in each direction.
Tinning and soldering:

1. Tin edges on both sides of sheet steel to be soldered.
2. Perform soldering slowly, thoroughly heating seams and completely sweating solder through full width of seams.

E. Exposed edges: Neatly double back sheet metal 1/2-inch to stiffen edges and to provide a finished appearance.
F. Provisions for attachment to structure: Furnish supports, hangers, bracing, anchors and other devices shown, specified or necessary for reinforcement and proper attachment of flashings and sheet metal to building.

2.7 FINISHES

A. Galvanized Sheet Metal flashing: See Section 09 90 00.

B. Exposed aluminum-fabricated copings and running flashing: Two-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Custom color and Gloss as selected by Architect. Finish to be non-reflective.

C. Concealed aluminum: Mill finish.

PART 3 - EXECUTION

3.1 EXAMINATION

Examine conditions and measurements affecting the work of this Section at site. Correct detrimental conditions before proceeding with installation.

3.2 GENERAL REQUIREMENTS

A. In addition to the assemblies listed above, provide required sheet metal flashings, counterflashings, transitional and interface flashings required to achieve a properly weatherproofed, flashed and counterflashed building envelope, including sheet metal flashings in the angles formed where exterior waterproofed decks abut walls, and as well at curbs, platforms, ventilators, pipes, roof hatches, and other vertical and horizontal surfaces, where indicated and necessary to make the Work weatherproof.

B. Comply with manufacturer’s installation instructions where applicable, and applicable SMACNA and NRCA details, except as indicated and specified.

C. Install counterflashing assemblies at a constant height above the roof.

1. Anchor counterflashing securely into reglet by friction, or provide lead wedges spaced 2-foot o.c. maximum.
2. Use manufacturer standard splice plates and preformed corners for a weathertight assembly.

D. Coordinate this work with other trades whose work penetrates, intersects and adjoins flashings and sheet metal work, to permit the correct sequencing and the watertightness of the assemblies.

E. Isolate copper from dissimilar metals and pressure-treated wood.

F. Isolate aluminum from cementitious materials and dissimilar metals.

3.3 INSTALLATION

A. General:

1. Install sheet metal work in accordance with the approved Shop Drawings.
2. Fasten coping on inside wall with hex head screws and bonded sealing washers through oversized holes in the back of the coping. Except as specified, lap and solder corners and angles; lapping and sealant method is not an acceptable substitute for coping corners; provide for thermal movement no more than 10 feet from corner.
3. Slope copings and sills with a minimum slope of 10 percent to drain away form walls and building interior. Slope gutters 1/4-inch per foot to drain.
4. Solder joints of window flashings (pans) and saddles.
5. Attach work securely to supporting construction, plumb, level, with tight, flush joints allowing for thermal movements.
6. Install work with lines, arises, and angles sharp and true.
7. Fold exposed edges neatly to form a 1/2-inch hem on the concealed side; hem all exposed edges, unless otherwise indicated.

8. Assemble work so that face of metal in contact has hairline joints, except where required for expansion or fitting. Provide back-up plates at joints.
9. Conceal fastenings and reinforcement where they would be visible by the public and the building occupants.
10. Vulcanize joints of the roof expansion joint covers and lap the sheet metal portion, after sealing for water tightness.
11. Finish work shall be straight, smooth and continuous, without dimples, dents and other damage.

B. Soldering:

1. Protect underlying waterproof membrane (flexible flashing) when soldering sheet metal.
2. Except as specified, solder all joints not intended for expansion and contraction.
3. Clean material and tin prior to soldering.
4. Solder slowly. Heat the seams thoroughly, and completely fill with solder.
5. Make exposed soldering on finish surfaces neatly, full flowing and smooth.
6. Wash acid flux with a soda solution after soldering and remove soldering flux on exposed surfaces.

C. Nailing:

1. Confine nailing of sheet metal generally to sheet metal having a maximum width of 18-inches. Nailing of flashings shall be confined to one edge only.
2. Space nails evenly not over 12-inches o.c, and approximately 2-inches from the edge.
3. Face nailing is not permitted. Do not nail sheet metal assemblies on horizontal surfaces.
4. Where sheet metal is applied to surfaces other than wood, furnish detailed Shop Drawings showing locations of required sleepers and nailing strips specified in Section 06 10 53 (06 10 00).

D. Cleats:

1. Provide cleats for sheet metal 18-inch and over in width. Space cleats evenly not over 12-inches o.c
2. Make cleats not less than 2-inch wide by 3-inch long, and of the same material and thickness as the sheet metal being installed.
3. Secure one end of the cleat with 2 nails and the cleat folded back over the nail heads. Lock the other end into the seam. Pre-tin cleats for soldered seams.

E. Bolts, rivets, and screws:

1. Install bolts, rivets, and screws where required. Space equally and symmetrically.
2. Use fastener sizes that penetrate substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.
3. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.
4. Provide compatible washers to protect surface of sheet metal and to provide a watertight connection.

F. Dissimilar material protection:

1. Protect sheet metal in contact with dissimilar metals, concrete, masonry and plaster with a heavy coating of bituminous paint, approved separation tape, or building felt or paper.
2. Set sheet metal assemblies supported by pressure-treated wood on building paper or felt attached to the wood nailer, except set copings on flexible flashing specified. Lap on vertical surfaces at least 2 inches.

G. Seams - general: Make seams straight, uniform in width and height, with no solder showing on the face.

1. Flat-lock seams: Finish not less than 3/4-inch wide made in the direction of water flow.
2. Lap seams: Finish soldered seams not less than one-inch wide. Overlap seams not soldered at least 3-inches.
3. Loose-lock expansion seams: No less than 3 inches wide, designed to provide minimum one-inch movement within the joint. Fill joint completely with sealant applied at not less than 1/8-inch thick bed.
4. Standing seams: Not less than one-inch high, double locked without solder.

H. Expansion and contraction:

1. Provide for thermal and building movement without over-stressing the material, breaking connections or producing wrinkles and distortion in finished surfaces. Make sheet metal installations weathertight at all locations.
2. Provide expansion and contraction joints at not more than 40-foot intervals, except that where the distance between the last expansion joint and the end of the continuous run is more than half the required interval spacing, provide an additional joint. Where expansion and contraction joints are exposed to view, their location is subject to the Architect's approval.
3. Exposed surfaces shall be free from visible wave, warp, and buckle.

I. Flexible flashing: Install under all parapet caps. Lap joints 2-inches. Carry flexible flashing down wall as far as the edge of the coping; overlap wall weather barrier at least 2-inches.

J. Install curbs and gravity roof vents level and square with tight, waterproof joints; attach securely to deck.

K. Completed flashings and sheet metal work shall be watertight, free of tool marks, dents, scratches and other damages, with joints and corners accurately machined, filed and fitted, and rigidly framed together and connected. Non-complying work shall either be repaired, when repairs are acceptable to the Architect, or replaced with new, undamaged flashings and sheet metal work.

END OF SECTION

SECTION 07 72 33 - ROOF HATCH

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Single leaf roof hatch.
2. Hatch railing and gate.
3. Safety post.

B. Related requirements:

1. Division 05 for “Safety Post” attached to ladder and for all other railings.

1.2 COORDINATION

A. Coordinate layout and installation of roof hatch with roofing membrane and base flashing and interfacing and adjoining construction to provide a leakproof, weathertight, secure, and noncorrosive installation.
B. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.

1.3 SUBMITTALS

A. Project Data:

1. Manufacturer Product Data for the hatch and railing.
2. Supplement with details showing attachment to supports and interface with adjacent construction, including roof membrane.

B. Shop Drawings:

1. Large scale, dimensioned Shop Drawings, showing fabrication and installation details. Indicate dimensions, weights, loading, required clearances, method of field assembly, and components.
2. Include plans, elevations, sections, details, and attachments to other work.

C. Samples: Provide samples with available manufacturer standard color for the Architect’s selection.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Type L by the Bilco Co., basis of design.
B. Acceptable manufactures include the following, provided the product meets or exceeds these specified requirements:

1. Babcock-Davis Hatchways, Inc.
2. J.L. Industries.

3. Lane-Aire Manufacturing Corp.
4. Or equal.

2.2 PERFORMANCE REQUIREMENTS

A. Design loads:

1. Hatch: Design, fabricate, and install so that the completed assembly will be weathertight when closed, will withstand dead and live loads caused by personnel and wind pressure and wind uplift Provide additional support and reinforcement to manufacturer standard assembly as required to conform to specified performance requirements.

    a. FM rating: Comply with insurance rating bureau requirements for class and securement rating (wind uplift resistance) of Factory Mutual (FM) Class I-90 requirements.
    b. Live load: 40 psf minimum.
    c. Concentrated load: 250 lb.
    d. Internal pressure: 20 psf.
    e. Design loads shall be supported without permanent deformation, or disengagement of seals or anchors.
    f. Hatch to be thermally broken.

2. Railing and gate: Design, fabricate, and install to comply with California Building Code and CALOSHA.

2.3 MATERIALS/CONSTRUCTION HATCH

A. Size: 30-inches by 96-inches.
B. Cover: 14-gage hot-dip galvanized steel with 3-inch beaded and welded flange, insulated with one-inch thick fiber glass insulation, and lined with a 22-gage galvanized steel liner.
C. Curb:

1. Fabricate curbs to minimum height of 12 inches above roofing surface unless otherwise indicated.
2. Fabricate from 14-gage hot-dip galvanized steel with integral flanges.
3. Continuously weld the curb at corners to insure watertightness.
4. Insulate the exterior face of the curb with one-inch thick rigid fiberboard or Perlite insulation.

D. Hardware: Assemble the hatch with heavy pintle hinges and compressive spring operators enclosed in telescopic tubes.

1. Provide positive snap latch with turn handles and padlock hasps inside and outside.
2. Equip cover with an automatic hold-open arm complete with vinyl grip handle for one hand release, and weatherstrip with neoprene draft seals.

E. Finishes:

1. Hardware: Zinc- or cadmium-plating standard with the manufacturer.
2. All other surfaces: Bonderized for paint adhesion and painted with manufacturer's standard rust-inhibitive primer followed by a powder coat finish of the color selected by the Architect from the manufacturer’s palette.

2.4 SAFETY POST

A. Provide Bilco "LadderUp" safety post or "Extend-A-Rail" (ER-1) by Precision Ladders, Ltd., or equal, complete with hardware and fasteners required for installation.

2.5 RAILING

A. Safety Railing System: Roof-hatch manufacturer's standard system including rails, clamps, fasteners, safety barrier at railing opening, and accessories required for a complete installation; attached to roof hatch and complying with 29 CFR 1910.23 requirements and authorities having jurisdiction.

1. Height: 42 inches above finished roof deck.
2. Posts and Rails: Galvanized-steel pipe, 1-1/4 inches in diameter or galvanized-steel tube, 1-5/8 inches (41 mm) in diameter.
3. Flat Bar: Galvanized steel, 2 inches high by 3/8 inch thick.
4. Maximum Opening Size: System constructed to prevent passage of a sphere 21 inches in diameter.
5. Chain Passway Barrier: Galvanized proof coil chain with quick link on fixed end.
6. Self-Latching Gate: Fabricated of same materials and rail spacing as safety railing system. Provide manufacturer's standard hinges and self-latching mechanism.
7. Post and Rail Tops and Ends: Weather resistant, closed or plugged with prefabricated end fittings.
8. Provide weep holes or another means to drain entrapped water in hollow sections of handrail and railing members.
9. Fabricate joints exposed to weather to be watertight.
10. Fasteners: Manufacturer's standard, finished to match railing system.
11. Finish: Manufacturer's standard.

a. Color: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine adjacent construction and supports.
B. Verify that opening is within allowable tolerances, plumb, level, will provide a solid anchoring surfaces.
C. Correct detrimental conditions before proceeding with installation.

3.2 INSTALLATION

A. Comply with the hatch manufacturer’s instructions.
B. Install the hatch over the opening, plumb, level and square.
C. Attach securely to supporting structure with a minimum of 2 bolts per side.
D. Mount railing securely to curbs in accordance with its manufacturer’s instructions; do not attach to, or on roof.
E. Verify operation of hatch cover and railing gate; adjust and lubricate the cover for ease of operation and watertightness where applicable.
F. Safety post:

1. Attach to the ladder side rails in accordance with the post manufacturer’s instructions.
2. Verify that post locks securely in “up” position.
3. Adjust and lubricate for smooth operation.

END OF SECTION

SECTION 07 84 00 – PENETRATION, JOINTS & PERIMETER FIRE BARRIERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes: firestop systems consisting of a material, or combination of materials installed to maintain the integrity of the fire-resistance rated construction by maintaining an effective barrier against the spread of flame, smoke, and hot gases through penetrations, blank openings, construction joints, or at the gap created at the building perimeter of the horizontal fire resistance rated assembly and non-fire-resistance rated exterior wall and in or adjacent to either fire-resistance or non-fire-resistance rated barriers in accordance with Authorities Having Jurisdiction (AHJ) requirements. Use firestop systems at locations including, but not limited to, the following:

1. Protected openings including both empty openings and openings that contain penetrations.
2. Penetrations through fire-resistance-rated wall assemblies including both empty openings and openings that contain penetrations.
3. Membrane penetrations in fire-resistance-rated wall assemblies where items penetrate one side of the barrier.
4. Joints in fire-resistance-rated assemblies that to allow independent movement.
5. Perimeter of the horizontal fire-resistance rated assembly and exterior wall between a rated floor/roof and an exterior wall assembly that is not fire-resistance rated.
6. Joints, through penetrations and membrane penetrations in Smoke Barriers, Smoke Partitions and those assemblies required to limit, restrict or retard the passage of smoke.

B. Related requirements: Divisions 07 and 09 for all other sealants.

1.2 REFERENCES

A. Comply with applicable requirements of the following standards. Where these standards conflict with other specified requirements, the most restrictive requirement governs.

1. American Society for Testing and Materials (ASTM).

    a. E 84 Test Method for Surface Burning Characteristics of Building Materials
    b. E 119 Test Method for Fire Tests of Building Construction and Materials
    c. E 136 Test Method for Behavior of Materials in a Vertical Tube Furnace at 750F
    d. E 814 Fire Tests of Through-Penetration Fire Stops
    e. E 1399 Cyclic Movement and Measuring Minimum and Maximum Joint Widths
    f. E 1966 Test Method for Resistance of Building Joint
    g. E 2174 Standard Practice for On-Site Inspection of Installed Fire Stops
    h. E 2393 Standard Practice for On-Site Inspection of Installed Fire Stop Joint Systems
    i. E 2307 Standard Test Method for Determining the Fire Endurance of Perimeter Fire Barrier Systems Using the Intermediate-Scale, Multi Story Test Apparatus (ISMA)
    j. E 2837 Standard Test Method for Determining the Fire Resistance of Continuity Head-of-Wall Joint Systems Installed Between Rated Wall Assemblies and Nonrated Horizontal Assemblies.

2. Factory Mutual (FM) Approvals:

    a. FM Approval Standard of Firestop Contractors – Class 4991
    b. FM Firestop Exam
    c. FM Approvals Standard for Firestops – Class 4990

3. Firestop Contractors International Association (FCIA):

    a. MOP – FCIA Firestop Manual of Practice
    b. FCIA Recommended Professional Practice RPP-L-2018-1, for the Identification of Fire-Resistance Rated and Smoke Resistant Penetration and Joint Firestopping
    c. International Accreditation Services: iAS Accreditation Criteria for Special Inspection Agencies AC-291.

4. International Firestop Council (IFC):

    a. Ref. 1 Recommended IFC Guidelines for Evaluating Firestop Engineering Judgments
    b. Ref. 2 Inspectors Field Pocket Guide
    c. Ref. 3 IFC Recommended Guidelines for Performing Destructive Testing for Installed Penetration Firestop Systems, Fire Resistive Joint Systems, or Perimeter Fire Barrier Systems.

5. National Fire Protection Association (NFPA):

    a. NFPA 1 – The Fire Code
    b. NFPA 70 - National Electric Code
    c. NFPA 101 - Life Safety Code
    d. NFPA 221 - Fire Walls and Fire Barriers (preliminary to be released)
    e. NFPA 251 - Fire Tests of Building Construction and Materials

6. Underwriters Laboratories, Inc. (UL):

    a. UL Qualified Firestop Contractor Program
    b. UL Firestop Exam
    c. UL 263 Fire Tests of Building Construction and Materials
    d. UL 723 Surface Burning Characteristics of Building Materials
    e. UL 1479 Fire-Tests of Through-Penetration Fire Stops
    f. UL 2079 Tests for Fire Resistance of Building Joint Systems

1.3 SUBMITTALS

A. Data: Manufacturer Product Data and installation instructions for materials and prefabricated devices.
B. Shop Drawings: Large scale Drawings indicating materials, installation methods, and interfaces with adjoining construction for each penetration firestop system.

    1. Include qualified testing and inspecting agency’s penetration firestop design designation evidencing compliance with requirements for each condition indicated.
    2. Include qualified testing and inspecting agency’s applicable illustrations showing each penetration firestop configuration at every construction assembly penetrated for each type of penetrating item.
    3. Where Project conditions require modification of qualified testing and inspecting agency's tested assembly to suit a particular penetration firestop condition, obtain acceptance of AHJ for the modification prior to submitting Shop Drawings.

C. Test reports: Certified laboratory test report demonstrating the material or combination of materials proposed for use meets the requirements specified in ASTM E 814, are so classified in UL Building Materials Directory and are approved by the AHJ.
D. Certificates: Product certificates signed by firestopping product manufacturers certifying their products comply with specified requirements.

E. Documentation

1. Provide details of installations, with Listed Systems and/or EJ/EFRRA's and locations on Life Safety Drawings for restoring the fire resistance rating or smoke resistant properties where a breach in an assembly occurs for a fire-resistance rated joint, penetration and/or safing slot, perimeter interior fire containment system.
2. Deliver such documentation as a binder, electronic or software application/program to the Architect at the end of construction.
3. Make this information part of the closeout documents.

1.4 QUALITY ASSURANCE

A. Uniformity: Obtain firestopping materials and components from a single manufacturer for each kind of penetration and construction condition indicated. Do not mix manufacturer's materials in the same assembly
B. Compatibility: Provide firestop systems compatible with one another, and with the assemblies into which they are installed.
C. Regulatory requirements: Materials proposed for use shall be approved by the AHJ for their intended use.
D. Installer's qualifications:

1. FM-approved in accordance with FM 4991 – Standard for the Approval of Firestop Contractors, or.
2. UL Qualified Firestop Contractor, and,
3. Firestop Contractors International Association Contractor Member in good standing.
4. Licensed by AHJ, where applicable.
5. Shown to have successfully completed not less than 5 comparable scale projects

E. Special Inspectors credentials: Special Inspectors with experience in the same type and complexity of work inspected. In addition, both with the competence and experience shall be acceptable to the AHJ.
F. Repairs: Provide a narrative that lists materials to be used and clearly explains repairs procedures to maintain the safing capabilities of the assemblies.

PART 2 - PRODUCTS

2.1 HANDLING

A. Store materials to prevent deterioration or damage.

2.2 SYSTEM PERFORMANCE REQUIREMENTS

A. Penetrations: Provide firestop products that when installed to the tested and listed system or engineering judgment (EJ)/equivalent fire-resistance rated assembly (EFRRA) to become firestop systems or EJ/EFRRA's produced to resist the spread of fire, and/or the passage of smoke through breaches, gaps, openings, in fire-resistance-rated and smoke-resistant assemblies according to requirements indicated, including but not limited to the following.

1. Firestop all breaches made in fire-resistance rated assemblies for penetrating items passing through fire-resistance-rated wall and floor assemblies and other locations as indicated on the Drawings.
2. Provide complete penetration firestopping systems tested and approved by a nationally recognized third-party testing agency to the listing and the manufacturers installation instructions.
3. F - Rated Through-Penetration Firestop Systems: Provide through-penetration firestop systems with F ratings indicated, as determined through testing in accordance with ASTM

E 814 or UL 1479, but not less than one hour or the no less than the fire-resistance rating of the construction assembly being penetrated by the penetrating item.

4. T - Rated Through-Penetration Firestop Systems: Provide firestop systems with T (temperature) ratings, in addition to F ratings, as determined per ASTM E 814 or UL 1479, where indicated and required by the applicable Building Code. T-rated assemblies are required where the following conditions exist.

    a. Where firestop systems protect floor penetrations located outside of wall cavities.
    b. Where firestop systems protect floor penetrations located outside fire-resistive shaft enclosures.
    c. Where firestop systems protect penetrations located in fire-resistive construction that have doors required to have a temperature-rise rating.
    d. Where firestop systems protect penetrating items larger than a 4-inch diameter nominal pipe or 16 square inches in overall cross-sectional area.

5. L – Rated Through-Penetration Firestop Systems: Provide firestop systems with Air Leakage (L) ratings, in addition to F and T ratings, as determined in accordance with UL 1479, where indicated.
6. Fire-resistive joint sealants: Provide joint sealants with a fire-resistance rating, determined in compliance with ASTM E 119, equaling or exceeding the fire-resistance rating of the construction penetrated but not less than one hour.

B. For firestopping exposed to view, traffic, moisture, or physical damage: Provide products that will not deteriorate when exposed to these conditions.

1. For plumbing and wet-pipe sprinkler system piping penetrations provide moisture-resistant penetration firestop systems.
2. For floor penetrations with annular spaces exceeding 4 inches or more in any dimension, and for penetrations exposed to possible loading and traffic: Provide penetration firestop system capable of supporting the floor load involved without damage to the firestop system.
3. For penetrations with insulated piping: Provide penetration firestop systems not requiring removal of piping insulation.

C. For firestop exposed to view: Provide products with a flame-spread rating of than 25 or less and a smoke-developed value of 450 or less, as determined in compliance with ASTM E 84.

2.3 MANUFACTURERS

A. Provide materials from one or a combination of the following, as selected by the installer, depending on the condition of use:

1. 3M Fire Protection Products.
2. Graber Construction Products.
3. Hilti Construction Chemicals, Inc.
4. STI Firestop.
5. Specified Technologies, Inc.
6. Tremco Inc.
7. Emseal Joint Systems Ltd.
8. Rectorseal/CSW Industrials

2.4 MATERIALS

A. Ceramic-fiber and mastic coating: Ceramic fibers in bulk form formulated for use with mastic coating, and ceramic fiber manufacturer's mastic coating.
B. Ceramic-fiber sealant: Single-component formulation of ceramic fibers and inorganic binders.
C. Endothermic, latex compound sealant: Single-component, endothermic, latex formulation.

D. Intumescent, latex sealant: Single-component, intumescent, latex formulation.
E. Intumescent putty: Non-hardening, dielectric, water-resistant putty containing no solvents, inorganic fibers, or silicone compounds.
F. Intumescent wrap strips: Single-component, elastomeric sheet with aluminum foil on one side.
G. Job-mixed vinyl compound: Prepackaged vinyl-based powder product for mixing with water at the Project site to produce a paintable compound, passing ASTM E 136, with flame-spread and smoke-developed ratings of zero per ASTM E 84.
H. Mortar: Prepackaged dry mix composed of a blend of inorganic binders, fillers, and lightweight aggregate formulated for mixing with water at the Project site to form a non-shrinking, homogenous mortar.
I. Pillows/bags: Re-usable, heat-expanding pillows/bags composed of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents and fire-retardant additives.
J. Silicone foam: 2-component, silicone-based liquid elastomer that, when mixed, expands and cures in place to produce a flexible, non-shrinking foam.
K. Silicone sealant: Moisture-curing, single-component, silicone-based, neutral-curing elastomeric sealant.
L. Solvent-release-curing intumescent sealant: Solvent release curing, single-component, synthetic polymer based sealant.
M. Color: Where firestopping/firesafing material is exposed to view, provide material color selected by the Architect from the manufacturer's palette, unless the material will be field painted.

2.5 ACCESSORIES

A. Provide accessories as required to install fill materials and complying with the system description above.

1. General: As specified by the firestopping manufacturer and approved by the qualified testing and inspecting agency for the designated fire-resistive assembly.
2. Permanent forming/damming/backing materials:

a. Semi-refractory fiber (mineral wool) insulation.
b. Ceramic fiber.
c. Sealants used in combination with other forming/damming materials to prevent leakage of fill materials in liquid state.
d. Fire-rated form board.
e. Joint fillers for joint sealants.

3. Temporary forming materials:

a. Substrate primers.
b. Collars.
c. Steel sleeves.

2.6 MIXING

A. For products that require field mixing prior to application, comply with firestopping manufacturer's directions.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions under which penetration firestop systems will be installed.
B. Verify that surfaces to be in contact with firestopping materials are clean of dirt, grease, oil, loose materials, rust, and other substances that may affect proper fitting or the required fire resistance.

C. Correct detrimental conditions before proceeding with installation.

3.2 INSTALLATION

A. General: Install materials in conformance with their manufacturer's instructions and to comply with UL Fire Resistance Directory.
B. Surface cleaning: Clean openings and joints immediately prior to installing firestopping in accordance with the recommendations of firestopping manufacturer and the following:

1. Remove foreign materials from surfaces of opening and joint substrates and from penetrating items that could interfere with adhesion of firestopping materials.
2. Clean opening and joint substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with firestopping. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form release agents from concrete.

C. Priming: Prime substrates where recommended by the firestopping manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.
D. Masking tape:

1. Use masking tape to prevent firestopping from contacting adjoining surfaces that will remain exposed and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from firestopping materials.
2. Remove tape as soon as it is possible to do so without disturbing firestopping's seal with substrates.

3.3 PENETRATION FIRESTOP SYSTEMS

A. Forming/damming materials and accessories:

1. Install as required to support fill materials during their application to produce the cross-sectional shapes and depths required to achieve fire ratings of firestop systems.
2. After installing fill materials, remove combustible forming materials and other accessories not indicated as permanent components of firestop systems.

B. Install fill materials for penetration firestop systems to produce the following results:

1. Completely fill voids and cavities formed by openings, forming materials, accessories, and penetrating items.
2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 FIRE-RESISTIVE JOINT SEALANTS

A. Install joint fillers to provide support of sealants during application, produce the cross sectional shapes and depths of installed sealants for optimum sealant movement capability, and develop fire-resistance rating required.
B. Install sealants so they will directly contact and fully wet joint substrates. Completely fill recesses provided for each joint configuration, and provide uniform, cross- sectional shapes and depths relative to joint width. Install sealants at the same time joint fillers are installed.
C. Tool non-sag sealants immediately after sealant application and before skinning or curing begins; form smooth, uniform beads. Eliminate air pockets to ensure contact and adhesion of sealants with sides of joint.

1. Remove excess sealant from surfaces adjacent to joint.

2. Do not use tooling agents that will discolor sealants or adjacent surfaces, or that are not approved by the sealant manufacturer.

3.5 FIELD QUALITY CONTROL

A. Examine penetration firestop systems to ensure proper installation prior to concealing or enclosing firesafed and firestopped areas.
B. Repair damaged areas and restore the integrity of the assembly.
C. Keep areas of work accessible until inspection and approval by applicable authorities having jurisdiction.

3.6 CLEANING

A. Cleanup spills of liquid components.
B. Cut and trim excess materials neatly, flush with adjacent surfaces.

3.7 ON SITE FIRESTOP IDENTIFICATION SYSTEMS:

A. Wall and floor identification system, shall be permanent, affixed, labels made that self-destruct upon removal, consisting of paper, metal or ceramic fiber materials, or hanging tags in accordance with CBC 703.7 and FCIA Recommended Professional Practice RPP-L-2018-1, for the Identification of Fire-Resistance Rated and Smoke Resistant Penetration and Joint Firestopping. The firestop system identification device shall be located within 6” of the firestop system edge, each side of the wall, accessible side of horizontal assemblies, in or out of view. Firestop identification systems shall be installed as each firestop system is completed. Firestop Identification system shall have the following minimum information:

1. The words – “Warning - Firestop System – Do Not Remove or Tamper”
2. UL or other laboratory tested and listed system number.
3. Date of Installation.
4. Installing subcontractor Company name, contact information.
5. Manufacturer Company Name
6. Installing Individual Identifier
7. Fire Resistance Rated Assembly Markings
8. Provide identification for all vertical fire resistance rated and smoke resistant assemblies.

    a. Identification markings: Adhesive tamper evident stickers, stencil painted with lettering at least 3 inches high with a minimum 3/8-inch stroke in contrasting color.
    b. Marking to incorporate the assembly’s fire-resistance rating and the type of assembly that the wall is. Examples below are from the IBC and NFPA:

        1) Fire Barrier – DO NOT BREACH - PROTECT ALL OPENINGS.
        2) Smoke Barrier – DO NOT BREACH - PROTECT ALL OPENINGS.
        3) Fire Wall – DO NOT BREACH - PROTECT ALL OPENINGS.
        4) Fire Partition – DO NOT BREACH - PROTECT ALL OPENINGS.
        5) Smoke Partition – DO NOT BREACH - PROTECT ALL OPENINGS.

END OF SECTION

SECTION 07 92 00 - JOINT SEALERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes requirements pertaining to all sealants required for the Project (except as specified below and becomes an integral part of all Sections containing references to this Section, as well as all locations where sealants are indicated on the Drawings and required to make the building weathertight.

B. Section also includes sealants for interior joints in vertical applications, where required to close gap between different materials (paintable and non-paintable), and horizontal traffic surfaces as follows:

1. Control and expansion joints on exposed interior surfaces of exterior walls.
2. Perimeter joints of exterior openings.
3. Joints between tops of non-load-bearing unit masonry walls and underside of cast-in-place concrete slabs and beams.
4. Tile control and expansion joints.
5. Vertical control joints on exposed surfaces of interior unit masonry and concrete walls and partitions.
6. Joints on underside of precast concrete beams and planks.
7. Perimeter joints between interior wall surfaces and frames of interior doors, windows, and elevator entrances.
8. Perimeter joints of toilet fixtures.
9. Other joints indicated.

C. In addition, the work of this Section also includes air sealing to supplement and provide continuity of main and primary air barrier assemblies, including sealing and/or filling perimeter of door and window openings, crevices, gaps, cracks in walls, roof/wall connections, mechanical and electrical penetrations in walls, floors, roofs, exterior glazed assemblies mullions, beams, columns enclosures and similar locations with foam to provide air barrier integrity and a permanent barrier against air infiltration and loss.

D. Section includes:

1. Exterior joints in vertical surfaces and non-traffic horizontal surfaces as indicated below:

   a. Control and expansion joints in cast-in-place concrete.
   b. Control and expansion joints in unit masonry.
   c. Control and expansion joints in Portland cement plaster.
   d. Joints between different materials listed above.
   e. Perimeter joints between materials listed above and frames of doors and glazed assemblies.
   f. Control and expansion joints in ceiling and overhead surfaces.
   g. Other joints as indicated and required to make the building weathertight.

2. Exterior joints in horizontal traffic surfaces as indicated below:

   a. Control, expansion, and isolation joints in cast-in-place concrete slabs.
   b. Tile control and expansion joints.
   c. Joints between different materials listed above.
   d. Other joints as indicated and required to make the building weathertight.

3. Interior joints in vertical surfaces and horizontal non-traffic surfaces as indicated below:

a. Control and expansion joints on exposed interior surfaces of exterior walls.
b. Perimeter joints of exterior openings where indicated.
c. Joints between tops of non-load-bearing unit masonry walls and underside of cast-in-place concrete slabs and beams.
d. Tile control and expansion joints.
e. Vertical control joints on exposed surfaces of interior unit masonry and concrete walls and partitions.
f. Perimeter joints between interior wall surfaces and frames of interior doors, windows, and elevator entrances.
g. Perimeter joints of toilet fixtures.
h. Other joints as indicated.

4. Interior joints in horizontal traffic surfaces as indicated below:

a. Control and expansion joints in cast-in-place concrete slabs.
b. Control and expansion joints in tile flooring.
c. Other joints as indicated.

E. Related requirements:

1. Division 03 for preformed compressible expansion joint fillers for concrete slabs.
2. Division 07 for firestopping sealants.
3. Division 08 for storefronts and glazing sealants.
4. Division 09 for acoustical sealants.
5. Division 23 for duct sealants.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Scheduling and sequencing:
B. Pre-installation meeting:

1. Prior to start of installation of exterior vertical sealants, arrange a pre-installation meeting between the sealant manufacturer authorized representative, the Contractor, the installer , and the Architect to review conditions of surfaces to be sealed, as well as other conditions that would affect the quality of this work, the Drawings and Specifications, and the sealant manufacturer’s data.
2. If more than one trade will be responsible for the successful performance of the work of this Section, these trades shall attend the meeting.
3. Review all typical and atypical details to verify the method of sealing joints that the Contractor will follow, as well as corrective actions that are required.
4. Special conditions not specifically referenced or addressed by the Project Drawings, manufacturer’s typical details, or the Shop Drawings, shall also be identified, reviewed and discussed.
5. Take photographs and notes of unresolved conditions, if any, along with sketches of the same unresolved conditions so that a determination can be made of actions to be taken to assure an installation that will be acceptable, watertight and acceptable to the sealant material manufacturer for issuance of the warranty.
6. Record meeting minutes and distribute PDF copy to all concerned, and the Architect, within 48 hours after the meeting.

1.3 DEFINITIONS

A. Substrates:

1. M type substrates: Concrete, concrete masonry units, brick, mortar, natural stone. The term "masonry" means brick, stone, and concrete masonry work.
2. G type substrates: Glass and transparent plastic glazing sheets.
3. A type substrates: Metals, porcelain, glazed tile, and smooth plastics.
4. O type substrates: Wood, unglazed tile; substrates not included under other categories.

1.4 SUBMITTALS

A. Data:

1. Manufacturer Product Data and published instructions for each type of sealant, backing, bond breaker, and other accessory materials, together with statement that the proposed materials comply with these Specifications.
2. Include manufacturers' recommendations for surface preparation and priming for all substrates to be in contact with sealant on the Project.

B. Certification: Sealant manufacturer certification that sealants, backing rods, and other materials proposed for use in the application of sealants, are chemically compatible with the materials which will come in contact with the sealants and will not cause deterioration, premature aging and staining of adjacent materials, or the sealants.

C. Test results: Results of adhesion and staining tests performed on same materials as those intended for use on the Project.

D. Samples: Cured Samples of the various types and colors of materials proposed for use, approximately 12 inches long, mounted on hardboard backing.

1.5 QUALITY ASSURANCE

A. Uniformity: All sealants used in or on the exterior walls of the building(**s**) shall be made by the same manufacturer.

B. Installer qualifications: Firm with a minimum 5 years of experience with joint sealant applications similar in material, design, and extent to that indicated for Project that have resulted in construction with a record of successful in-service performance.

C. Color selection:

1. Final color selection of sealants to be used for exterior locations will be made by the Architect from job-applied Samples on in-place materials.
2. The Architect will select locations and extent of these Samples, but their lengths will not exceed 10 feet for vertical and horizontal joints of each sealant color.

D. Quality control by sealant manufacturer:

1. Submit statements on the manufacturer's letterhead, dated no earlier than one year prior to submittal, for tests listed below.
2. Test data more than a year old will be acceptable provided manufacturer states that formulations or manufacturing methods have not changed sufficiently to change test results.
3. Submit Samples of materials to be used for the Project to the manufacturer as required for tests.

4. Test methods: The following ASTM standards methods apply to sealants to be provided for the Project.

    a. C 794: Sealant compatibility and adhesion to each substrate to be encountered on the Project.
    b. Compliance with C 920 for elastomeric sealants. Include test results for hardness, stain resistance, adhesion and cohesion under cyclic movement (ASTM C 719), low temperature flexibility, modulus of elasticity at 100 percent strain, effects of heat aging, and effects of accelerated weathering.
    c. C 1087: Sealant compatibility with backing.
    d. C 1087: Sealant compatibility and lack of adhesion to bond breaker.
    e. C 1184: Structural Glazing Specifications.
    f. C 1193: Guide for Use of Sealants.
    g. C 1247: Durability of sealants exposed to continuous water immersion.
    h. C 1248: Stain Test Method.
    i. C 1401: Guide for Structural Glazing.
    j. C 1472: Guide for Calculating Joint Movement.

5. Include identification of any special substrate cleaning process and required adhesion promoter or primer.

E. Preconstruction field testing: Prior to installation of joint sealants, field-test their adhesion to joint substrates as follows.

1. Locate test joints where indicated or, if not indicated, as directed by Architect.

    a. Each type of elastomeric sealant and joint substrate for exterior joints only.
    b. Each type of non-elastomeric sealant and joint substrate indicated.

2. Notify Architect one week in advance of the dates and times when mockups will be erected.
3. Arrange for tests to take place with joint sealant manufacturer's technical representative present.
4. Test method: Test joint sealants by hand pull method described below:

    a. Install joint sealants in 5-foot joint lengths using same materials and methods for joint preparation and joint sealant installation required for completed Work. Allow sealants to cure fully before testing.
    b. Make knife cuts horizontally from one side of joint to the other followed by 2 vertical cuts approximately 2 inches long at side of joint and meeting horizontal cut at top of 2-inch cuts. Place a mark one-inch from top of 2-inch piece.
    c. Use fingers to grasp a 2-inch piece of sealant just above one-inch mark; pull firmly down at a 90-degree angle or more while holding a ruler along side of sealant. Pull sealant out of joint to the distance recommended by sealant manufacturer for testing adhesive capability, but not less than that equaling specified maximum movement capability in extension; hold this position for 10 seconds.

5. Report whether or not sealant in joint connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each type of product and joint substrate.
6. Evaluation of field test results: Sealants not evidencing adhesive failure from testing, in absence of other indications of non-compliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

1.6 HANDLING

A. Store sealant containers in a protected location in compliance with their manufacturer's instructions until their use. Do not store at temperature higher than 80-degree F.

1.7 JOB CONDITIONS

A. Do not install sealants under adverse weather conditions, or when temperatures are beyond manufacturer's recommended limits.
B. Proceed with the installation only when forecasted weather conditions are favorable for proper sealant cure and development of early bond strength.

1.8 WARRANTY

A. Warrant sealants against defective materials and workmanship for the following length of time after Substantial completion:

1. Manufacturer:

a. Exterior vertical sealant: Manufacturer’s 20-year weatherseal warranty, including non-staining warranty for Dowsil 795 and 756 SMS.
b. All other exterior locations: Manufacturer’s 5 years weatherseal warranty.

2. Installer: 5 years labor and material warranty.

B. Warranty shall further state that installed sealants are warranted against the following:

1. Water leakage through exterior sealed joints.
2. Adhesive or cohesive failure of sealant.
3. Staining of adjacent surfaces caused by migration of sealants or primer.
4. Chalking or visible color change of the cured sealants.

C. Make repairs during the 5-year warranty period at no cost to the Owner.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Exterior joint sealants are required to establish and maintain airtight and waterproof continuous seals on a permanent basis, with recognized limitations of wear and aging as indicated for each application.
B. Sealant VOC limits shall conform to Table 5.504.4.2.of CALGreen, current edition.

2.2 MANUFACTURER/TYPE - SEALANTS

A. Colors: Match sealant color to color of adjacent materials as closely as possible using colors selected from the manufacturer's standard palette, as approved by the Architect.
B. General:

1. Do not mix multiple component materials until required for use.
2. Use materials “as received” from manufacturer, without additions, deletions and adulterations of materials.
3. Do not use sealants that have started to cure and those whose shelf life expired.

C. Compatibility: Provide joint sealers, joint fillers and other related materials as follows:

1. That will not cause staining, degradation and premature aging of the adjacent surfaces and the sealant itself, when in contact with these surfaces.
2. Compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.

D. Bulk sealants:

1. For interior slabs where heavy wheeled traffic will occur: One of the following.

   a. L&M:

      1) “Epoflex” (epoxy).
      2) “Joint Tite” (urea).

   b. Atlas “Epoxy Joint Filler.”
   c. Nox-Crete:

      1) “Dynaflex JF-85.”
      2) “High-Mod 602LD.”
      3) “Nox-Crete “Dynaflex 502.”

   d. VersaFlex, Inc.: SL Series (polyurea) as recommended by the manufacturer after surveying the conditions at the site.

2. For interior and exterior horizontal application subject to pedestrian or vehicular traffic: Single component silicone sealant.

   a. Type and grade: S (single component) SL (self-leveling).
   b. Class: 25.
   c. Use related to exposure: T (traffic).
   d. Uses related to joint substrates: M, A, and, as applicable to joint substrates indicated, O.
   e. Products:

      1) Dowsil; “888”” or “SL Parking Structure Sealant” (basis of design).
      2) Pecora Corp.; “300 SL Pavement Sealant.”
      3) Crafco Inc.; “RoadSaver Silicone SL.”

3. For all other exterior applications, except where stone occurs:

   a. Type and grade: S (single component) and NS (nonsag), neutral- and basic-curing silicone sealant.
   b. Class: 100/50.
   c. Use related to exposure: NT (non-traffic).
   d. Uses related to joint substrates: M, G, A, and, as applicable to joint substrates indicated, O.
   e. Products:

      1) Dowsil “795” (basis of design).
      2) General Electric “Silpruf,” “Silpruf LM,” “Silpruf NB.”
      3) Tremco “Spectrem 1.”

4. For stone joints where sealant will contact stonework (interior and exterior):

   a. Type and grade: S (single component) and NS (nonsag), neutral- and basic-curing silicone sealant.
   b. Class: 100/50.
   c. Use related to exposure: NT (non-traffic).

d. Uses related to joint substrates: M, G, A, and, as applicable to joint substrates indicated, O.
e. Products:

1) Dowsil “756 SMS,” (basis of design).

a) Dowsil “795” may be used if tested on stone prior to final installation and no staining is observed.

2) General Electric “GE SC S9000 SMS.”
3) Tremco “Spectrem 3.”
4) Pecora “895 NST.”

5. For interior damp, wet and semi-wet locations, other than floors, such as toilet rooms where a mildew-resistant sealant is required: Provide white sealant, unless otherwise noted. Single-component mildew-resistant neutral-curing silicone sealant:

a. Type and Grade: S (single component) and NS (nonsag).
b. Class: 25.
c. Use related to exposure: NT (non-traffic).
d. Uses related to joint substrates: M, G, A, and, as applicable to joint substrates indicated, O.
e. Products:

1) Dowsil. “786” basis of design.
2) Pecora Corp. “898.”
3) General Electric Corp. “1700.”

6. For all other interior applications (paintable sealant): Latex sealant complying with ASTM C 834, Type P, Grade NF.

a. Pecora Corp. “AC-20+.”
b. Schnee-Morehead, Inc. “SM 8200.”
c. Sonneborn, Division of ChemRex Inc. “Sonolac.”
d. Tremco “Tremflex 834” or “Acrylic Latex 384.”

7. Acoustical sealant: See Section 09 80 00.

E. Tape sealants: American Saint-Gobain “Norseal 730” or “Norseal 770,” or equal by Pres-On Tape & Gasket Corp. or Schnee-Morehead.

2.3 ACCESSORY MATERIALS

A. Sprayed polyurethane foam sealant: One- or 2-component, foamed-in-place, polyurethane foam sealant, 1.5 to 2.0 pcf density; flame spread index of 25 or less according to ASTM E 162; with primer and noncorrosive substrate cleaner recommended by foam sealant manufacturer.
B. Joint cleaner, primer and sealer: As recommended by the sealant manufacturer, for the surfaces to be cleaned, primed or sealed.
C. Bond breaker tape:

1. Polyethylene or other plastic tape recommended by the sealant manufacturer to prevent 3-sided adhesion where backer rod cannot be used, except for non-moving joints.
2. Use self-adhering tape wherever possible.

D. Backer rod:

1. General: Provide size, density and shape of rod which will control the joint depth for sealant placement, break bond of sealant at bottom of joint, form optimum shape of sealant bead on back, and provide a highly compressible backer to minimize the possibility of sealant extrusion when joint is compressed.
2. Type: ASTM C 1330, of type indicated below:

    a. Type C: Closed-cell material with a surface skin, Nomaco “SOF ROD/Dual Rod,” or equal.
    b. For sealant in vehicular traffic areas, provide solvent-resistant backer rods, Nomaco HBR/Green Rod, or equal.
    c. For fillet and cove joints, Nomaco “HBR” 1/4-inch Round.”

3. Elastomeric tubing sealant backings:

    a. Neoprene, butyl, EPDM, or silicone tubing complying with ASTM D 1056, non-absorbent to water and gas, and capable of remaining resilient at temperatures down to minus 26-degree F.
    b. Provide products with low compression set.

4. In paving subject to traffic: Provide hard joint filler such as cork; prevent 3-sided adhesion by using bond breaker tape.

E. Masking tape: Non-staining, non-absorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions and measurements affecting the work of this Section at site.
B. Correct detrimental conditions before proceeding with installation.

3.2 JOINT PREPARATION

A. Clean-out joints immediately before installing sealants to comply with recommendations of joint sealant manufacturer and the following.
B. Remove foreign material from joint substrates that could interfere with adhesion of sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer),oil, grease, waterproofing, water-repellents, water, surface dirt, and frost.
C. Clean concrete, masonry, unglazed surfaces of ceramic tile, and similar porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants.

    1. Remove loose particles remaining from above cleaning operations by vacuuming or blowing out joints with oil-free compressed air.

D. Remove laitance and form release agents from concrete.
E. Clean metal, glass glazed surfaces of ceramic tile, and other non-porous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.

F. Do not proceed with sealant installation over surfaces that have been painted, waterproofed or treated with water-repellent or other coating unless specifically approved in writing by the sealant manufacturer.
G. Use masking tape or other protection to limit coverage of sealant to joints to be sealed. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION

A. Comply with sealant manufacturer's instructions and ASTM C 1193, except where more stringent requirements are specified herein. At the Architect's option, ASTM C 1193 may also be used for rejection of unacceptable installations.
B. Prime or seal surfaces when recommended by the sealant manufacturer; when the manufacturer's instructions on priming are optional, prime the surface. Do not allow primer/sealer to spill or migrate onto adjacent surfaces.
C. Install backer rod for all sealants, except (1) for exterior sealants subject to traffic (verify that joint filler in paving is installed at the proper depth), (2) where the size of joint prevents the insertion of a backer rod, and (3) where recommended otherwise by the sealant manufacturer.

    1. Install backer rods with blunt or rounded tools to avoid puncturing the material.
    2. Do not twist, stretch or braid the backer rod.

D. Install bond breaker tape where space limitation does not permit use of a backer rod.
E. In no case shall sealant have 3-sided adhesion, except for non-moving joints.
F. Employ only proven installation techniques that will ensure that sealants are installed in uniform, continuous ribbons without gaps or air pockets and with complete "wetting" of the rabbet surfaces equally on opposite sides.

    1. Fill concave joints to the configuration shown on Figure 8A of ASTM C 1193.
    2. Provide flush joints to the configuration shown on Figure 8B of ASTM C 1193.
    3. Provide recessed joints configuration as shown on Figure 8C of ASTM C 1193, unless otherwise indicated or required to match adjacent non-moving joint.
    4. Where horizontal joints occur between horizontal and vertical surfaces, fill joints to form a slight cove to prevent trapping moisture and dirt.
    5. Immediately after sealant application and prior to beginning of skinning or curing, tool sealant using tooling agents that will not discolor sealants or adjacent surfaces and are approved by sealant manufacturer.

G. Do not allow sealant or other compound to overflow, spill or migrate into voids of adjacent construction.
H. Remove excess sealant spillage promptly as this work progresses. Clean adjacent surfaces by recommended means to remove sealant, but not damage the surfaces.

3.4 CURING/PROTECTING

A. Cure sealants in compliance with their manufacturer's instructions to obtain high early bond strength, internal cohesive strength and durability.
B. Protect sealants during and after curing period from contact with contaminating substances or from damage resulting from construction operations or other causes so that they are without deterioration or damage at time of Substantial Completion.

END OF SECTION

DIVISION 08
OPENINGS

SECTION 08 11 13 – HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Flush steel doors.
2. Stile and rail full louvered steel doors.
3. Transom panels.
4. Steel door and window frames, including sidelights and transom panels.
5. Louvers and vision panel frames in steel doors.

B. Work furnished but installed in other Sections: Division 04 for building-in of anchors and grouting of frames in masonry.
C. Work installed but furnished in other Sections: Division 08 for finish hardware.
D. Related requirements:

1. Division 08 for access panels and frames, glazing vision panels in steel doors, and glazing steel windows.
2. Division 09 for finish painting the work of this Section.
3. Division 14 for elevator doors and frames.

1.2 REFERENCES

A. SDI 117, Manufacturing Tolerances Standard Steel Doors and Frames.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Scheduling and sequencing:
B. Pre-installation meeting:

1.4 SUBMITTALS

A. Shop Drawings: Show the following.

1. Door and frame elevations, materials, construction, gage, finish, anchoring for each wall condition, conditions of openings, vision panel and louver sizes and locations, and accessories.
2. Location and size of reinforcement for finish hardware.
3. Locations of field splice joints, including associated details to assure proper assembly at Project site.
4. Identify work that cannot be permanently factory-assembled before shipment.
5. Details of removable stops, and glazing.
6. Details of conduit and preparations for power, signal, and control systems in doors and frames.
7. Use same reference numbers for openings and details as shown on Contract Drawings.

B. Schedule: Door schedule indicating opening identification symbol, door and frame types, sizes, including thickness, swing, label requirements, louvers, vision and transom panels, and undercuts.

C. Samples:

1. Twenty-four-inch square Sample of door illustrating typical head, bottom and jamb conditions, cutouts for hinge, lock/latch and magnetic contact, and vision panel centered in sample.
2. Frames showing profile, welded corner joint, welded hinge reinforcement, dust cover boxes, floor and wall anchors, and silencers. Include panel and louver sections and glazing stops where applicable.

D. Data: Manufacturer or fabricator Product Data for doors, frames and shop primer**,** and louvers.

1.5 QUALITY ASSURANCE

A. Uniformity: Provide all steel doors and frames for the Project made by a single firm, unless otherwise acceptable to the Architect.
B. Regulatory requirements:

1. Fire-rated doors shall be listed by a nationally recognized testing and certification agency acceptable to AHJ. The listed doors shall meet or exceed the requirements of UL10B, NFPA 252 and NFPA 80. Doors shall carry either a UL or ITS (Intertek Testing Services-Warnock Hersey) label.
2. Comply with CBC requirements. Provide tested products that passed, as an assembly, the CBC Standard 7-2 positive pressure smoke testing requirements.
3. Comply with ASTM E 2074, Standard Test Method for Fire Tests of Door Assemblies, Including Positive Pressure on Side-Hinged and Pivoted Swinging Door Assemblies.
4. Doors in exit enclosures shall bear an “S” label.

C. Oversize fire-rated door assemblies: For units exceeding sizes of tested assemblies, provide a label or a certificate of inspection, by a testing agency acceptable to AHJA, that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.

1.6 HANDLING

A. Procedure: In accordance with SDI recommendations.
B. Packing: Deliver doors and frames cardboard-wrapped or crated to provide protection during transit and job storage. Provide additional protection to prevent damage to finish of factory-finished doors and frames.
C. Delivery:

1. Inspect doors, frames, and accessories delivered to the site for damage. Unload and store, as specified, with a minimum of handling.
2. During delivery, provide temporary steel spreaders securely fastened to the bottom of each frame.
3. Replace doors and frames damaged before installation. Do not install damaged doors and frames.

D. Storage:

1. Store doors and frames carefully under cover. Provide a minimum of 1/2-inch space between doors. Do not stack doors and frames.
2. The storage spaces shall be dry and accessible, adequately ventilated and free from dust or water, and shall permit easy access for inspection and handling.
3. Do not use non-vented plastic or canvas shelters that create a humidity chamber.
4. If doors are shipped with fiberboard wrapper and it becomes wet, remove it immediately.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. One of the following, or equal:

1. Door Components, Inc.
2. CECO.
3. Curries Co.
4. Security Metal Products.
5. Steelcraft Manufacturing Co.
6. Stiles Hollow Metal.

2.2 MATERIALS

A. Cold rolled steel: ASTM A 1008, “Standard Specification for Steel Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability” and A 568, “Standard Specification for Steel Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for.”

B. Hot rolled, pickled and oiled steel: ASTM A 1011, “Standard Specification for Steel Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability” and A 568, “Standard Specification for Steel Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for.”

C. Hot dip zinc coated steel: Alloyed type complying with ASTM A 924, “Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process” and A 653, “Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.” The coating weight shall meet or exceed the minimum requirements for coatings having 0.4 oz/ft² total both sides, i.e., A40 (ZF120). Comply also with SDI-112 “Zinc-Coated (Galvanized/Galvannealed) Standard Steel Doors and Frames”.

1. When zinc-coated steel is specified for anchors and accessories, and electrolytically deposited zinc coated steel is provided, it shall comply with ASTM A 591, “Standard Specification for Steel Sheet, Electrolytic Zinc-Coated, for Light Coating Weight [Mass] Applications.” The minimum coating weight shall be a class “B”, i.e., 0.075 oz/ft².

    a. Coated steel sheets: ASTM A 653, QC classification, with a G60 or A60 zinc coating, mill-phosphatized.

2. Inserts, bolts and fasteners: Manufacturer standard units, except hot-dip galvanize all items in exterior walls.

D. Paints:

1. Shop primer: Rust-inhibitive enamel or paint, either air-drying or baking, suitable as a base for specified finish paints complying with ANSI A250.10, "Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames", and compatible with finish paint system specified in Section 09 90 00.
2. For touchup of damaged galvanized surfaces: SSPC Paint No. 20, Type II (Organic) zinc -rich primer by Tnemec, Porter International, Valspar Corp., Ameron Protective Coatings or DuPont Co.
3. For back-coating frames: 3M Undercoating Black 08881, or fibrous asphaltic compound.

E. Door filler: In compliance with SDI 250.8, except use UL-listed materials in fire-rated doors.

2.3 FABRICATION - GENERAL

A. Do not begin fabrication until the fabricator has received the hardware schedule approved by the Architect and submitted by the hardware supplier.
B. Fabricate work to required profiles by roll-forming, brake-forming and welding to produce hollow metal work with straight and square edges, with surfaces free from warp, wave, buckle, oil-canning and other defects.
C. Fabricate without grind marks, hollow or other out-of-plane areas, holes, burned-out spots, weld build-up and other defacing work. Fill to close cracks and to preserve shapes. Tightly fit loose stops, to hairline joints.
D. Comply with SDI 250.8 and SDI 117, Manufacturing Tolerances Standard Steel Doors and Frames, except for the following:

    1. 0.005-inch in 3-inch span anywhere on the exposed surfaces. Fill depressions with Bondo or other automotive type filler. Sand bumps down, flush with adjacent surfaces.

E. Conform to AWS standards for welding. Face weld frames with exposed welds ground flush and smooth with parent metal. Welded joints shall be invisible after assembly is painted.
F. Fabricate doors, frames and sidelights at the following locations from coated steel; garage, assemblies in exterior walls, toilet rooms and shower rooms. Elsewhere, fabricate doors and frames from coated or uncoated steel.
G. Finish hardware preparation:

    1. Prepare doors to receive finish hardware, including cutouts, reinforcement as specified below, mortising, drilling, and tapping in compliance with templates provided by hardware supplier.
    2. Reinforce doors to receive hardware; provide internal reinforcement of sufficient size to avoid the use of through bolts that are not permitted. Drilling and tapping for surface-applied hardware may be done at Project site.
    3. Provide 16-gage (0.053-inch) stainless steel reinforcement for pull plates and bars. Provide internal reinforcement for closers on all door frames. Thru bolts (Chicago fasteners) are not permitted.
    4. Locate finish hardware as accepted on final Shop Drawings.

H. Except on weatherstripped frames, drill stops to receive 3 silencers on strike jambs of single-door frames and 2 silencers on heads of double-door frames. Surface-applied (adhesively-applied) stops are not allowed.
I. Provide minimum 26-gage (0.0179-inch) steel plaster guards or mortar boxes at back of hardware cutouts where mortar or other materials might obstruct hardware operation and to close off interior of openings.
J. Steel members shall be pre-straightened, free of wind or twist. Factory-align to a diagonal tolerance of plus or minus 1/16-inch.

2.4 FLUSH DOORS

A. Standards: Comply with the following, except as specified. Note that the following applies to swinging doors; for sliding doors, assemble and finish the doors same as the swinging doors, except that the doors shall comply with Level 3 (Extra Heavy Duty, Performance Level A).

    1. SDI 250.8, Specifications for Standard Steel Doors and Frames (SDI-100).
    2. SDI 117, Manufacturing Tolerances for Standard Steel Doors and Frames.
    3. SDI 118, Basic Fire Door, Fire Door Frame, Transom/Sidelight Frame, and Window Frame Requirements.

B. Steel doors:

1. SDI Level 2 and Physical Performance Level 2 and Physical Performance level B (Heavy Duty), Model 2 (Seamless), 18-gage (0.042-inch) for doors up to 3-foot wide, and Level 3 and Level 3 Extra Heavy Duty, Performance Level A, model 2 (Seamless), 16-gage (0.053-inch) for doors wider than 3 feet Provide doors with seamless welded edges ground to be invisible from adjacent surfaces; do not use Bondo or similar material to close gap between face sheets at door edge.
2. Close the top and bottom of doors with an inverted flush channel, minimum thickness of 0.042-inch thick.
3. Close openings for vision panels and louvers with an inverted flush channel, minimum thickness of 0.042-inch thick.
4. Insulate exterior doors to provide a U factor of 0.24 BTU/hr. by square foot by degree F when tested in compliance with ASTM C 236.

2.5 STILE AND RAIL LOUVERED DOORS

A. Standard: Complying with SDI 250.8, Recommended Specifications Standard Steel Doors and Frames, Level 3 (Extra Heavy Duty, Performance Level A), except as specified.
B. Stiles and rails:

1. Minimum 16[14]-gage galvanized steel.
2. Miter or butt door corners.
3. Internally-reinforce joints, then weld and grind smooth so that joints are invisible after painting.
4. Intermediate rails shall be butted and internally welded to door stiles.
5. Hardware reinforcements shall be specified in table 4 of table 5 of SDI 250.8.

C. Louver blades:

1. Not less than 18-gage galvanized steel sheet formed into stationary; weatherproof Zee shaped blades and U-shaped frames, not less than 1-3/8-inch thick.
2. Space louver blades not more than 1-1/2-inch o.c.
3. Assemble by welding continuously all joints and grinding welds so they will be invisible when the door is painted.
4. Provide removable insect screens on interior side of frame, consisting of 14 by 18 aluminum wire mesh in rigid, formed metal frame.

2.6 FRAMES

A. General:

1. Fabricate frames to the dimensions and profiles indicated in compliance with SDI 250.8, Specifications for Standard Steel Doors and Frames (SDI-100), except as noted.
2. Reinforce and miter corners, interlock and/or weld internally. Weld faces continuously and grind smooth.

B. Stand alone door frames: Fabricate with coped or mitered, fully welded corners of steel 2-gage heavier than door face in same opening, minimum 16-gage (0.053-inch), corners reinforced, mitered, interlocked and/or welded, and visible joints continuously welded and ground smooth; non-welded joints visible in the finish work are not permitted.
C. Integral windows, glazed transom panels, and sidelights frames: For door frames with integral sidelights and transom panels, fabricate of same gage as the door frame.
D. Stand alone window frames: Fabricate of 18-gage (0.042-inch) steel.

E. Windows and glazed sidelights and transom panels: Provide integrally-formed glass stops on security side of glazed assemblies, and removable glass stops on opposite side.

1. Size rabbet to fit glass thickness indicated.
2. Miter glass stop corners; square, butt joints are unacceptable.
3. Attach removable glass stops securely with countersunk oval head machine screws spaced equally and symmetrically at not more than 12 inches o.c. and 2 inches from corners.

F. Mullions and transom bars:

1. Closed or tubular mullions and transom bars where indicated.
2. Join mullions and transom bars at crossings and to jambs by butt-welding.
3. Reinforce joints between frame members with concealed clip angles or sleeves of same metal and thickness as frame.
4. Provide false head member to receive lower ceiling where frames extend to finish ceilings of different heights.

2.7 DOOR LOUVERS

A. V, Y or Z shaped louver blades formed of 18-gage (0.042-inch) sheet steel welded to surrounding frame set flush with both sides of doors, by Air Louvers, Inc., Airolite Co., Anemostat Products Div/Dynamics Corp. of America, or Ventilouver Co. Provide same shape louver blade (V, Y or Z) throughout the Project.
B. When installed in fire-rated doors provide UL labeled, spring-actuated louver blades activated by a fusible link, or Zero International “Advantage Intumescent AI” louvers.

2.8 VISION PANELS IN DOORS

A. Make cutouts for vision panels square and parallel with door edges.
B. Provide integrally-formed glass stops on security side of doors and removable glass stops on opposite side.

1. Size rabbet to fit glass thickness indicated.
2. Miter glass stop corners; square, butt joints are unacceptable.
3. Attach removable glass stops securely in place with countersunk oval head machine screws spaced equally at not more than 12 inches o.c. and 2 inches from corners.

2.9 WINDOWS AND SIDELIGHT FRAMES

A. Fabricate as specified for door frames.

2.10 FLUSH TRANSOM PANELS

A. Clearly mark door and associated transom panel to assist in installation.
B. Fabricate as specified for door in same opening, except for hardware blocking and preparation.
C. No visible fasteners allowed when panel is in place.

2.11 SHOP PRIMING

A. After assembly, clean and prepare steel surfaces by removing mill scale, rust, oil, grease, dirt, and other foreign materials before painting. For coated steel, comply with ASTM D 2092 and the primer manufacturer’s instructions.

1. Grind welds and fabrication marks flush and smooth with parent metal.
2. Fill depressions with metal filler before applying the shop primer.

3. Apply one or more coats of epoxy mineral filler to conceal spot welds.
4. Where zinc coating is damaged, touchup with zinc-rich primer.

B. Acid-etch galvanized surfaces before pretreating.
C. Apply shop primer, within time limits recommended by pretreatment manufacturer, to provide a smooth coat of even consistency and to produce a dry film thickness of not less than 1-1/2 mils.
D. Assemblies with visible spot welds before or after application of finish paint will be unacceptable.

2.12 BACK COATING FRAMES

A. For frames installed in concrete and CMU openings, and frames in contact with plaster, factory-coat surfaces that will be concealed after installation with the back-coating material specified applied in a uniform thickness, without holidays.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine adjacent construction and supports.
B. Verify that openings are within allowable tolerances, plumb, level, clean, and will provide a solid anchoring surface for frames.
C. Correct detrimental conditions before proceeding with installation.

3.2 INSTALLING FRAMES

A. Set frames accurately in their scheduled locations, plumb, straight, square and rigid.

1. Comply with these Specifications, the Drawings; ANSI/SDI A250.11, Recommended Erection Instructions for Steel Frames, the approved Shop Drawings and UL tested procedures and NFPA 80 for fire-rated openings. When in conflict, the most restrictive provision applies.
2. Brace frames to prevent their displacement during erection of adjacent walls.
3. Coordinate the installation of built-in anchors for wall and partition construction with related trades. Refer to Division 04 for frames in CMU walls.
4. Provide 2 anchors at head of frames exceeding 42 inches in width for frames mounted in steel stud walls.
5. Provide 3/8-inch by 2-inch vertical steel struts extending from top of frame at each jamb to supporting construction above, unless frame is anchored to masonry, continuous boxed studs, or to other structural support at each jamb.

    a. Bend top of struts to provide flush contact for securing to supporting construction above.
    b. Provide adjustable wedged or bolted anchorage to frame jamb members in compliance with UL 63.

B. Frame anchors: 18-gage (0.0478-inch) galvanized steel.

1. CMU construction: Adjustable, flat, corrugated, or perforated, Tee-shaped to suit frame size, with leg not less than 2 inches wide by 10 inches long. Provide at least 3 anchors per jamb up to 7 feet high; 4 anchors up to 8 feet height; one additional anchor for each 24 inches or fraction thereof over 8-foot high.
2. Stud partitions: Insert “nail-on” type with notched clip to engage stud, welded to back of frames. Provide at least 4 anchors for each jamb for frames up to 90 inches high; 5 anchors up to 96 inches high; one additional anchor each 24 inches or fraction thereof

over 96 inches. Attach jamb anchors to studs with a minimum of four 3/8-inch diameter self-tapping screws or bolts (2 per side).

3. In-place concrete or CMU: Anchor frame jambs with minimum 3/8-inch concealed bolts into expansion shields or inserts at 6 inches from top and bottom and 26 inches o.c., unless otherwise shown. Reinforce frames at anchor locations. Except for fire-rated openings, apply removable stop to cover anchor bolts unless otherwise indicated.

C. Provide UL-tested adjustable floor clips for all frames. Anchor clips to floor with powder-driven pins or bolts in expansion shields.
D. Leave frame spreader bars intact, wherever possible, until frames are set perfectly square and plumb and all anchors are securely attached and grouted where required.
E. Installation tolerances: Adjust door frames for squareness, alignment, twist, and plumb to the following tolerances:

1. Squareness: Plus or minus 1/16-inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
2. Alignment: Plus or minus 1/16-inch, measured at jambs on a horizontal line parallel to plane of wall.
3. Twist: Plus or minus 1/16-inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
4. Plumbness: Plus or minus 1/16-inch, measured at jambs at floor.

3.3 HANGING DOORS

A. Install finish hardware in compliance with its manufacturer's templates and instructions.
B. Hang doors in compliance with their manufacturer's instructions, and adjust to the clearances specified in SDI 250.8, except as specified below, as indicated on the Drawings, or as required by UL listing and NFPA 80 for fire-rated doors.
C. Do not install doors warped, bowed, dented or otherwise damaged.
D. Adjust hardware so that doors operate freely for their entire travel, but not loosely, without sticking or hinge binding, with hardware adjusted and functioning properly.
E. Fit doors accurately in frames, within clearances specified below. Shim as necessary.

1. Non-fire-rated standard steel doors:

a. Jambs and head: 1/8-inch plus or minus 1/16-inch.
b. Between edges of pairs of doors: 1/8-inch plus or minus 1/16-inch.
c. Between bottom of door and top of threshold: Maximum 3/8-inch.
d. Between bottom of door and top of finish floor (no threshold): Maximum 3/4-inch.

2. Fire-rated doors: Install doors with clearances as required by UL listing and complying with NFPA 80.
3. Smoke-control doors: Install doors according to NFPA 105.

F. Glazing:

1. Comply with installation requirements in Section 08 80 00 and with standard steel door and frame manufacturer's instructions.
2. Secure stops with countersunk flat- or oval-head machine screws spaced equally and symmetrically not more than 8 inches o.c., and not more than 2 inches from each corner.

3.4 TOUCHUP

A. Clean damaged primer, sand smooth, re-clean and spot-prime with paint compatible with the primer and the scheduled finish coats.

B. Before application of primer, touchup galvanized surfaces with zinc-rich coating where zinc coating is removed or damaged.

END OF SECTION

SECTION 08 14 16 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Flush wood doors.
2. Louvers and vision panel frames in wood doors.

B. Work installed but furnished in other Sections: Division 08 for finish hardware.
C. Related requirements:

1. Section 09 90 00 for finish painting wood doors schedule to receive an opaque finish.

1.2 SUBMITTALS

A. Shop Drawings:

1. Door schedule indicating opening identifying number, door type, grade, size, thickness, swing, label requirements, and undercuts.
2. Door elevations indicating hand of each door, and type of construction
3. Prefitting and premachining requirements, including dimensions and locations of mortises and holes for hardware.
4. Rating for fire-rated doors.
5. Use same reference numbers for openings and details as Contract Drawings.

B. Data: Manufacturer Product Data for the finish system.
C. Certificate: Manufacturer’s certificate showing door compliance with these Specifications and the AWI.
D. Warranty: Warranty form from the door manufacturer.

1.3 QUALITY ASSURANCE

A. Regulatory requirements:

1. Fire rated doors shall be listed by a nationally recognized testing and certification agency acceptable to authorities having jurisdiction. The listed doors shall meet or exceed the requirements of UL10B, NFPA 252 and NFPA 80. Doors requiring fire-rating shall carry either a UL or ITS (Intertek Testing Services-Warnock Hersey) label.
2. Comply with CBC requirements. Provide tested products that have passed as an assembly in compliance with CBC Standard 7-2 positive pressure smoke testing requirements.
3. Comply with ASTM E 2074, Standard Test Method for Fire Tests of Door Assemblies, Including Positive Pressure on Side-Hinged and Pivoted Swinging Door Assemblies.

B. Uniformity: the same manufacturer shall make all flush wood doors for the Project.

1.4 HANDLING

A. Procedure: In accordance with WI Bulletin No. 416-R and Recommended Handling and Finishing Instructions for Wood Fire Doors.
B. Marking: Mark each door on top and bottom rail with opening number used on Shop Drawings.

C. Delivery:

1. Deliver prefinished doors factory-wrapped in polyethylene bags, unitized and palletized. Shrink-wrap each pallet and provide corner guards for protection.
2. Mark each door with architectural opening number in distribution and installation.
3. Do not deliver doors to the Project until proper storage space is available.

D. Storage:

1. Store doors in an assigned space having controlled temperature and humidity as recommended by WI.
2. Store doors flat on factory pallets.
3. Protect doors from construction activity and store away from direct sunlight.

E. Handling:

1. Handle doors with clean hands, except that doors to receive a transparent finish shall be handled with clean white gloves.
2. Do not drag doors across one another.
3. When provided, maintain factory packaging or other means of protection of doors until Substantial Completion.

1.5 JOB CONDITIONS

A. Do not deliver or install doors until conditions for temperature and relative humidity have been stabilized and will be maintained in storage and installation areas during remainder of construction period.
B. Comply with referenced WI quality standard including Technical Bulletin 419 for moisture content and relative humidity.

1.6 WARRANTY

A. Special warranty:

1. Furnish to the Owner the door manufacturer written warranty against doors delaminating, telegraphing core through face veneer and against non-conformance with tolerance limitations of referenced quality standards for life of the installation 5 years after installation.
2. Include reinstallation that may be required due to repair or replacement of defective doors, during the warranty period, when defect was not apparent prior to hanging.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. One of the following, or equal:

1. Eggers Industries.
2. Marshfield-Algoma Door Systems by Masonite Architectural.
3. Haley Brothers, Inc.
4. VT Industries.
5. Western Oregon Doors.
6. Or equal.

2.2 DOORS

A. Flush wood doors - general: The following complying with AWS “Heavy Duty” “Extra Heavy Duty” classification.

B. Non-rated doors:

1. Grade: Premium.

2. Wood veneer for doors scheduled to receive a transparent finish:

a. Specie: TBD.
b. Face veneer grade:
c. “A” Grade.
d. Face veneer match: Bookmatch.
e. Face veneer assembly: Center balance.

3. Face veneer for doors scheduled to receive an opaque finish:

a. Medium density overlay (**MDO**).
b. Close grained Maple, Birch or other close-grain hardwood; no horizontal joints.

C. Labeled, flush, fire-rated doors complying with Code as follows. Provide concealed (built-in blockings) for all hardware; thru bolting (Chicago fasteners) are not acceptable.

1. Model: FD *.

2. Grade: Premium.
3. Face: As scheduled and specified for non-rated doors above.
4. Fire seals: Category A
5. Rating: As scheduled.

2.3 FACTORY-MACHINING/FINISHING

A. Factory-machine doors by manufacturer or qualified distributor for cutouts, hinges, louvers, vision panels, locks and all hardware requiring routing or mortising.

1. When machining labeled doors comply with UL 10C and use caution to avoid voiding the manufacturer warranty.
2. Refer to Article 3.2 below for door clearances.

B. Prepare doors to receive finish hardware as follows:

1. Pilot drill screw and bolt holes.
2. Rout-out hinge locations.
3. Bore accurately for locks and latches.
4. Locate hardware where indicated on the Drawings as specified for steel doors in Section 08 11 13.

C. Factory-finish doors scheduled to receive a transparent finish to match Architect’s control sample. Comply with WDMA TR-6 or OP-6 Catalyzed Polyurethane.

D. Factory-finish all faces and edges of doors to receive an opaque finish. Use painting system equivalent to WI North America Architectural Woodwork Standards section 5, Custom Grade System 2 “Water Reducible Acrylic Lacquer.

EXECUTION

2.4 EXAMINATION

A. Examine frames, adjacent construction and supports.
B. Verify that openings are within allowable tolerances, plumb, level, clean, will provide a solid anchoring surface.
C. Correct detrimental conditions before proceeding with installation.

2.5 INSTALLING FINISH HARDWARE/HANGING DOORS

A. Install finish hardware in compliance with its manufacturer's instructions and the requirements of Section 08 71 00. Fit accurately to doors.
B. Condition doors to average prevailing humidity in installation area prior to hanging.
C. Factory-fit doors to suit frame opening sizes indicated, with uniform clearances and bevels. Comply with clearance requirements of referenced quality standard for fitting. Comply with requirements in NFPA 80 for labeled doors.

1. Trim non-fire rated doors by cutting equally at both edges
2. Trim door height by cutting bottom edge, maximum 3/4-inch; trim fire rated doors at bottom edges only, in accordance with fire rating requirements

D. Hang doors to operate freely for their entire travel, but not loosely, without sticking or hinge binding, with all hardware adjusted and functioning properly.

2.6 REPLACING DAMAGED DOORS

A. Replace doors showing chips, scratches, unbonded face veneers, glue stains, excessive warp or other damage that cannot be satisfactorily repaired, as determined by the Architect, with acceptable doors.

END OF SECTION

SECTION 08 32 13 - ALUMINUM-FRAMED SLIDING GLASS DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Sliding glass doors complete with hardware.
2. Glass and glazing for the work of this Section.

B. Related requirements: All other exterior glass assemblies and door hardware.

1.2 SUBMITTALS

A. Data: Manufacturer Product Data for doors, including the following.

1. Construction details and fabrication methods.
2. Profiles and dimensions of individual components.
3. Data on hardware, accessories, and finishes.
4. Energy Model Submissions

    a. Provide a copy of the project ENV-1 form.
    b. Provide evidence that the proposed products can meet or exceed the energy values listed on the ENV-1 form. Preferred method is an NFRC site certificate, but a simulation report by an independent NFRC certified simulator will be considered. AAMA test reports and or simulations will not be accepted as they are not allowed under the current code.
    c. Provide a statement of who will be the “responsible party” in issuing the NFRC site certificates.

B. Shop Drawings: Large scale dimensioned Drawings: Include information not fully detailed in manufacturer's standard Product Data and the following.

1. Layout and installation details, including anchors.
2. Elevations of units at 3/4-inch scale.
3. Full-size section details of typical composite members, including reinforcement.
4. Hardware, including operators.
5. Glazing details.
6. Accessories.

C. Samples: 12-inch long sections of door frame with specified finish. Where finish involves normal color variations, include sample sets showing the full range of variations expected.

D. Certification:

1. Certification by a recognized independent testing laboratory or agency showing that each type, grade, and size of unit complies with performance requirements indicated.
2. Where reports are not available, engage a recognized independent testing laboratory or agency to perform tests specified. Provide certified test results showing that unit complies with performance requirements indicated.

E. Closeout: Recommendations for maintenance and cleaning of surfaces.

1.3 QUALITY ASSURANCE

A. Installer qualifications: Firm who has completed installation of sliding glass doors similar in design and extent to those required for the Project and whose work has resulted in construction with a record of successful in-service performance.
B. Standards: Requirements for doors, terminology and standards of performance, and fabrication workmanship are those specified and recommended in AAMA 101 and applicable general recommendations published by AAMA.
C. Single source responsibility: Provide all sliding aluminum doors from one source and produced by a single manufacturer.

1.4 HANDLING

A. Transport, store and handle assemblies to prevent damage. Store off the floor in a protected location.

PART 2 - PRODUCTS

2.1 MANUFACTURER/TYPE

A. Design is based on the following:

1. Arcadia, Inc. ULT5920 thermal, Multi-Sliding Doors (basis of design).

B. Acceptable manufacturers: Provide either the product identified as "Basis of Design" or an equivalent product of another manufacturer

1. For any product not identified as "Basis of Design", submit information as specified for substitutions.
2. Substitution may or may not be accepted after Architect and District review with complete evaluation for content and schedule impact.
3. Substitutions shall include all costs for redesign with consequential changes by other trades along with the Architect and related approvals by governing agencies.

a. Revision to shop drawings illustrating changes is not considered adequate for DSA review and approval.

4. Substitutions may be acceptable, based on Architect's review and approval, for submittal to DSA.

a. If substituted manufacturer cannot reproduce design and DSA approval in a timely manner, then they shall be subject to a time and material back charge for any delays in the project.
b. Architect approval is required prior to DSA submittal and DSA approval is required prior to installation.

2.2 PERFORMANCE REQUIREMENTS

A. General: Provide doors that comply with performance requirements specified, as demonstrated by testing manufacturer's corresponding stock systems according to test methods indicated.
B. Design requirements:

1. Comply with structural performance, air infiltration, and water penetration requirements indicated in AAMA 101 SGD-R15.
2. Comply with Code for design wind velocity at the Project site as indicated.

2.3 MATERIALS

A. Windows & doors fabricated from aluminum extrusions of 6063-T5 alloy and temper with a minimum wall thickness of 0.090" for the door frame sill member and a minimum of 0.072" for all other members including frame, panel and optional horizontal muntins. The aluminum shall be free of defects which impair strength and appearance.
B. Component parts and accessories shall be of aluminum alloy, stainless steel or non-metallic materials which will neither deteriorate nor promote corrosion.
C. Thermal break barrier shall provide a continuous uninterrupted thermal separation around the entire perimeter of the panel only which shall consist of a two-part, chemically curing, high-strength urethane.
D. Sill shall have a full-length nylon track cap.
E. Panel members shall have a minimum of 5/8" glass penetration into the aluminum.
F. Operable panel shall be equipped with two adjustable steel tandem ball bearing rollers (all stainless-steel tandem rollers and housings optional).
G. Locking device Adams-Rite maximum security lock MS+1850 with stainless steel hook bolt standard. Multi-slider doors & windows including all pocket windows can be supplied with locking flush pulls and an Adams-Rite MS+1847 stainless steel mortise lock-optional.
H. Operating panels shall have an extruded 3/4" diameter - 8" O.C. aluminum wire pull handle set in either clear or black architect finish - other colors available.
I. Operating panels shall contain a bottom rail vinyl sweep.
J. Horizontal members shall have two contact points incorporating silicone treated woven pile with mylar center fins. All vertical members shall have four contact points of silicone treated woven pile with mylar center fins. All shall be held in integral extruded slots and secured to prevent movement or loss while operating sash.
K. Fixed and/or sliding panels shall be constructed to allow for either factory or field glazing. Panel glazing shall be accomplished using a "marine" style reusable, wraparound black flexible PVC or EPDM material per commercial standard CS23060 without the need for separate glazing beads or putty style bedding compounds. The glazing channel shall be provided with the unit for either 1" insulating glass or 3/16" or 1/4" single glazing.
L. All assembly and installation screws shall be 18-8 or 410 stainless steel.
M. Fasteners: Aluminum, non-magnetic stainless steel, epoxy adhesive, or other materials warranted by the manufacturer to be non-corrosive and compatible with aluminum members, trim, hardware, anchors, and other components of units.

    1. Reinforcement: Where fasteners screw-anchor into aluminum less than 0.125-inch thick, reinforce the interior with aluminum or non-magnetic stainless steel to receive screw threads, or provide standard non-corrosive pressed-in splined grommet nuts.
    2. Exposed fasteners: Except where unavoidable for application of hardware, do not use exposed fasteners. For the application of hardware, use fasteners that match the finish of member or hardware being fastened.

        a. Provide Phillips flat-head machine screws for exposed fasteners.

N. Anchors, clips, and accessories: Fabricate of aluminum, non-magnetic stainless steel, hot-dip zinc-coated steel or iron, complying with the requirements of ASTM B 633; provide sufficient strength to withstand design pressure indicated.
O. Compression weatherstripping: Manufacturer's standard replaceable compressible weatherstripping gaskets of molded neoprene complying with ASTM D 2000 or molded PVC complying with ASTM D 2287.
P. Sliding weatherstripping: Manufacturer's standard replaceable weatherstripping of wool, polypropylene, or nylon woven pile, with nylon fabric or aluminum strip backing, complying with AAMA 701.2.
Q. Glass and glazing materials: As indicated and specified in Section 08 80 00.

R. Sealants and back-up rods:

1. Within assemblies: Manufacturer's standard non-drying, non-skinning sealant complying with AAMA 809.2.
2. Between assemblies and adjacent materials: As specified in Section 07 92 00.
3. Glazing sealants: Refer to Section 08 80 00.

S. Glazing gaskets: Manufacturer standard black gaskets.
T. Hardware: Manufacturer standard hardware fabricated from aluminum, stainless steel, or other corrosion-resistant material compatible with aluminum and of sufficient strength to perform the function for which it is intended.

2.4 FABRICATION

A. Primary frame must be a minimum of 2" deep per panel required.
B. Frame sections interlock together to form any number of repetitious sections, each capable of accommodating a panel.
C. Each frame corner joint shall be secured with two stainless steel screws.
D. Profile of the fixed jamb and the latching jamb shall include two weather-stripped pockets to receive the fixed and latching stiles.
E. Fixed and sliding panels shall have a nominal 1-1/2" depth and shall have overlapped joints of the mortise type to provide extra strength and interlocking mechanically fastened hairline joints.
F. Interlocks and latching stiles shall be heavy gauge tubular sections assuring precise alignment and to resist twisting under load conditions.
G. Glazing: Factory-glaze doors. Comply with glass manufacturer's recommendations and requirements of Section 08 80 00.

2.5 FINISH:

A. PPG Duranar® 70% PVDF Solid Extrusion Coatings in accordance with AAMA 2605.

1. Color: See Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine adjacent construction and supports.
B. Verify that openings are within allowable tolerances, plumb, level, clean, will provide a solid anchoring surface.
C. Correct detrimental conditions before proceeding with installation.

3.2 INSTALLATION

A. Install in accordance with approved shop drawings and manufacturers installation instructions.
B. Do not install components that are bowed, dented, abraded, broken or otherwise defective.
C. Install doors level, plumb, square and with tight fitting joints. Attach to supporting construction with non-staining and non-corrosive shims, anchors, fasteners and spacers.
D. Install sills in a full bed of sealant.
E. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials by complying with the requirements specified under "Dissimilar Materials" in the Appendix to AAMA 101.
F. Provide all accessories such as fasteners, sealants and concealed anchorage needed for a complete, weatherproof installation.

3.3 ADJUSTING

A. Adjust operating panels, and hardware to provide a tight fit at contact points and weatherstripping for smooth operation and weathertight closure.
B. Weatherstrips shall not bind or prevent sash or ventilator from closing easily and tight with weathertight contact between metal.
C. Lubricate hardware and moving parts.

3.4 FIELD QUALITY CONTROL & CLEANING

A. Clean aluminum surfaces immediately after installing sliding aluminum-framed glass doors. Avoid damaging finish.
B. Remove protective coating and excess glazing and sealants, dirt, and other substances.
C. Clean glass immediately after installing doors. Comply with manufacturer's recommendations for final cleaning and maintenance. Remove nonpermanent labels from glass surfaces.
D. Remove and replace glass broken, chipped, cracked, abraded, or damaged during the construction period.

END OF SECTION

SECTION 08 33 23 - OVERHEAD COILING DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes power-operated coiling doors complete with Pass door, hardware, operators and accessories.
B. Work installed but furnished in other Sections: Division 08 for lock cylinders.
C. Related requirements:

1. Division 09 for finish painting doors.
2. Division 26 for power and disconnect switch for door motors, and conduits between motors and controls.
3. Division 28 for security system.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Pre-installation meeting:

1.3 SUBMITTALS

A. Data: Manufacturer Product Data, including specifications, roughing-in diagrams, and installation instructions.
B. Shop Drawings:

1. For special components and installation conditions not fully dimensioned or detailed on manufacturer's data sheets.
2. Show attachment details to support and interface with adjacent construction.

C. Wiring diagrams: Detail wiring for power, signal, and control systems. Differentiate between manufacturer-installed and field-installed wiring and between components provided by door manufacturer and those provided by other trades.
D. Samples: 12-inch long Samples of slat.
E. Installer’s certificates: Signed by manufacturer certifying that installer complies with specified requirements.
F. Closeout submittals: Operating and maintenance instructions for the door.

1.4 QUALITY ASSURANCE

A. Installer qualifications: Manufacturer authorized representative trained and approved for both installation and maintenance of units required for this Project.
B. Source limitations:

1. Obtain overhead coiling doors through one source from a single manufacturer.
2. Obtain operators and controls from overhead coiling door manufacturer.

C. Fire-test-response characteristics: Provide assemblies complying with NFPA 80 that are identical to door and frame assemblies tested for fire-test-response characteristics per UL 10b and NFPA 252, and that are listed and labeled for fire ratings indicated by UL, FMG, ITS, or another testing and inspecting agency acceptable to authorities having jurisdiction.
D. Oversize fire-rated door assemblies: For units exceeding sizes of tested assemblies, provide certification by a testing agency acceptable to authorities having jurisdiction that doors comply

with all standard construction requirements of tested and labeled fire-rated door assemblies except for size.

E. Electrical components, devices, and accessories: Listed and labeled as defined in NFPA 70, Article 100.

1.5 WARRANTY

A. Warranty: Manufacturer's limited door and operator system, except the counterbalance spring and finish, to be free from defects in materials and workmanship for 3 years or 20,000 cycles, whichever occurs first.
B. PowderGuard Finish
   1. PowderGuard Max: Applied to curtain, guides, bottom bar, headplates: Manufacturer's limited Max Finish warranty for 5 years.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Model 625 Rolling Steel Service Doors by the Overhead Door Corp. (basis of design).
B. Cornell/Cookson
C. Pacific Rolling Door Co.
D. Lawrence Doors.

2.2 PERFORMANCE REQUIREMENTS

A. Wind load: Design, engineer and fabricate doors to safely support a wind load of 20 psf without failure, and with a maximum deflection on curtain and guides of L/240 of span.
B. Operation-cycle requirements: Design overhead coiling door components and operator for a useful life of 10,000 cycles, at a minimum of 10 operations per day and a speed of not less than 2/3 fpm.
C. Motor size: Adequate to open or close the door from any position in its travel at a speed of 2/3 fpm.

2.3 INSULATED ROLLING SERVICE DOORS

A. Stormtite Insulated Rolling Service Doors: Overhead Door Corporation Model 625.
   1. Curtain: Interlocking roll-formed slats as specified following. Endlocks shall be attached to each end of alternate slats to prevent lateral movement.
      a. Flat profile type F-265i for doors up to 40 feet (12.19 m) wide.
      b. Front slat fabricated of 20 gauge galvanized steel.
   2. Performance:
      a. Through Curtain Sound Rating: Sound Rating: STC-28 (STC-30+ with HZ noise generator) as per ASTM E 90.
      b. Installed System Sound Rating: STC-21 as per ASTM E 90.
      c. U-factor: 0.91 NFRC test report, maximum U-factor of no higher than 1.00.
      d. Air Infiltration: Meets ASHRAE 90.1 & IECC 2012/2015 C402.4.3 Air leakage <1.00 cfm/ft2.

3. Slats and Hood Finish and exposed parts:

    a. Galvanized Steel: Slats and hood galvanized in accordance with ASTM A 653 and receive rust-inhibitive, roll coating process, including 0.2 mils 08330-6 thick baked-on prime paint, and 0.6 mils thick baked-on polyester top coat.
    b. Topcoat: PowderGuard Max.

2.4 MATERIALS

A. Basic materials:

1. Sheet steel: ASTM A 653, Grade 33, galvanized.
2. Structural shapes and plates: ASTM A 36.

B. Component materials:

1. Endlocks and windlocks: Heavy malleable iron castings.
2. Hood:

    a. Galvanized steel, nominal 0.028-inch thick, hot-dip galvanized steel sheet with G90 (Z275) zinc coating, complying with ASTM A 653.
    b. Include automatic drop baffle on fire-rated doors to guard against passage of smoke or flame.

3. Barrel: Steel pipe.
4. Brackets: Cold-formed galvanized steel plates or hot-rolled sections.
5. Smoke seals: Equip each fire-rated door with smoke-seal perimeter gaskets for smoke and draft control as required for door listing and labeling by a qualified testing agency.
6. Weatherseals: Equip exterior door with weather-stripping gaskets fitted to entire perimeter of door for a weathertight installation.

    a. At door head, use 1/8-inch- thick, replaceable, continuous sheet secured to inside of hood.
    b. At door jambs, use replaceable, adjustable, continuous, flexible, 1/8-inch- thick seals of flexible vinyl, rubber, or neoprene.

2.5 FABRICATION

A. Curtain:

1. Provide with endlocks securely attached to both ends of alternate slats with a minimum of 2 galvanized rivets.
2. Use windlocks where required to meet design criteria.
3. Reinforce bottom slat with 2 steel angles and provide angled closure plate where required to affect a weathertight closure at sloping surfaces.

B. Guides:

1. Three continuous steel angles bolted together to form a groove for the curtain and extended above door opening to support coil brackets.
2. Top of each guide shall be flared to facilitate entry of curtain and provided with removable stops.

C. Brackets: Manufacturer standard design, with bellmouth guide groove for curtain.
D. Gears:

1. Cast iron with teeth cast from machine cut patterns.

2. The pinion gears shall not be less than 3-inch pitch diameter.
3. Gear ratio shall be designed for a maximum manual effort of 30 lb.

E. Barrel:

1. Not less than 4-inch diameter steel tubing designed to limit maximum deflection, when fully loaded with door in the retracted position, to 0.03-inch/ft.
2. Oil-tempered torsion springs capable of correctly counterbalancing weight of curtain and adjustable by an exterior wheel.

F. Hood: Formed to fit the curvature of the brackets and attached securely thereto. Roll and reinforce top and bottom edges. Brace to limit deflection to 0.25-inch.

2.6 OPERATION

A. Motorized operation: Door shall be electrically operated, driven by an integral power unit enclosed in NEMA 1 housing. Components shall be as follows.

1. Gear reducer; belt or chain drives are not acceptable.
2. Enclosed emergency hand-chain operator and electrical device.
3. Motor: High torque, totally enclosed with thermal protective device, UL listed.
4. Disc brake.
5. Geared limit switch.
6. Magnetic reversing contactor encased in power unit and prewired as required by legal requirements.
7. Motor and brake removable without affecting chain operator or limit switch setting. Power unit connected to operating shaft to raise and lower door not less than 1/2-foot per second.

    a. Equip motor with an endless cadmium-plated steel hand chain for emergency operation when the power is off. Design chain hoist with a self-locking mechanism to allow curtain to be stopped at any point in its travel, and to remain in position until movement is reactivated.

8. Flush-mounted control station, unless otherwise indicated, key-operated "OPEN" and "CLOSE," NEMA 3R enclosure, with stop button.
9. Electrical leads between motor, brake, interlock and limit switch factory prewired.
10. Pass Door(s): Hinged frame with lockset.
11. Pass Door(s): Swinging-door and frame assembly constructed integrally with the coiling-door assembly[and bearing the same fire rating]. Comply with the accessibility standard of authorities having jurisdiction.

    a. Door Frame and Integral Jamb Guide: Fabricate of angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading.
    b. Hinged Frame: Hinged pass door and frame that swings out of the way, as a unit, to allow use of the full coiling-door opening width. One jamb of the pass-door frame is hinged and the other jamb includes a guide for the lower, narrower part of the coiling-door curtain.
    c. Locking Hardware: As specified in Section 08 71 00 "Door Hardware".
    d. Thresholds: Equip pass doors with integral thresholds that comply with the accessibility standard of authorities having jurisdiction.

12. Except as otherwise indicated on Drawings, required by electrical power source (junction box) locations, or required for obstruction clearances, locate motor operators on the right side of door assembly when viewed from the "interior" side.

B. Automatic closing operation:

1. Equip fire-rated door assemblies with manufacturer's standard, UL or FM listed, electronically controlled, automatic door release (closing) device with delay feature. Provide with governor to limit closing speed to not more than 24 inches/second.

    a. Replaceable fusible links with temperature rise and melting point of 165 deg F; interconnected and mounted on both sides of door opening.

2. Provide a time-delay device, equivalent to Cookson Co. "Firefly" to prevent closing due to momentary interruption of the electrical current.
3. Provide ADA-compliant audible/visible warning device for fire release closure.

C. Safety device:

1. Provide safety edge to automatically reverse the door if the device detects an obstruction in the downward travel of the door.
2. The system shall operate with airwave technology and shall not rely on pneumatic pressure or electrical strip contacts to operate properly, and shall not be subject to interference by temperature, barometric pressure, water infiltration or cuts in the rubber boot.
3. Connecting electrical cable attached to the sensor is not acceptable.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine adjacent construction and supports.
B. Verify that opening is within allowable tolerances, plumb, level, clean, will provide solid anchoring surfaces.
C. Correct detrimental conditions before proceeding with installation.

3.2 INSTALLATION

A. Install doors and their operating equipment in compliance with the door manufacturer's instructions, plumb, in true alignment, free of springing, forcing, racking or distortion.
B. Provide necessary hardware, jamb and head mold stops, anchors, inserts, hanger, equipment supports, and other accessories required for a complete installation.
C. Attach door guide assembly to walls with galvanized bolts (in expansion shields for masonry walls) for a rigid installation of the door curtain and operating equipment. Place anchor bolts to be concealed from exterior when doors are closed.

3.3 TOUCHUP

A. Touchup damaged shop primer by cleaning and sanding the damaged area and applying the same paint as that used for shop painting.

3.4 FIELD QUALITY CONTROL/DEMONSTRATION

A. Touchup: Touchup damaged finish to match adjacent undamaged surfaces, when the results are satisfactory to the Architect, otherwise return the damaged component to the shop for refinishing.

B. Demonstration: Engage a factory-authorized service representative to perform startup services and to train Owner’s maintenance personnel as specified below:

1. Startup:

    a. Test and adjust controls and safeties.
    b. Replace damaged and malfunctioning controls and equipment.
    c. Test door closing when activated by detector or alarm connected fire-release system. Reset door-closing mechanism after successful test.

2. Training:

    a. Schedule training with the Owner with at least 7 days' advance notice.
    b. Train Owner’s maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, preventive maintenance, and procedures for testing and resetting release devices.
    c. Review data in the maintenance manuals.

END OF SECTION

SECTION 08 41 23 - FIRE RATED GLASS AND FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fire rated window and framing systems for installation as windows in interior openings.

1.2 DEFINITIONS

A. Manufacturer: A firm that produces primary glass, fabricated glass or framing as defined in referenced glazing publications.

1.3 SUBMITTALS

A. Product Data:

1. Technical Information: Submit latest edition of manufacturer's product data providing product descriptions, technical data, Underwriters Laboratories, Inc. listings and installation instructions.

B. Shop Drawings:

1. Include plans, elevations and details of product showing component dimensions; framed opening requirements, dimensions, tolerances, and attachment to structure

C. Samples: For following products:

1. Glass sample-as provided by manufacturer
2. Sample of frame
3. Verification of sample of selected finish.

D. Warranties: Submit manufacturer's warranty.

E. Certificates of compliance from glass and glazing materials manufacturers attesting that glass and glazing materials furnished for project comply with requirements.

1. Separate certification will not be required for glazing materials bearing manufacturer's permanent label designating type and thickness of glass, provided labels represent a quality control program involving a recognized certification agency or independent testing laboratory acceptable to authority having jurisdiction.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to

1. International Accreditation Service for a Type A Third-Party Inspection Body (Field Services ICC-ES Third-Party Inspections Standard Operating Procedures, 00-BL-S0400 and S0401)
2. International Accreditation Service for Testing Body-Building Materials and Systems
    a. Fire Testing
        1) ASTM Standard E 119
        2) CPSC Standard 16 CFR 1201
        3) NFPA Standards 251, 252, 257
        4) UL Standards 9, 10B, 10C, 1784, UL Subject 63
        5) BS 476; Part 22: 1987
        6) EN 1634-1

B. Installer Qualifications: An experienced installer who has completed glazing similar in material, design, and extent to that indicated for Project and whose work has resulted in construction with a record of successful in-service performance.

C. Source Limitations for Glazing Accessories: Obtain framing system, glazing and glazing accessories from one source for each product and installation method indicated.

D. Fire-Rated Window Assemblies: Assemblies complying with NFPA 80 that are classified and labeled by UL, for fire ratings indicated, based on testing according to NFPA 257. Assemblies must be factory-welded or come complete with factory-installed mechanical joints and must not require job site fabrication.

E. Listings and Labels - Fire Rated Assemblies: Under current follow-up service by Underwriters Laboratories® maintaining a current listing or certification. Label assemblies' accordance with limits of manufacturer's listing.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver, store and handle under provisions specified by manufacturer.

1.6 PROJECT CONDITIONS

A. Obtain field measurements prior to fabrication of frame units. If field measurements will not be available in a timely manner coordinate planned measurements with the work of other sections.

1. Note whether field or planned dimensions were used in the creation of the shop drawings.

B. Coordinate the work of this section with others effected including but not limited to: other interior and/or exterior envelope components and door hardware beyond that provided by this section

1.7 WARRANTY

A. Provide the Fireframes® Designer Series standard five-year manufacturer warranty.

PART 2 - PRODUCTS

2.1 MANUFACTURERS - FIRE RATED WINDOW

A. Glass Material: Pilkington Pyrostop® fire-rated glazing as fabricated and distributed by Technical Glass Products, 8107 Bracken Place SE, Snoqualmie, WA 98065 phone (800.426.0279) fax (425.396.8300) e-mail sales@fireglass.com, web site http://www.fireglass.com.

B. Frame System: "Fireframes® Designer Series by TGP" fire-rated steel frame system as manufactured and supplied by Technical Glass Products, 8107 Bracken Place SE, Snoqualmie, WA 98065 phone (800.426.0279) fax (425.396.8300) e-mail sales@fireglass.com web site http://www.fireglass.com.

C. Substitutions: Substitutions for Glazing Material and Frame System not permitted.

2.2 PERFORMANCE REQUIREMENTS

A. Fire Rating Requirements

1. Duration-- Window Assembly: Capable of providing a fire rating for 60 minutes.

B. Design Requirements:

1. Dimensions -- Window Assembly:

a. Perimeter framing face dimension: 2 3/4-inch at head, sill and jamb.
b. Horizontal and/or vertical mullions: 3 9/16-inch on the face.
c. Depth of perimeter and mullion: 1 15/16-inch.

C. Structural Performance

1. Member deflection: Limit deflection of the edge of the glass normal to the plane of the glass to flexure limit of glass of any framing member
2. Accommodate movement between storefront and adjoining systems

D. Air infiltration: Provide systems that allow a maximum air leakage through fixed glazed openings of 0.06 cfm/sq. ft. of area when tested per ASTM E 283 at a static air differential of 1.57 lbf/sq ft

2.3 MATERIALS - GLASS

A. Fire Rated Glazing: ASTM C 1036 and ASTM C 1048; composed of laminated glass with intumescent interlayers glazing material.

B. Thickness of Glazing Material:

1. 7/8-inch Pilkington Pyrostop® Optiwhite.

C. Approximate Visible Transmission: Varies with thickness (approximate range 88 percent).

D. Logo: Each piece of fire-rated glazing shall be labeled with a permanent logo including name of product, manufacturer, testing laboratory (UL® only), fire rating period, safety glazing standards, and date of manufacture.

E. Performance: Glass must be rated to stop fire from either direction and must meet all testing requirements including the required hose-stream test (where fire-rating exceeds 20 minutes).

2.4 MATERIALS – STEEL FRAMES

A. Steel Framing System including 60-minute rated windows.

1. Frame: Steel profiled formed tubing.
2. Fasteners: As recommended by manufacturer
3. Glazing Accessories: calcium silicate setting blocks.
4. Glazing Compounds:

a. Pilkington Pyrostop®: Approved, Fibrefrax, or pure silicone sealant.

1) When glazed with Pilkington Pyrostop (60-90 minutes) glazing products, doors meet the maximum transmitted temperature rise of not more than 450 degrees Fahrenheit (250 degrees Celsius) at the end of 30 minutes of the standard fire test exposure.

2.5 Fabrication

A. Furnish frame assemblies pre-welded.

1. When necessary, splice frames too large for shop fabrication or shipping or to fit in available building openings.
2. Fit with suitable fasteners.
3. Knock-down frames are not permitted

B. Furnish interior welded frame assemblies.

1. When necessary, splice frames too large for shop fabrication or shipping or to fit in available building openings.

2. Fit with suitable fasteners.

C. Field glaze window and frame assemblies.

D. Fabrication Dimensions: Fabricate to fire-rated field dimensions.

E. Obtain approved shop drawings prior to fabrication.

2.6 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish frames after assembly.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable. Noticeable variations in the same piece are not acceptable.

2.7 POWDERCOAT FINISHES

A. Finish after fabrication.

B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable. Noticeable variations in the same piece are not acceptable.

C. Interior Steel Finishes.

1. Powder-Coat Finish: Polyester Super Durable powder coating which meets AAMA 2604 for chalking and fading. Apply manufacturer's standard powder coating finish system applied to factory-assembled frames before shipping, complying with manufacturer's recommended instructions for surface preparation including pretreatment, application, and minimum dry film thickness.
2. Color and Gloss: Match Architect's sample.
3. Acceptable Manufacturers:

a. Tiger Drylac
b. Additional manufacturers as approved by TGP

2.8 ACCESSORY MATERIALS

A. Bituminous Paint: Cold-applied, asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos; formulated for 30-mil thickness per coat.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and members to which the work of this section attaches or adjoins prior to frame installation.

B. Provide openings plumb, square and within allowable tolerances.

1. Provide 3/8 inch shim space at all walls

C. Notify Architect of any conditions which jeopardize the integrity of the proposed fire wall / door system.

D. Do not proceed until such conditions are corrected.

3.2 INSTALLATION

A. See Fireframes Designer Series Installation Manual

3.3 REPAIR AND TOUCH UP

A. Limited to minor repair of small scratches. Use only manufacturer's recommended products.

1. Such repairs shall match original finish for quality or material and view.

B. Remove and replace glass that is broken, chipped, cracked, abraded, or damaged.

3.4 ADJUSTING

A. Adjust door function and hardware for smooth operation. Coordinate with other hardware suppliers for function and use of any other attached hardware.

3.5 PROTECTION AND CLEANING

A. Protect glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels, and clean surfaces.

1. Do not clean with astringent cleaners. Use a clean "grit free" cloth and a small amount of mild soap and water or mild detergent.
2. Do not use any of the following:

a. Steam jets.
b. Abrasives.
c. Strong acidic or alkaline detergents, or surface-reactive agents.
d. Detergents not recommended in writing by the manufacturer.
e. Do not use any detergent above 77 degrees F.
f. Organic solvents including but not limited to those containing ester, ketones, alcohols, aromatic compounds, glycol ether, or halogenated hydrocarbons.
g. Metal or hard parts of cleaning equipment must not touch the glass surface.

B. Protect glass from contact with contaminating substances resulting from construction operations, including weld splatter. If, despite such protection, contaminating substances do come into contact with glass, remove them immediately as recommended by glass manufacturer.

C. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended by glass manufacturer.

END OF SECTION

SECTION 08 43 13 - ALUMINUM-FRAMED STOREFRONTS AND ENTRANCES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Storefront framing.
2. Aluminum-framed glass doors.
3. Mullion covers, subframes, reinforcement and anchors, and sealants for the work of this Section.
4. Supplementary parts and components, such as inserts, clips, fasteners, anchors, bracing and other miscellaneous supports required for a complete, weatherproof installation.

B. Work installed but furnished in other Sections:

1. Division 08 for finish hardware on doors.

C. Related work:

1. Division 08 for glazing requirements for the work of this Section.

1.2 ADMINISTRATE REQUIREMENTS

A. Structural and Energy design of the system has already been used as a basis of approval by Division of the State Architect and other agencies. If a substitution is proposed, then the Contractor is responsible for the re-approval of the documents in a timely manner within the original project schedule, along with all professional and agency fees related to this substitution. See Section 01 60 00 - Product Requirements.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 SUBMITTALS

A. Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Energy Model Submissions

a. Provide a copy of the project ENV-1 form.
b. Provide evidence that the proposed products can meet or exceed the energy values listed on the ENV-1 form. Preferred method is an NFRC site certificate, but a simulation report by an independent NFRC certified simulator will be considered. AAMA test reports and or simulations will not be accepted as they are not allowed under the current code.
c. Provide a statement of who will be the “responsible party” in issuing the NFRC site certificates.

B. Shop drawings:

1. Large scale dimensioned shop and erection drawings for the work of this Section showing the following:

a. Elevations.
b. Detail sections of typical composite members.
c. Hardware mounting heights.

d. Hardware schedule and indicate operating hardware types, quantities, and locations.
e. Expansion provisions.
f. Glazing details.

2. Include full-size isometric details of each type of vertical-to-horizontal intersection of aluminum-framed entrances and storefronts, showing the following:

a. Joinery, including concealed welds.
b. Anchorage.
c. Expansion provisions.
d. Glazing.
e. Flashing and drainage.

3. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.
4. Identify shop and field sealants by product name and locate on shop drawings.
5. Identify welds, both shop and field, by AWS welding symbols.

C. Samples:

1. Cutaway sample: Of each vertical-to-horizontal framing intersection of systems, made from minimum 6-inch lengths of full-size components and showing details of the following.

a. Joinery.
b. Anchorage.
c. Expansion provisions.
d. Glazing.
e. Identify samples gage, alloy, color and finish.

2. Glazing gaskets: 12-inch long samples.
3. Finish Sample: 2 x 3 inches in size illustrating finished aluminum surface

D. Qualification Data: For Installer.
E. Hardware Schedule: Complete itemization of each item of hardware to be provided for each door, cross-referenced to door identification numbers in Contract Documents.
F. Certification: Certified test results showing that entrance and storefront systems have been tested by a recognized testing laboratory or agency and comply with specified performance characteristics.

1.5 QUALITY ASSURANCE

A. Fabricator/installer’s qualifications: Single firm with a minimum of 5 years of successful experience fabricating and erecting work similar to that required for this Project.
B. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.

1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

1.6 MOCKUPS

A. Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build mockup of typical wall area as shown on Drawings.

2. Testing shall be performed on mockups according to requirements in "Field Quality Control" Article.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 HANDLING

A. Procedure: "Care and Handling of Architectural Aluminum from Shop to Site" published by AAMA.

1.8 WARRANTY

A. Special Warranty: [Manufacturer] agrees to repair or replace components of aluminum-framed entrances and storefronts that do not comply with requirements or that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures, including, but not limited to, excessive deflection.
b. Noise or vibration created by wind and thermal and structural movements.
c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
d. Water penetration through fixed glazing and framing areas.
e. Failure of operating components.

2. Warranty Period: Five years from date of Substantial Completion.

B. Special Finish Warranty, Factory-Applied Finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.

1. Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Delta E units when tested according to ASTM D2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Warranty Period: 20 years from date of Substantial Completion.

C. Warrant the work of this Section against defective materials and workmanship for 2 years after Substantial Completion. Refer to Section 07 92 00 for sealant warranty.
D. Repair or replace, when repairs are acceptable to the College, defective materials, and workmanship during the warranty period at no cost to the College.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Source Limitations: Obtain all components of aluminum-framed entrance and storefront system, including framing and accessories, from single manufacturer.
B. Basis of Design: Arcadia.

1. AFG601T Series (2-inches by 6-inches).
2. AFG451T Series, (2-inches by 4-1/2-inches).
3. AR450 (interior for 1/4-inch. glass).
4. AR450+ (interior for 1/2-inch glass).

C. Acceptable manufacturers: Provide either the product identified as "Basis of Design" or an equivalent product of another manufacturer

1. For any product not identified as "Basis of Design", submit information as specified for substitutions.
2. Substitution may or may not be accepted after Architect and District review with complete evaluation for content and schedule impact.
3. Substitutions shall include all costs for redesign with consequential changes by other trades along with the Architect and related approvals by governing agencies.

    a. Revision to shop drawings illustrating changes is not considered adequate for DSA review and approval.

4. Substitutions may be acceptable, based on Architect's review and approval, for submittal to DSA.

    a. If substituted manufacturer cannot reproduce design and DSA approval in a timely manner, then they shall be subject to a time and material back charge for any delays in the project.
    b. Architect approval is required prior to DSA submittal and DSA approval is required prior to fabrication.

D. Aluminum-framed doors:

1. Type: WS512HD.

E. Fixed storefront sections: Of the dimensions and profiles indicated.

2.2 PERFORMANCE REQUIREMENTS

A. General: Provide aluminum entrance and storefront systems capable of withstanding loads, and thermal, seismic and structural movement indicated without failure, based on testing manufacturer standard units in assemblies similar to those indicated for this Project. Failure includes the following.

1. Air infiltration and water penetration exceeding specified limits for exterior assemblies.
2. Framing members transferring stresses, including those caused by thermal and structural movement, to glazing units.

B. Glazing: Physically and thermally isolate glazing from framing members.

C. Glazing-to-glazing joints: Provide glazing-to-glazing joints that accommodate thermal and mechanical movements of glazing and system, prevent glazing-to-glazing contact, and maintain required edge clearances.

D. Air infiltration:

1. Provide exterior storefront systems with permanent resistance to air leakage of not more than 0.06 cfm/square foot of fixed wall area when tested according to ASTM E 283 at a static air pressure difference of 6.24 psf.
2. Provide exterior single acting offset doors with air infiltration not exceeding 0.50 cfm/lineal foot of perimeter crack. A pair of 6-foot by 7-foot doors and frame shall not exceed 1 cfm/linear foot of perimeter crack.

E. Water penetration:

1. Provide exterior storefront systems that do not evidence water leakage through fixed glazing and frame areas when tested according to ASTM E 331 at minimum differential pressure of 20 percent of inward-acting wind-load design pressure as defined by ASCE 7, "Minimum Design Loads for Buildings and Other Structures," but not less than 8 psf.
2. Water leakage is defined as uncontrolled water infiltrating systems or appearing on systems' normally exposed interior surfaces from sources other than condensation.

3. Water controlled by flashing and gutters that is drained back to the exterior and cannot damage adjacent materials or finishes is not water leakage.

F. Thermal movements:

1. Provide exterior assemblies, including anchorage, that accommodate thermal movements of systems and supporting elements resulting from the following maximum change (range) in ambient and surface temperatures without buckling, damaging stresses on glazing, failure of joint sealants, damaging loads on fasteners, failure of doors or other operating units to function properly, and other detrimental effects.
2. Temperature change (range): 120-degree F. ambient, 180-degree F. material surfaces.

G. Movements of the structural-support: Provide assemblies that accommodate structural movements including, but not limited to, sway and deflection.

H. Dimensional tolerances: Provide entrance and storefront systems that accommodate dimensional tolerances of building frame and other adjacent construction.

I. Performance requirements for doors: Resistance to corner racking shall be tested by the "Dual Moment Load" test as follows.

1. Test section shall consist of a standard top door corner assembly. Side rail section shall be 24 inches long; top rail section shall be 12 inches long.
2. Anchor "top rail" positively to test bench so that corner protrudes 3 inches beyond the bench edge.
3. Anchor a lever arm positively to "side rail" at a point 19 inches from the inside edge of "top rail." Attach weight support pad at a point 19 inches from inner edge of "side rail".
4. Test section shall withstand a load of 170 lb. on the lever arm before reaching the point of a 1/18 inch gap at the stile/rail, joint or a 3-degree rotation in the stile. Further failure, defined as a rotation of the lever arm in excess of 45, shall not be reached before 270 lb.

2.3 STOREFRONT SYSTEMS

A. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.

1. Exterior Framing Construction: Thermally broken.
2. Interior Vestibule Framing Construction: Nonthermal.
3. Glazing System: Retained mechanically with gaskets on four sides.
4. Glazing Plane: As detailed.
5. Finish: .
6. Fabrication Method: Field-fabricated stick system.
7. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
8. Steel Reinforcement: As required by manufacturer.

2.4 ENTRANCE DOOR SYSTEMS

A. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing or automatic operation.

1. Door Construction: 1-3/4-inch (44.5-mm) overall thickness, with minimum 0.188-inch-thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.
2. Door Design Wide stile; 5-inch nominal width.
3. Glazing Stops and Gaskets: Square, snap-on, extruded-aluminum stops and preformed gaskets.

   a. Provide nonremovable glazing stops on outside of door.

4. Finish: Match adjacent storefront framing finish.

2.5 ENTRANCE DOOR HARDWARE

A. Entrance Door Hardware: Hardware not specified in this Section is specified in Section 08 71 00 "Door Hardware."

B. General: Provide entrance door hardware and for each entrance door, to comply with requirements in this Section.

1. Entrance Door Hardware Sets: Provide quantity, item, size, finish, or color indicated, and named manufacturers' products.
2. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.
3. Opening-Force Requirements:

a. Egress Doors: Not more than 15 lbf (67 N) to release the latch and not more than 30 lbf (133 N) to set the door in motion and not more than 15 lbf (67 N) to open the door to its minimum required width.
b. Accessible Interior Doors: Not more than 5 lbf (22.2 N) to fully open door.

C. Designations: Requirements for design, grade, function, finish, quantity, size, and other distinctive qualities of each type of entrance door hardware are indicated in "Entrance Door Hardware Sets" Article. Products are identified by using entrance door hardware designations as follows:

1. Named Manufacturers' Products: Manufacturer and product designation are listed for each door hardware type required for the purpose of establishing minimum requirements. Manufacturers' names are abbreviated in "Entrance Door Hardware Sets" Article.
2. References to BHMA Standards: Provide products complying with these standards and requirements for description, quality, and function.

D. Pivot Hinges: BHMA A156.4, Grade 1.

1. Offset-Pivot Hinges: Provide top, bottom, and intermediate offset pivots at each door leaf.

E. Automatic and Self-Latching Flush Bolts: BHMA A156.3, Grade 1.

F. Cylinders:

1. As specified in Section 08 71 00 "Door Hardware."

G. Strikes: Provide strike with black-plastic dust box for each latch or lock bolt; fabricated for aluminum framing.

H. Operating Trim: BHMA A156.6.

I. Closers: BHMA A156.4, Grade 1, with accessories required for a complete installation, sized as required by door size, exposure to weather, and anticipated frequency of use; adjustable to comply with field conditions and requirements for opening force.

J. Concealed Overhead Holders and Stops: BHMA A156.8, Grade 1.

K. Door Stops: BHMA A156.16, Grade 1, floor or wall mounted, as appropriate for door location indicated, with integral rubber bumper.

L. Weather Stripping: Manufacturer's standard replaceable components.

1. Compression Type: Made of ASTM D2000 molded neoprene or ASTM D2287 molded PVC.
2. Sliding Type: AAMA 701/702, made of wool, polypropylene, or nylon woven pile with nylon-fabric or aluminum-strip backing.

M. Weather Sweeps: Manufacturer's standard exterior-door bottom sweep with concealed fasteners on mounting strip.

N. Thresholds: BHMA A156.21 raised thresholds beveled with a slope of not more than 1:2, with maximum height of 1/2 inch (12.7 mm).

O. Finger Guards: Manufacturer's standard collapsible neoprene or PVC gasket anchored to frame hinge-jamb at center-pivoted doors

2.6 GLAZING

A. Glazing: Comply with Section 08 80 00 - Glazing.

2.7 MATERIALS

A. Aluminum: Alloy and temper recommended by the manufacturer for strength and application of required finish, complying with ASTM B 221 for extrusions and ASTM B 209 for sheet or plate.

B. Steel mullion reinforcement, if required by wind loading and other considerations: Proprietary bent steel plate or structural steel shape complying with the following.

1. Hot-rolled sections: ASTM A 36.
2. Structural tube framing: ASTM A 500, Grade B.

C. Fasteners: 300 Series (18-8) non-magnetic stainless steel for all screws, bolts, nuts, washers and rivets, except for the following applicable to Self-drilling and self-tapping screws.

1. Comply with SAE J78, except shanks and heads of fasteners shall comply with SAE i429, Grade 5 with 827 MPa (120 ksi) tensile strength and Rockwell C34 maximum hardness.
2. Where additional corrosion resistance is required, such as where fastener heads are exposed to aggressive environments, shanks and heads of fasteners shall be made of Series 300 (18-8) stainless steel complying with ASTM F 593, Condition CW (i.e. cold-worked), 689 to 1034 MPa (100 to 150 ksi) tensile strength, Rockwell 895 to C32 hardness.
3. Emboss fastener heads with manufacturer’s mark for inspection purpose and to indicate fasteners comply with Specifications.
4. Carbon steel fasteners shall have corrosion-resistant, hexavalent chrome-free coating with a zinc-rich base coat and an aluminum-pigmented organic topcoat. Fastener shall withstand 800 hours test, without forming red rust, when tested according to ASTM B 11 7.
5. Emboss 300 series stainless steel fasteners with the manufacturers mark for inspection purpose and to indicate fasteners comply with Specifications and applicable standards. Fasteners shall have a galvanically-compatible finish and coating, hexavalent chrome-free, zinc plate base and an aluminum-pigmented organic topcoat.

D. Reinforcement: Where fasteners screw-anchor into aluminum less than 0.125-inch thick, reinforce the interior with aluminum or non-magnetic stainless steel to receive screw threads, or provide standard non-corrosive pressed-in splined grommet nuts.

1. Welding electrodes: As recommended by AWS for the type of metal to be welded and the conditions of use.

E. Brackets: Where feasible, provide high-strength aluminum brackets and reinforcements; otherwise provide non-magnetic stainless steel or steel complying with ASTM A 386.

F. Compression weatherstripping: Manufacturer's standard replaceable compressible weatherstripping gaskets of molded neoprene complying with ASTM D 2000 or molded silicone of the color selected by the City Engineer.

G. Sliding weatherstripping: Manufacturer's standard replaceable weatherstripping of wool, polypropylene, or nylon woven pile, with nylon fabric or aluminum strip backing, complying with AAMA 701.2.

H. Glass and glazing materials: As indicated on the Drawings and specified in Section 08800.

I. Sealants and backup rods:

1. Within assemblies: Manufacturer standard non-drying, non-skinning sealant complying with AAMA 809.2.
2. Between assemblies and adjacent materials: As specified in Section 07 9200.
3. Glazing sealants: Refer to Section 08 80 00.

J. Paint:

1. Exposed aluminum finishes: See below.
2. Shop primer for ferrous metal: Manufacturer or fabricator standard, fast-curing, lead-free, universal rust-inhibitive alkyd primer complying with performance requirements of FS TT-P645.
3. Shop primer for concealed aluminum surfaces: Alkyd barium metaborate made by one of the manufacturers listed in Section 09900, or bituminous paint.
4. Galvanizing repair paint: SSPC Paint No. 20, Type II (Organic), by Tnemec, Porter International, Valspar Corp., Ameron Protective Coatings, or DuPont Co.
5. Bituminous paint: Cold-applied asphalt mastic complying with SSPC Paint 12, but containing no asbestos fibers.

2.8 FABRICATION

A. Furnish shop drawings, inserts and similar items to other trades, at appropriate times as required for proper sequence of construction.

1. Verify dimensions of the supporting structure and other elements that precede this work before fabrication of the required components.
2. Provide erection tolerances corresponding with specified tolerances for other work wherever field measurements cannot be obtained.

B. Maintain the visual design concept shown, including member sizes, profiles and alignment of components.

C. Fabricate and assemble components with proper and acceptable provision for noiseless thermal expansion and contraction, fabrication and erection tolerances, adjoining building component tolerances, and dynamic movements.

D. Fabricate and assemble components with minimum perimeter clearances and shim spacing but enable installation and dynamic movement of perimeter seals.

E. Removable members such as glass stops, fillers or closures shall be extruded, and securely engaged into adjacent components. Fabricate extrusions to eliminate edge projection, bowing, and misalignment at joints.

F. Design and construct expansion joints so that they will be, and remain, permanently watertight, and will accommodate weather and building dynamics.

G. For surfaces exposed to view employ only materials which are free from alloy defects, die marks, scratches, streaks and other surface blemishes.

H. When using aluminum sheets, use material light enough to permit workability but heavy enough to accurately retain the brake shape or contour without oil-canning when fastened to backing or blocking.

I. Complete the fabrication and assembly of the components in the shop to the greatest extent possible to minimize field cutting, splicing, fastening, sealing and finishing.

1. Maintain provisions for expansion and movement.
2. Disassemble only as necessary for shipment and erection.
3. Provide secure attachment and support at joints, with hairline, flush fit between contacting members.

J. Complete the cutting, fitting, forming, drilling and grinding of metal before cleaning and applying specified finish. Remove arrises from cut edges and ease edges and corners to a radius of approximately 1/64 inch minimum, 1/32 inch maximum.

K. Welding:

1. Comply with industry standards for assembly and fabrication using system and rods for exposed metals that will provide texture match with materials being joined.
2. Grind exposed welds smooth and flush with parent metal using clean grinding wheels of a type that will not result in stains or discoloration.

L. Hardware:

1. Cut, reinforce, drill and tap doors and frames at the factory to receive hardware.
2. Provide hardware reinforcement of stainless steel or hot-dip galvanized steel secured by welding or stainless-steel screws.

M. Door fabrication:

1. Make proper allowance for clearances at jambs, head and threshold thickness and clearance.
2. Close the top of out-swinging doors with a plate or inverted channel.
3. Cut, reinforce, drill and tap doors and frames at the factory to receive hardware. Provide hardware reinforcement of stainless steel or hot-dip galvanized steel secured by welding or stainless-steel screws.

2.9 EXPOSED ALUMINUM FINISHES

A. Superior-Performance Organic Finish, Four-Coat PVDF: Fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat.

1. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
2. Color and Gloss: As indicated on Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine adjacent construction and supports.
B. Verify that openings are within allowable tolerances, plumb, level, clean, will provide a solid anchoring surface, and that other conditions detrimental to the proper or timely completion of this work are corrected before proceeding with installation.

3.2 INSTALLATION

A. General:

1. Do not install defective components, including warped, bowed, dented, abraded and broken members, and glass with damaged edges.
2. Remove and replace members that have been damaged during installation or thereafter before final acceptance.
3. Do not cut, trim, or weld components during erection in a manner that would damage the finish, decrease their strength, or result in a visual imperfection or a failure in performance of the work.
4. Return components that require alteration to the shop for refabrication or replacement.
5. Install components level, plumb, true to line and with uniform tight joints and reveals. Attach to structure with non-staining and non-corrosive shims, anchors, fasteners and spacers.
6. Provide all accessories such as fastenings, sealants and concealed anchorage needed for a complete weatherproof installation.

B. Erection tolerances:

1. Provide adjustment within the assemblies to accommodate job variations.

2. Install the work of this Section within the following tolerances:

    a. Deviation from established vertical, horizontal, or designed position shall not exceed 1/8 inch in 12 feet of length of any member, or 1/4 inch in any total run in any line.
    b. Maximum offset from true alignment between 2 consecutive members placed end-to-end shall not exceed 1/16 inch.
    c. Maximum offset between glass framing members at corners of glazing pocket must not exceed 1/32 inch.

C. Assembly and anchorage:

1. Anchor components securely by bolting, welding or other permanent mechanical attachments system that will comply with specified requirements and permit movements that are intended or necessary.
2. Install slip-joint linings where required to ensure movement without damage of the components.
3. Provide tape separator between contact surfaces of dissimilar materials where there is a possibility of corrosive or electrolytic action.
4. Remove weld slag and apply primer over welds. Touchup shop applied paint damaged by welding or other causes.

D. Glazing:

1. Glaze assemblies as specified in Section 08800.
2. Carefully match joints of glazing beads.

E. Hanging doors:

1. Install finish hardware on doors in compliance with its manufacturer's instructions.
2. Hang doors with minimum clearance to frame and threshold to meet the performance criteria specified.
3. Hang doors and adjust hardware so doors operate freely for their entire travel, without sticking or binding, and with minimum clearance to frame to comply with performance criteria specified.

3.3 SEALANTS

A. The requirements of Section 07 9200 apply to sealants used in this work. Seal all joints between the work of this Section and adjacent construction to be weathertight.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
B. Field Quality-Control Testing: Perform the following test on representative areas of aluminum-framed entrances and storefronts.

1. Water-Spray Test: Before installation of interior finishes has begun, areas designated by Architect shall be tested according to AAMA 501.2 and shall not evidence water penetration.

    a. Perform a minimum of three tests in areas as directed by Architect.

C. Aluminum-framed entrances and storefronts will be considered defective if they do not pass tests and inspections.
D. Prepare test and inspection reports.

3.5 ADJUSTING

A. Adjust door hardware for smooth operation according to hardware manufacturers' instructions.
B. Adjust closers to provide a 3-second closer sweep period for doors to move from a 70-degree open position to 3 inches from the latch measured to the leading door edge.

END OF SECTION

SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes commercial door hardware for the following:

1. Swinging doors.
2. Sliding doors.
3. Other doors to the extent indicated.

B. Door hardware includes, but is not necessarily limited to, the following:

1. Mechanical door hardware.
2. Electromechanical door hardware.
3. Cylinders specified for doors in other sections.

C. Related Sections:

1. Division 08 Section “Hollow Metal Doors and Frames”.
2. Division 08 Section “Flush Wood Doors”.
3. Division 08 Section “Aluminum-Framed Entrances and Storefronts”.

D. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.

1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
2. ICC/IBC - International Building Code.
3. NFPA 70 - National Electrical Code.
4. NFPA 80 - Fire Doors and Windows.
5. NFPA 101 - Life Safety Code.
6. NFPA 105 - Installation of Smoke Door Assemblies.
7. State Building Codes, Local Amendments.

E. Standards: All hardware specified herein shall comply with the following industry standards as applicable. Any undated reference to a standard shall be interpreted as referring to the latest edition of that standard:

1. ANSI/BHMA Certified Product Standards - A156 Series.
2. UL10C - Positive Pressure Fire Tests of Door Assemblies.
3. ANSI/UL 294 - Access Control System Units.
4. UL 305 - Panic Hardware.
5. ANSI/UL 437- Key Locks.

1.3 SUBMITTALS

A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.

B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."

2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.

3. Content: Include the following information:

   a. Type, style, function, size, label, hand, and finish of each door hardware item.
   b. Manufacturer of each item.
   c. Fastenings and other pertinent information.
   d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
   e. Explanation of abbreviations, symbols, and codes contained in schedule.
   f. Mounting locations for door hardware.
   g. Door and frame sizes and materials.
   h. Warranty information for each product.

4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.

C. Shop Drawings: Details of electrified access control hardware indicating the following:

1. Wiring Diagrams: Upon receipt of approved schedules, submit detailed system wiring diagrams for power, signaling, monitoring, communication, and control of the access

control system electrified hardware. Differentiate between manufacturer-installed and field-installed wiring. Include the following:

a. Elevation diagram of each unique access controlled opening showing location and interconnection of major system components with respect to their placement in the respective door openings.
b. Complete (risers, point-to-point) access control system block wiring diagrams.
c. Wiring instructions for each electronic component scheduled herein.

2. Electrical Coordination: Coordinate with related sections the voltages and wiring details required at electrically controlled and operated hardware openings.

D. Keying Schedule: After a keying meeting with the owner has taken place prepare a separate keying schedule detailing final instructions. Submit the keying schedule in electronic format. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner must approve submitted keying schedule prior to the ordering of permanent cylinders/cores.

E. Proof of Compliance: (California located Projects): Provide a list of product(s) containing chemicals known to cause cancer or reproductive toxicity as defined by the Office of Environmental Health Hazard Assessment (OEHHA) under Proposition 65 (CA Code of Regulations, Title 27, Section 27001). The list includes the specific chemical(s), if the chemical will be exposed to consumers, the means of warning, and an illustration of the label.

F. Informational Submittals:

1. Product Test Reports: Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified independent testing agency.

G. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Procedures.

1.4 QUALITY ASSURANCE

A. Manufacturers Qualifications: Engage qualified manufacturers with a minimum 5 years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.

B. Certified Products: Where specified, products must maintain a current listing in the Builders Hardware Manufacturers Association (BHMA) Certified Products Directory (CPD).

C. Installer Qualifications: A minimum 3 years documented experience installing both standard and electrified door hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

D. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier recognized as a factory direct distributor by the manufacturers of the primary materials with a warehousing facility in Project's vicinity. Supplier to have on staff a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware and keying.

E. Automatic Operator Supplier Qualifications: Power operator products and accessories are required to be supplied and installed through the Norton Preferred Installer (NPI) program. Suppliers are to be factory trained, certified, and a direct purchaser of the specified power operators and be responsible for the installation and maintenance of the units and accessories indicated for the Project.

F. Source Limitations: Obtain each type and variety of door hardware specified in this section from a single source unless otherwise indicated.

1. Electrified modifications or enhancements made to a source manufacturer's product line by a secondary or third party source will not be accepted.

2. Provide electromechanical door hardware from the same manufacturer as mechanical door hardware, unless otherwise indicated.

G. California Building Code: Provide hardware that complies with CBC Section 11B.

1. All openings as a part of an accessible route shall comply with CBC Section 11B-404.

2. The clear opening width for a door shall be 32” minimum. For a swinging door it shall be measured between the face of the door and the stop, with the door open 90 degrees. There shall be no projections into it below 34” and 4” maximum projections into it between 34” and 80” above the finish floor or ground. Door closers and stops shall be permitted to be 78” minimum above the finish floor or ground. CBC Section 11B-404.2.3.

3. Operable hardware on accessible doors shall comply with CBC Section 11B-309.4 and shall be operable with one hand and shall not require tight grasping, pinching, or twisting of the wrist. Operable parts of such hardware shall be 34” minimum and 44” maximum above finish floor or ground. Where sliding doors are in the fully open position, operating hardware shall be exposed and usable from both sides.

4. Hardware (including panic hardware) shall not be provided with “nightlatch” function for any accessible doors or gates unless the following conditions are met:

   a. Such hardware has a ‘dogging’ feature and is dogged during the time the facility is open.
   b. All ‘dogging’ operation is performed only by employees as their job function (non-public use).

5. The force for pushing or pulling open a door shall be in accordance with CBC Section 11B-404.2.9.

a. Interior hinged doors, sliding or folding doors, and exterior hinged doors: 5 pounds (22.2 N) maximum. Required fire doors: the minimum opening force allowable by the DSA authority, not to exceed 15 pounds (66.7N). These forces do not apply to the force required to retract latch bolts or disengage other devices that hold the door in a closed position.
b. The force required for activating any operable parts, such as lever hardware, or disengaging other devices shall be 5 pounds (22.2N) maximum to comply with CBC Section 11B-309.4.
c. The 5 pound (22.2 N) maximum force shall be validated for the size of the door used. The Building Materials Listing of the California State Fire Marshal shall indicate that the door hardware meets the 5 pound (22.2 N) force and shall also list the largest door that can be used.

6. Door closing speed shall comply with CBC Section 11B-404.2.8. Closers shall be adjusted so that the required time to move a door from an open position of 90 degrees to a position of 12 degrees from the latch is 5 seconds minimum. Spring hinges shall be adjusted so that the required time to move a door from an open position of 70 degrees to the closed position is 1.5 seconds minimum.

7. Floor stops shall not be located in the path of travel and 4” maximum from walls.

8. Thresholds shall comply with CBC Section 11B-404.2.5.

H. Each unit to bear third party permanent label demonstrating compliance with the referenced standards.

I. Keying Conference: Conduct conference to comply with requirements in Division 01 Section "Project Meetings." Keying conference to incorporate the following criteria into the final keying schedule document:

1. Function of building, purpose of each area and degree of security required.
2. Plans for existing and future key system expansion.
3. Requirements for key control storage and software.
4. Installation of permanent keys, cylinder cores and software.
5. Address and requirements for delivery of keys.

J. Pre-Submittal Conference: Conduct coordination conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier(s), Installer(s), and Contractor(s) to review proper methods and the procedures for receiving, handling, and installing door hardware.

1. Prior to installation of door hardware, conduct a project specific training meeting to instruct the installing contractors' personnel on the proper installation and adjustment of their respective products. Product training to be attended by installers of door hardware (including electromechanical hardware) for aluminum, hollow metal and wood doors. Training will include the use of installation manuals, hardware schedules, templates and physical product samples as required.
2. Inspect and discuss electrical roughing-in, power supply connections, and other preparatory work performed by other trades.
3. Review sequence of operation narratives for each unique access controlled opening.

4. Review and finalize construction schedule and verify availability of materials.
5. Review the required inspecting, testing, commissioning, and demonstration procedures

K. At completion of installation, provide written documentation that components were applied to manufacturer's instructions and recommendations and according to approved schedule.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.

B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.

C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

1.6 COORDINATION

A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.

B. Door and Frame Preparation: Doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

1.7 WARRANTY

A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:

1. Structural failures including excessive deflection, cracking, or breakage.
2. Faulty operation of the hardware.
3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
4. Electrical component defects and failures within the systems operation.

C. Standard Warranty Period: One year from date of Substantial Completion, unless otherwise indicated.

D. Special Warranty Periods:

1. Ten years for mortise locks and latches.
2. Five years for exit hardware.
3. Twenty five years for manual overhead door closer bodies.
4. Five years for motorized electric latch retraction exit devices.
5. Two years for electromechanical door hardware, unless noted otherwise.

1.8 MAINTENANCE SERVICE

A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

A. General: Provide door hardware for each door to comply with requirements in Door Hardware Sets and each referenced section that products are to be supplied under.

B. Designations: Requirements for quantity, item, size, finish or color, grade, function, and other distinctive qualities of each type of door hardware are indicated in the Door Hardware Sets at the end of Part 3. Products are identified by using door hardware designations, as follows:

1. Named Manufacturer's Products: Product designation and manufacturer are listed for each door hardware type required for the purpose of establishing requirements. Manufacturers' names are abbreviated in the Door Hardware Schedule.

C. Substitutions: Requests for substitution and product approval for inclusive mechanical and electromechanical door hardware in compliance with the specifications must be submitted in writing and in accordance with the procedures and time frames outlined in Division 01, Substitution Procedures. Approval of requests is at the discretion of the architect, owner, and their designated consultants.

2.2 HANGING DEVICES

A. Hinges: ANSI/BHMA A156.1 butt hinges with number of hinge knuckles and other options as specified in the Door Hardware Sets.

1. Quantity: Provide the following hinge quantity:

a. Two Hinges: For doors with heights up to 60 inches.

b. Three Hinges: For doors with heights 61 to 90 inches.
c. Four Hinges: For doors with heights 91 to 120 inches.
d. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.

2. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:

a. Widths up to 3’0”: 4-1/2” standard or heavy weight as specified.
b. Sizes from 3’1” to 4’0”: 5” standard or heavy weight as specified.

3. Hinge Weight and Base Material: Unless otherwise indicated, provide the following:

a. Exterior Doors: Heavy weight, non-ferrous, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate standard weight.
b. Interior Doors: Standard weight, steel, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate heavy weight.

4. Hinge Options: Comply with the following:

a. Non-removable Pins: With the exception of electric through wire hinges, provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for the all out-swinging lockable doors.

5. Manufacturers:

a. Hager Companies (HA) - AB Series, 2 knuckle.
b. McKinney (MK) - TA Series. 2 knuckle.
c. No Substitution.

6. Manufacturers:

a. Hager Companies (HA) - AB Series, 3 knuckle.
b. Ives (IV) - 3CB Series, 3 knuckle.
c. McKinney (MK) - TA Series, 3 knuckle.
d. dormakaba Best (ST) - CB Series, 3 knuckle.
e. No Substitution.

7. Manufacturers:

a. Hager Companies (HA) - BB Series, 5 knuckle.
b. Ives (IV) - 5BB Series, 5 knuckle.
c. McKinney (MK) - TA/T4A Series, 5 knuckle.
d. dormakaba Best (ST) - F/FBB Series, 5 knuckle.
e. No Substitution.

B. Pin and Barrel Continuous Hinges: ANSI/BHMA A156.26 Grade 1-600 pin and barrel continuous hinges with minimum 14 gauge Type 304 stainless steel hinge leaves, concealed stainless pin, and twin self-lubricated nylon bearings at each knuckle separation. Factory trim hinges to suit door height and prepare for electrical cut-outs.

1. Manufacturers:

    a. Markar Products; ASSA ABLOY Architectural Door Accessories (MR).
    b. Pemko (PE).

2.3 POWER TRANSFER DEVICES

A. Electrified Quick Connect Transfer Hinges: Provide electrified transfer hinges with Molex™ standardized plug connectors and sufficient number of concealed wires (up to 12) to accommodate the electrified functions specified in the Door Hardware Sets with a 1-year warranty. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Wire nut connections are not acceptable.

    1. Manufacturers:

        a. Ives (IV) - Connect.
        b. McKinney (MK) - QC (# wires) Option.

B. Concealed Quick Connect Electric Power Transfers: Provide concealed wiring pathway housing mortised into the door and frame for low voltage electrified door hardware. Furnish with Molex™ standardized plug connectors and sufficient number of concealed wires (up to 12) to accommodate the electrified functions specified in the Door Hardware Sets. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Wire nut connections are not acceptable.

    1. Manufacturers:

        a. Pemko (PE) - EL-CEPT Series.
        b. Securitron (SU) - EL-CEPT Series.

C. Electric Door Wire Harnesses: Provide electric/data transfer wiring harnesses with standardized plug connectors to accommodate up to twelve (12) wires. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Provide sufficient number and type of concealed wires to accommodate electric function of specified hardware. Provide a connector for through-door electronic locking devices and from hinge to junction box above the opening. Wire nut connections are not acceptable. Determine the length required for each electrified hardware component for the door type, size and construction, minimum of two per electrified opening.

    1. Provide one each of the following tools as part of the base bid contract:

        a. McKinney (MK) - Electrical Connecting Kit: QC-R001.
        b. McKinney (MK) - Connector Hand Tool: QC-R003.

    2. Manufacturers:

        a. Falcon (FA) - Connect.
        b. McKinney (MK) - QC-C Series.
        c. Schlage (SC) - Connect.

d. Dormakaba Best (ST) - WH Series.
e. Von Duprin (VD) - Connect.

2.4 DOOR OPERATING TRIM

A. Flush Bolts and Surface Bolts: Provide products conforming to ANSI/BHMA A156.3 and A156.16, Grade 1.

1. Flush bolts to be furnished with top rod of sufficient length to allow bolt retraction device location approximately six feet from the floor.
2. Furnish dust proof strikes for bottom bolts.
3. Surface bolts to be minimum 8” in length and U.L. listed for labeled fire doors and U.L. listed for windstorm components where applicable.
4. Provide related accessories (mounting brackets, strikes, coordinators, etc.) as required for appropriate installation and operation.

5. Manufacturers:

a. Burns Manufacturing (BU).
b. Door Controls International (DC).
c. Rockwood (RO).

B. Coordinators: ANSI/BHMA A156.3 door coordinators consisting of active-leaf, hold-open lever and inactive-leaf release trigger. Model as indicated in hardware sets.

1. Manufacturers:

a. Burns Manufacturing (BU).
b. Door Controls International (DC).
c. Rockwood (RO).

C. Door Push Plates and Pulls: ANSI/BHMA A156.6 door pushes and pull units of type and design specified in the Hardware Sets. Coordinate and provide proper width and height as required where conflicting hardware dictates.

1. Push/Pull Plates: Minimum .050 inch thick, size as indicated in hardware sets, with beveled edges, secured with exposed screws unless otherwise indicated.
2. Door Pull and Push Bar Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door unless otherwise indicated.
3. Offset Pull Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door and offset of 90 degrees unless otherwise indicated.
4. Fasteners: Provide manufacturer's designated fastener type as indicated in Hardware Sets.

5. Manufacturers:

a. Burns Manufacturing (BU).
b. Hiawatha, Inc. (HI).
c. Rockwood (RO).

2.5 CYLINDERS AND KEYING

A. General: Cylinder manufacturer to have minimum (10) years experience designing secured master key systems and have on record a published security keying system policy.

B. Source Limitations: Obtain each type of keyed cylinder and keys from the same source manufacturer as locksets and exit devices, unless otherwise indicated.

C. Cylinder Types: Original manufacturer cylinders able to supply the following cylinder formats and types:

1. Threaded mortise cylinders with rings and cams to suit hardware application.
2. Rim cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
3. Bored or cylindrical lock cylinders with tailpieces as required to suit locks.
4. Tubular deadlocks and other auxiliary locks.
5. Mortise and rim cylinder collars to be solid and recessed to allow the cylinder face to be flush and be free spinning with matching finishes.
6. Keyway: Match Facility Standard.

D. Removable Cores: Provide removable cores as specified, core insert, removable by use of a special key, and for use with only the core manufacturer's cylinder and door hardware.

E. Keying System: Each type of lock and cylinders to be factory keyed.

1. Supplier shall conduct a "Keying Conference" to define and document keying system instructions and requirements.
2. Furnish factory cut, nickel-silver large bow permanently inscribed with a visual key control number as directed by Owner.
3. Existing System: Field verify and key cylinders to match Owner's existing system.

F. Key Quantity: Provide the following minimum number of keys:

1. Change Keys per Cylinder: Two (2)
2. Master Keys (per Master Key Level/Group): Five (5).
3. Construction Keys (where required): Ten (10).

G. Construction Keying: Provide temporary keyed construction cores.

H. Key Registration List (Bitting List):

1. Provide keying transcript list to Owner's representative in the proper format for importing into key control software.
2. Provide transcript list in writing or electronic file as directed by the Owner.

2.6 KEY CONTROL

A. Key Control Cabinet: Provide a key control system including envelopes, labels, and tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent

markers, and standard metal cabinet. Key control cabinet shall have expansion capacity of 150% of the number of locks required for the project.

1. Manufacturers:

    a. Lund Equipment (LU).
    b. MMF Industries (MM).
    c. Telkee (TK).

P. Electronic Key Management System: Provide an electronic key control system with Stand-alone Plug and Play features including advanced RFID technology. Touchscreen interface with PIN access for keys individually locked in place. Minimum 1,000 system users and 21 iFobs for locking receptors. System shall have a minimum 250,000 audit events screen displayed or ability to be exported via USB port.

1. Manufacturers:

    a. Medeco (MC).
    b. Traka (TA).

2.7 MECHANICAL LOCKS AND LATCHING DEVICES

A. Mortise Locksets, Grade 1 (Heavy Duty): ANSI/BHMA A156.13, Series 1000, Operational Grade 1 Certified Products Directory (CPD) listed. Locksets are to be manufactured with a corrosion resistant steel case and be field-reversible for handing without disassembly of the lock body.

1. Extended cycle test: Locks to have been cycle tested in ordinance with ANSI/BHMA 156.13 requirements to 14 million cycles or greater.

2. Manufacturers:

    a. Sargent Manufacturing (SA) - 8200 Series.
    b. No Substitution.

2.8 ELECTROMECHANICAL LOCKING DEVICES

A. Electromechanical Mortise Locksets, Grade 1 (Heavy Duty): ANSI/BHMA A156.13, Series 1000, Operational Grade 1 Certified Products Directory (CPD) listed, subject to same compliance standards and requirements as mechanical mortise locksets, electrified locksets to be of type and design as specified below and in the hardware sets.

1. Electrified Lock Options: Where indicated in the Hardware Sets, provide electrified options including: outside door lock/unlock trim control, latchbolt and lock/unlock status monitoring, deadbolt monitoring, and request-to-exit signaling. Support end-of-line resistors contained within the lock case. Unless otherwise indicated, provide electrified locksets standard as fail secure.

2. Energy Efficient Design: Provide lock bodies which have a holding current draw of 15mA maximum, and can operate on either 12 or 24 volts. Locks are to be field configurable for fail safe or fail secure operation.

3. Manufacturers:

   a. Sargent Manufacturing (SA) - 8200 Series.
   b. No Substitution.

2.9 AUXILIARY LOCKS

A. Mortise Deadlocks, Large Case: ANSI/BHMA A156.13 Grade 1 Certified Products Directory (CPD) listed large case mortise type deadlocks constructed of heavy gauge wrought corrosion resistant steel. One piece stainless steel bolts with a 1" throw. Deadlocks to be products of the same source manufacturer and keyway as other locksets.

   1. Manufacturers:

      a. Sargent Manufacturing (SA) - 8200 Series.
      b. No Substitution.

B. Behavioral Health, Cylindrical: ANSI/BHMA A156.2, Series 4000, Operational and Security Grade 1 Certified Products Directory (CPD) listed cylindrical locks that exceed 3,100 in-lb with no entry; lock to maintain egress functionality in compliance with BHMA certification requirements. Locksets shall be listed for low, medium and high risk areas in the NYS-OMH Patient Safety Standard. Latch retraction with preload shall exceed 100 lb. while maintaining ANSI/BHMA requirements for operation in warped doors. Locksets shall be provided standard with Torx® fasteners and with optional lead-lining and antimicrobial coating as specified in Hardware Sets.

   1. Manufacturers:

      a. Corbin Russwin (RU) - CLX3300 BHSS Series.
      b. Sargent Manufacturing (SA) - 10X BHW Series.
      c. No Substitution.

2.10 LOCK AND LATCH STRIKES

A. Strikes: Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:

   1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
   2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
   3. Aluminum-Frame Strike Box: Provide manufacturer's special strike box fabricated for aluminum framing.

4. Double-lipped strikes: For locks at double acting doors. Furnish with retractable stop for rescue hardware applications.

B. Standards: Comply with the following:

1. Strikes for Mortise Locks and Latches: BHMA A156.13.
2. Strikes for Bored Locks and Latches: BHMA A156.2.
3. Strikes for Auxiliary Deadlocks: BHMA A156.36.
4. Dustproof Strikes: BHMA A156.16.

2.11 CONVENTIONAL EXIT DEVICES

A. General Requirements: All exit devices specified herein shall meet or exceed the following criteria:

1. At doors not requiring a fire rating, provide devices complying with NFPA 101 and listed and labeled for "Panic Hardware" according to UL305. Provide proper fasteners as required by manufacturer including sex nuts and bolts at openings specified in the Hardware Sets.

2. Where exit devices are required on fire rated doors, provide devices complying with NFPA 80 and with UL labeling indicating "Fire Exit Hardware". Provide devices with the proper fasteners for installation as tested and listed by UL. Consult manufacturer’s catalog and template book for specific requirements.

3. Except on fire rated doors, provide exit devices with hex key dogging device to hold the pushbar and latch in a retracted position. Provide optional keyed cylinder dogging on devices where specified in Hardware Sets.

4. Devices must fit flat against the door face with no gap that permits unauthorized dogging of the push bar. The addition of filler strips is required in any case where the door light extends behind the device as in a full glass configuration.

5. Lever Operating Trim: Where exit devices require lever trim, furnish manufacturer's heavy duty escutcheon trim with threaded studs for thru-bolts.

   a. Lock Trim Design: As indicated in Hardware Sets, provide finishes and designs to match that of the specified locksets.
   b. Where function of exit device requires a cylinder, provide a cylinder (Rim or Mortise) as specified in Hardware Sets.

6. Vertical Rod Exit Devices: Where surface or concealed vertical rod exit devices are used at interior openings, provide as less bottom rod (LBR) unless otherwise indicated. Provide dust proof strikes where thermal pins are required to project into the floor.

7. Rim Exit Devices: Exit device rails shall release with less than 5 pounds of pressure per the California Building Code.

8. Narrow Stile Applications: At doors constructed with narrow stiles, or as specified in Hardware Sets, provide devices designed for maximum 2” wide stiles.

9. Dummy Push Bar: Nonfunctioning push bar matching functional push bar.

10. Rail Sizing: Provide exit device rails factory sized for proper door width application.

11. Through Bolt Installation: For exit devices and trim as indicated in Door Hardware Sets.

B. Conventional Push Rail Exit Devices (Heavy Duty): ANSI/BHMA A156.3, Grade 1 Certified Products Directory (CPD) listed panic and fire exit hardware devices furnished in the functions specified in the Hardware Sets. Exit device latch to be stainless steel, pullman type, with deadlock feature.

1. Manufacturers:

a. Sargent Manufacturing (SA) - 80 Series.
b. No Substitution.

2.12 ELECTROMECHANICAL EXIT DEVICES

A. Electromechanical Push Rail Exit Devices (Heavy Duty): ANSI/BHMA A156.3, Grade 1 Certified Products Directory (CPD) listed panic and fire exit hardware devices subject to same compliance standards and requirements as mechanical exit devices. Electrified exit devices to be of type and design as specified below and in the hardware sets.

1. Energy Efficient Design: Provide devices which have a holding current draw of 15mA maximum, and can operate on either 12 or 24 volts. Locks are to be field configurable for fail safe or fail secure operation.

2. Where conventional power supplies are not sufficient, include any specific controllers required to provide the proper inrush current.

3. Motorized Electric Latch Retraction: Devices with an electric latch retraction feature must use motors which have a maximum current draw of 600mA. Solenoid driven latch retraction is not acceptable.

4. Manufacturers:

a. Sargent Manufacturing (SA) - 80 Series.
b. No Substitution.

2.13 DOOR CLOSERS

A. All door closers specified herein shall meet or exceed the following criteria:

1. General: Door closers to be from one manufacturer, matching in design and style, with the same type door preparations and templates regardless of application or spring size. Closers to be non-handed with full sized covers.

2. Standards: Closers to comply with UL-10C for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.

3. Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Where closers are indicated for doors required to be accessible to the Americans with Disabilities Act, provide units complying with ANSI ICC/A117.1.

4. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.

5. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics.

6. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates as required for proper installation. Provide through-bolt and security type fasteners as specified in the hardware sets.

B. Door Closers, Surface Mounted (Heavy Duty): ANSI/BHMA A156.4, Grade 1 Certified Products Directory (CPD) listed surface mounted, heavy duty door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron or aluminum alloy body construction, with adjustable backcheck and separate non-critical valves for closing sweep and latch speed control. Provide non-handed units standard.

1. Manufacturers:

   a. Norton Rixson (NO) - 7500 Series.
   b. Sargent Manufacturing (SA) - 351 Series.

C. Door Closers, Overhead Concealed Double Acting (Heavy Duty): Center pivot, double acting ANSI/BHMA 156.4 Grade 1 Certified Products Directory (CPD) overhead door closers. UL Listed and ADA-compliant for interior or exterior doors up to 250 lbs. Closers are non-handed, with adjustable spring strength, hydraulic back check, and two closing speed adjustments for sweep and latch. Latch speed can be independently adjustable per door direction. Cast iron body construction with 1-1/4" dual pistons and an optional hold open feature. Closer bodies shall fit in a 1-3/4" x 4" metal or aluminum transom and 2-1/2" x 4-1/2" wood frame.

1. Manufacturers:

   a. dormakaba (DO) - RTS88 Series.
   b. LCN Closers (LC) - 6030 Series.
   c. Norton Rixson (RF) - 73 Series.
   d. No Substitution.

D. Door Closers, Overhead Concealed Single Acting (Heavy Duty): Single Acting (Heavy Duty): Center pivot, single acting ANSI/BHMA 156.4 Grade 1 Certified Products Directory (CPD) overhead door closers. UL Listed and ADA-compliant for interior or exterior doors up to 250 lbs. Closers are non-handed, with adjustable spring strength, hydraulic back check, and two closing speed adjustments for sweep and latch. Latch speed can be independently adjustable per door direction. Cast iron body construction with 1-1/4" dual pistons and an optional hold open feature. Closer bodies shall fit in a 1-3/4" x 4" metal or aluminum transom and 2-1/2" x 4-1/2" wood frame.

1. Manufacturers:

    a. dormakaba (DO) - RTS88 Series.
    b. LCN Closers (LC) - 2030 Series.
    c. Norton Rixson (RF) - 93 Series.
    d. No Substitution.

2.14 ARCHITECTURAL TRIM

A. Door Protective Trim

1. General: Door protective trim units to be of type and design as specified below or in the Hardware Sets.

2. Size: Fabricate protection plates (kick, armor, or mop) not more than 2" less than door width (LDW) on stop side of single doors and 1” LDW on stop side of pairs of doors, and not more than 1" less than door width on pull side. Coordinate and provide proper width and height as required where conflicting hardware dictates. Height to be as specified in the Hardware Sets.

3. Where plates are applied to fire rated doors with the top of the plate more than 16” above the bottom of the door, provide plates complying with NFPA 80. Consult manufacturer’s catalog and template book for specific requirements for size and applications.

4. Protection Plates: ANSI/BHMA A156.6 protection plates (kick, armor, or mop), fabricated from the following:

    a. Stainless Steel: 300 grade, 050-inch thick.

5. Options and fasteners: Provide manufacturer's designated fastener type as specified in the Hardware Sets. Provide countersunk screw holes.

6. Manufacturers:

    a. Burns Manufacturing (BU).
    b. Hiawatha, Inc. (HI).
    c. Rockwood (RO).

2.15 DOOR STOPS AND HOLDERS

A. General: Door stops and holders to be of type and design as specified below or in the Hardware Sets.

B. Door Stops and Bumpers: ANSI/BHMA A156.16, Grade 1 door stops and wall bumpers. Provide wall bumpers, either convex or concave types with anchorage as indicated, unless floor or other types of door stops are specified in Hardware Sets. Do not mount floor stops where they will impede traffic. Where floor or wall bumpers are not appropriate, provide overhead type stops and holders.

1. Manufacturers:

a. Burns Manufacturing (BU).
b. Hiawatha, Inc. (HI).
c. Rockwood (RO).

C. Overhead Door Stops and Holders: ANSI/BHMA A156.8, Grade 1 Certified Products Directory (CPD) listed overhead stops and holders to be surface or concealed types as indicated in Hardware Sets. Track, slide, arm and jamb bracket to be constructed of extruded bronze and shock absorber spring of heavy tempered steel. Provide non-handed design with mounting brackets as required for proper operation and function.

1. Manufacturers:

a. Norton Rixson (RF).
b. Rockwood (RO).
c. Sargent Manufacturing (SA).

2.16 ARCHITECTURAL SEALS

A. General: Thresholds, weatherstripping, and gasket seals to be of type and design as specified below or in the Hardware Sets. Provide continuous weatherstrip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated. At exterior applications provide non-corrosive fasteners and elsewhere where indicated.

B. Smoke Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke control ratings indicated, based on testing according to UL 1784.

1. Provide smoke labeled perimeter gasketing at all smoke labeled openings.

C. Fire Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to UL-10C.

1. Provide intumescent seals as indicated to meet UL10C Standard for Positive Pressure Fire Tests of Door Assemblies, and NPFA 252, Standard Methods of Fire Tests of Door Assemblies.

D. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated.

E. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.

F. Manufacturers:

1. Pemko (PE).
2. Reese Enterprises, Inc. (RE).

2.17 ELECTRONIC ACCESSORIES

A. Door Position Switches: Door position magnetic reed contact switches specifically designed for use in commercial door applications. On recessed models the contact and magnetic housing snap-lock into a 1" diameter hole. Surface mounted models include wide gap distance design complete with armored flex cabling. Provide SPDT, N/O switches with optional Rare Earth Magnet installation on steel doors with flush top channels.

1. Manufacturers:

a. Securitron (SU) - DPS Series.

2.18 FABRICATION

A. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to manufacturers recognized installation standards for application intended.

2.19 FINISHES

A. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.

B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware

C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine scheduled openings, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.

B. Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

3.2 PREPARATION

A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.

B. Wood Doors: Comply with ANSI/DHI A115-W series.

3.3 INSTALLATION

A. Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.

1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: hanging devices; locking devices; closing devices; and seals.

B. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:

1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
2. DHI TDH-007-20: Installation Guide for Doors and Hardware.
3. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."
4. Provide blocking in drywall partitions where wall stops or other wall mounted hardware is located.

C. Retrofitting: Install door hardware to comply with manufacturer's published templates and written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.

D. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."

E. Storage: Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

3.4 FIELD QUALITY CONTROL

A. Field Inspection (Punch Report): Reference Division 01 Sections “Closeout Procedures”. Produce project punch report for each installed door opening indicating compliance with approved submittals and verification hardware is properly installed, operating and adjusted. Include list of items to be completed and corrected, indicating the reasons or deficiencies causing the Work to be incomplete or rejected.

1. Organization of List: Include separate Door Opening and Deficiencies and Corrective Action Lists organized by Mark, Opening Remarks and Comments, and related Opening Images and Video Recordings.
2. Submit documentation of incomplete items in the following formats:

    a. PDF electronic file.
    b. Electronic formatted file integrated with the Openings Studio™ door opening management software platform.

3.5 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

3.6 CLEANING AND PROTECTION

A. Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.

B. Clean adjacent surfaces soiled by door hardware installation.

C. Clean operating items as necessary to restore proper finish. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.

3.7 DEMONSTRATION

A. Instruct Owner's maintenance personnel to adjust, operate, and maintain mechanical and electromechanical door hardware.

3.8 DOOR HARDWARE SETS

A. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.

1. Quantities listed are for each pair of doors, or for each single door.

2. The supplier is responsible for handing and sizing all products.

3. Where multiple options for a piece of hardware are given in a single line item, the supplier shall provide the appropriate application for the opening.

B. Manufacturer's Abbreviations:

1. MK - McKinney
2. OT - Other
3. MR - Markar
4. SU - Securitron
5. RO - Rockwood
6. AD - Adams Rite
7. SA - SARGENT
8. RF - Rixson
9. PE - Pemko

Hardware Sets

Set: 1.0

Doors: 100, 115A, 115C, 200A, 200B

2	Continuous Hinge	FM300 CTP WEP	630	MR	
2	Electric Power Transfer	CEPT-10		SU	⚡
1	Dust Proof Strike	570	US26D	RO	
1	Concealed Vert Rod Exit, Exit Only	43 5CH 56 MD8610 EO 525	US32D	SA	⚡
1	Concealed Vert Rod Exit, Nightlatch	LC 43 5CH 56 MD8610 106 Less Pull 525	US32D	SA	⚡
1	Cylinder	Match Facility Standard		OT	
2	Pull	RM2120-84 Mtg-Type HD	US32D	RO	
2	Conc Overhead Stop	1-X36	630	RF	

2	Door Closer	351 P10	EN	SA
2	Drop Plate	As required		
1	Threshold	271A x FHSL14 (verify with details)	Al	PE
1	Rain Guard	346A		PE
2	Sweep	315CN		PE
2	Frame Harness	QC-C1500		MK
2	Door Harness	QC-C__ (as required)		MK
2	Position Switch	DPS-M-WH		SU
1	Power Supply	AQDx (fire relay as required)		SU

Notes: Card reader by integrator

Doors normally closed and locked with free egress at all times. Valid credential will momentarily unlatch both doors. Doors remain locked with loss of power.

Seals by Frame MFG

Set: 1.1

Doors: 115F

2	Continuous Hinge	FM300 CTP WEP	630	MR
2	Electric Power Transfer	CEPT-10		SU
1	Dust Proof Strike	570	US26D	RO
1	Concealed Vert Rod Exit, Exit Only	43 5CH 56 MD8610 EO 525	US32D	SA
1	Concealed Vert Rod Exit, Nightlatch	LC 43 5CH 56 MD8610 106 Less Pull 525	US32D	SA
1	Cylinder	Match Facility Standard		OT
2	Pull	RM2120-84 Mtg-Type HD	US32D	RO
2	Door Closer	351 P10	EN	SA
2	Drop Plate	As required		
2	Door Stop	466-RKW	Black	RO
1	Threshold	271A x FHSL14 (verify with details)	Al	PE
1	Rain Guard	346A		PE
2	Sweep	315CN		PE
2	Frame Harness	QC-C1500		MK
2	Door Harness	QC-C__ (as required)		MK
2	Position Switch	DPS-M-WH		SU
1	Power Supply	AQDx (fire relay as required)		SU

Notes: Card reader by integrator

Doors normally closed and locked with free egress at all times. Valid credential will momentarily unlatch both doors. Doors remain locked with loss of power.

template to swing 180 degrees

Seals by Frame MFG

Set: 2.0

Doors: 114B, P03

1	Continuous Hinge	FM300 CTP WEP	630	MR	
1	Electric Power Transfer	CEPT-10		SU	⚡
1	Fail Secure Lock	LC RX 8271-24V LNP	US32D	SA	⚡
1	Cylinder	Match Facility Standard		OT	
1	Conc Overhead Stop	1-X36	630	RF	
1	Door Closer	351 P10	EN	SA	
1	Drop Plate	As required			
1	Threshold	271A x FHSL14 (verify with details)	Al	PE	
1	Rain Guard	346A		PE	
1	Sweep	315CN		PE	
1	Frame Harness	QC-C1500		MK	⚡
1	Door Harness	QC-C__ (as required)		MK	⚡
1	Power Supply	AQDx (fire relay as required)		SU	⚡

Notes: Card reader by integrator

Door normally closed and locked with free egress at all times. Valid credential will unlock active door. Door remains locked with loss of power.

Seals by Frame MFG

Set: 3.0

Doors: 200C

1	Continuous Hinge	FM300 WEP	630	MR
1	Rim Exit Device, Storeroom	LC 16 43 5CH 8804 Less Pull 525	US32D	SA
3	Cylinder	Match Facility Standard		OT
1	Pull	RM2120-12 Mtg-Type HD	US32D	RO

1	Door Closer	351 P10	EN	SA
1	Drop Plate	As required		
1	Door Stop	466-RKW	Black	RO
1	Threshold	271A x FHSL14 (verify with details)	Al	PE
1	Rain Guard	346A		PE
1	Sweep	315CN		PE
1	Position Switch	DPS-M-WH		SU

Notes: template to swing 180 degrees

Seals by Frame MFG

Set: 4.0

Doors: 115B, 116A, 117A

1	Continuous Hinge	FM300 WEP	630	MR
1	Rim Exit Device, Storeroom	LC 16 43 5CH 8804 Less Pull 525	US32D	SA
2	Cylinder	Match Facility Standard		OT
1	Pull	RM2120-84 Mtg-Type HD	US32D	RO
1	Conc Overhead Stop	1-X36	630	RF
1	Door Closer	351 P10	EN	SA
1	Drop Plate	As required		
1	Threshold	271A x FHSL14 (verify with details)	Al	PE
1	Sweep	315CN		PE
1	Position Switch	DPS-M-WH		SU

Notes: Seals by Frame MFG

Set: 5.0

Doors: 110B

1	Continuous Hinge	FM300 WEP	630	MR
1	Electric Power Transfer	CEPT-10		SU
1	Rim Exit Device, Storeroom	LC 43 5CH 56 8804 ETP	US32D	SA
1	Cylinder	Match Facility Standard		OT
1	Conc Overhead Stop	1-X36	630	RF
1	Door Closer	351 P10	EN	SA
1	Kick Plate	K1050 10" BEV CSK	US32D	RO

1	Threshold	271A x FHSL14 (verify with details)	Al	PE
1	Gasketing	290AS		PE
1	Rain Guard	346A		PE
1	Sweep	315CN		PE
1	Frame Harness	QC-C1500		MK
1	Door Harness	QC-C__ (as required)		MK
1	Position Switch	DPS-M-WH		SU
1	Power Supply	AQDx (fire relay as required)		SU

Notes: Card reader by integrator

Door normally closed and locked with free egress at all times. Valid credential will momentarily unlatch door. Door remains locked with loss of power.

Set: 6.0

Doors: 115E

1	Continuous Hinge	FM300 WEP	630	MR
1	Rim Exit Device, Exit Only	43 5CH 8810 EO 525	US32D	SA
1	Pull	RM2120-84 Mtg-Type HD	US32D	RO
1	Conc Overhead Stop	1-X36	630	RF
1	Door Closer	351 P10	EN	SA
1	Kick Plate	K1050 10" BEV CSK	US32D	RO
1	Threshold	271A x FHSL14 (verify with details)	Al	PE
1	Gasketing	290AS		PE
1	Sweep	315CN		PE
1	Position Switch	DPS-M-WH		SU

Notes:

Set: 7.0

Doors: 106B

1	Continuous Hinge	FM300 CTP WEP	630	MR
1	Continuous Hinge	FM300 WEP	630	MR
2	Electric Power Transfer	CEPT-10		SU
1	Flush Bolt	2845	US32D	RO
1	Dust Proof Strike	570	US26D	RO

1	Fail Secure Lock	LC RX 8271-24V LNP	US32D	SA	⚡
1	Cylinder	Match Facility Standard		OT	
1	Coordinator	2600 x FB x Mtg Brkts	US28	RO	
2	Door Closer	351 P10	EN	SA	
2	Kick Plate	K1050 10" BEV CSK	US32D	RO	
2	Door Stop	466-RKW	Black	RO	
1	Threshold	271A x FHSL14 (verify with details)	Al	PE	
1	Gasketing	290AS		PE	
1	Rain Guard	346A		PE	
2	Sweep	315CN		PE	
1	Astragal	357C		PE	
1	Frame Harness	QC-C1500		MK	⚡
1	Door Harness	QC-C__ (as required)		MK	⚡
2	Position Switch	DPS-M-WH		SU	⚡
1	Power Supply	AQDx (fire relay as required)		SU	⚡

Notes: Card reader by integrator

Door normally closed and locked with free egress at all times. Valid credential will unlock active door. Door remains locked with loss of power.

Set: 8.0

Doors: P01B, P01C

1	Continuous Hinge	FM300 CTP WEP	630	MR	
1	Continuous Hinge	FM300 WEP	630	MR	
2	Electric Power Transfer	CEPT-10		SU	⚡
1	Flush Bolt	2845	US32D	RO	
1	Dust Proof Strike	570	US26D	RO	
1	Fail Secure Lock	LC RX 8271-24V LNP	US32D	SA	⚡
1	Cylinder	Match Facility Standard		OT	
1	Coordinator	2600 x FB x Mtg Brkts	US28	RO	
2	Conc Overhead Stop	1-X36	630	RF	
2	Door Closer	351 P10	EN	SA	
2	Kick Plate	K1050 10" BEV CSK	US32D	RO	
1	Threshold	271A x FHSL14 (verify with details)	Al	PE	
1	Gasketing	290AS		PE	
1	Rain Guard	346A		PE	
2	Sweep	315CN		PE	

1	Astragal	357C		PE
1	Frame Harness	QC-C1500		MK
1	Door Harness	QC-C__ (as required)		MK
2	Position Switch	DPS-M-WH		SU
1	Power Supply	AQDx (fire relay as required)		SU

Notes: Card reader by integrator

Door normally closed and locked with free egress at all times. Valid credential will unlock active door. Door remains locked with loss of power.

Set: 9.0

Doors: 111D

2	Hinge (heavy weight)	T4A3786	US26D	MK
1	Hinge, Full Mortise, Hvy Wt	T4A3786 QCx	US26D	MK
1	Fail Secure Lock	LC RX 8271-24V LNP	US32D	SA
1	Cylinder	Match Facility Standard		OT
1	Door Closer	351 O/P9	EN	SA
1	Kick Plate	K1050 10" BEV CSK	US32D	RO
1	Wall Stop	409	US32D	RO
1	Threshold	271A x FHSL14 (verify with details)	Al	PE
1	Gasketing	290AS		PE
1	Rain Guard	346A		PE
1	Sweep	315CN		PE
1	Frame Harness	QC-C1500		MK
1	Door Harness	QC-C__ (as required)		MK
1	Position Switch	DPS-M-WH		SU
1	Power Supply	AQDx (fire relay as required)		SU

Notes: Card reader by integrator

Door normally closed and locked with free egress at all times. Valid credential will unlock door. Door remains locked with loss of power.

Set: 10.0

Doors: 109, P01

1	Continuous Hinge	FM300 CTP WEP	630	MR	
1	Electric Power Transfer	CEPT-10		SU	⚡
1	Fail Secure Lock	LC RX 8271-24V LNP	US32D	SA	⚡
1	Cylinder	Match Facility Standard		OT	
1	Door Closer	351 P10	EN	SA	
1	Kick Plate	K1050 10" BEV CSK	US32D	RO	
1	Door Stop	466-RKW	Black	RO	
1	Threshold	271A x FHSL14 (verify with details)	Al	PE	
1	Gasketing	290AS		PE	
1	Rain Guard	346A		PE	
1	Sweep	315CN		PE	
1	Frame Harness	QC-C1500		MK	⚡
1	Door Harness	QC-C__ (as required)		MK	⚡
1	Power Supply	AQDx (fire relay as required)		SU	⚡

Notes: Card reader by integrator

Door normally closed and locked with free egress at all times. Valid credential will unlock active door. Door remains locked with loss of power.

Set: 11.0

Doors: P02

1	Continuous Hinge	FM300 CTP WEP	630	MR	
1	Electric Power Transfer	CEPT-10		SU	⚡
1	Fail Secure Lock	LC RX 8271-24V LNP	US32D	SA	⚡
1	Cylinder	Match Facility Standard		OT	
1	Conc Overhead Stop	1-X36	630	RF	
1	Door Closer	351 P10	EN	SA	
1	Kick Plate	K1050 10" BEV CSK	US32D	RO	
1	Threshold	271A x FHSL14 (verify with details)	Al	PE	
1	Gasketing	290AS		PE	
1	Rain Guard	346A		PE	
1	Sweep	315CN		PE	
1	Frame Harness	QC-C1500		MK	⚡
1	Door Harness	QC-C__ (as required)		MK	⚡
1	Power Supply	AQDx (fire relay as required)		SU	⚡

Notes: Card reader by integrator

Door normally closed and locked with free egress at all times. Valid credential will unlock active door. Door remains locked with loss of power.

Set: 12.0

Doors: 113A, 114A, 114C

4	Hinge (heavy weight)	T4A3786	US26D	MK	
1	Storeroom/Closet Lock	LC 8204 LNP	US32D	SA	
1	Cylinder	Match Facility Standard		OT	
1	Door Closer	351 O/P9	EN	SA	
1	Kick Plate	K1050 10" BEV CSK	US32D	RO	
1	Wall Stop	409	US32D	RO	
1	Threshold	271A x FHSL14 (verify with details)	Al	PE	
1	Gasketing	290AS		PE	
1	Rain Guard	346A		PE	
1	Sweep	315CN		PE	

Notes:

Set: 13.0

Doors: 206A

1	Continuous Hinge	FM300 CTP WEP	630	MR	
1	Continuous Hinge	FM300 WEP	630	MR	
2	Electric Power Transfer	CEPT-10		SU	⚡
1	Concealed Vert Rod Exit, Nightlatch	LC NB 43 5CH 56 MD8610 106 Less Pull 525 (rated as required)	US32D	SA	⚡
1	Concealed Vert Rod Exit, Exit Only	NB 43 5CH MD8610 EO 525 (rated as required)	US32D	SA	
1	Cylinder	Match Facility Standard		OT	
2	Pull	RM2120-12 Mtg-Type HD	US32D	RO	
2	Door Closer	351 P10	EN	SA	
2	Drop Plate	As required			
2	Wall Stop	409	US32D	RO	
1	Frame Harness	QC-C1500		MK	⚡
1	Door Harness	QC-C__ (as required)		MK	⚡
1	Position Switch	DPS-M-WH		SU	⚡

1	Power Supply	AQDx (fire relay as required)		SU	⚡

Notes: Card reader by integrator

Doors normally closed and locked with free egress at all times. Valid credential will momentarily unlatch active door leaf. Doors remain locked with loss of power.

Seals by Frame MFG

Set: 13.5

Doors: 105

1	Continuous Hinge	FM300 CTP WEP	630	MR	
1	Continuous Hinge	FM300 WEP	630	MR	
2	Electric Power Transfer	CEPT-10		SU	⚡
1	Concealed Vert Rod Exit, Nightlatch	LC NB 43 5CH 56 MD8610 106 Less Pull 525 (rated as required)	US32D	SA	⚡
1	Concealed Vert Rod Exit, Exit Only	NB 43 5CH MD8610 EO 525 (rated as required)	US32D	SA	
1	Cylinder	Match Facility Standard		OT	
2	Pull	RM2120-12 Mtg-Type HD	US32D	RO	
2	Door Closer	351 P10	EN	SA	
2	Drop Plate	As required			
2	Wall Stop	409	US32D	RO	
1	Frame Harness	QC-C1500		MK	⚡
1	Door Harness	QC-C__ (as required)		MK	⚡
1	Position Switch	DPS-M-WH		SU	⚡
1	Power Supply	AQDx (fire relay as required)		SU	⚡

Notes: Card reader by integrator

Doors normally closed and locked with free egress at all times. Valid credential will momentarily unlatch active door leaf. Doors remain locked with loss of power.

Seals by Frame MFG

Set: 14.0

Doors: 206B, 209, 210

1	Continuous Hinge	FM300 CTP WEP	630	MR

1	Electric Power Transfer	CEPT-10		SU
1	Rim Exit Device, Storeroom	LC 43 5CH 56 8804 Less Pull 525 (rated as required)	US32D	SA
1	Cylinder	Match Facility Standard		OT
1	Offset Door Pull	RM3131-12	US32D	RO
1	Door Closer	351 P10	EN	SA
1	Drop Plate	As required		
1	Wall Stop	409	US32D	RO
1	Frame Harness	QC-C1500		MK
1	Door Harness	QC-C__ (as required)		MK
1	Power Supply	AQDx (fire relay as required)		SU

Notes: Card reader by integrator

Door normally closed and locked with free egress at all times. Valid credential will unlock active door. Door remains locked with loss of power.

Seals by Frame MFG

Set: 15.0

Doors: 207, 208B, 208C, 216

1	Continuous Hinge	FM300 CTP WEP	630	MR
1	Electric Power Transfer	CEPT-10		SU
1	Fail Secure Lock	LC RX 8271-24V LNP	US32D	SA
1	Cylinder	Match Facility Standard		OT
1	Door Closer	351 O/P9	EN	SA
1	Drop Plate	As required		
1	Wall Stop	409	US32D	RO
1	Frame Harness	QC-C1500		MK
1	Door Harness	QC-C__ (as required)		MK
1	Power Supply	AQDx (fire relay as required)		SU

Notes: Card reader by integrator

Door normally closed and locked with free egress at all times. Valid credential will unlock active door. Door remains locked with loss of power.

Seals by Frame MFG

Set: 16.0

Doors: 111C, 112A, 211

1	Continuous Hinge	FM300 WEP	630	MR
1	Classroom Lock	LC 8237 LNP	US32D	SA
1	Cylinder	Match Facility Standard		OT
1	Door Closer	351 O/P9	EN	SA
1	Drop Plate	As required		
1	Wall Stop	409	US32D	RO

Notes: Seals by Frame MFG

Set: 16.5

Doors: 204

1	Continuous Hinge	FM300 WEP	630	MR
2	Pull	RM2120-12 BTB	US32D	RO
1	Door Closer	351 O/P9	EN	SA
1	Drop Plate	As required		
1	Wall Stop	409	US32D	RO

Notes: Seals by Frame MFG

Set: 17.0

Doors: 205

1	Continuous Hinge	FM300 WEP	630	MR
1	Rim Exit Device, Storeroom	LC 16 43 5CH 8804 ETP 525	US32D	SA
2	Cylinder	Match Facility Standard		OT
1	Door Closer	351 O/P9	EN	SA
1	Drop Plate	As required		
1	Wall Stop	409	US32D	RO

Notes: Seals by Frame MFG

Set: 18.0

Doors: 110A

3	Hinge (heavy weight)	T4A3386 NRP	US32D	MK	
1	Hinge, Full Mortise, Hvy Wt	T4A3786 QCx	US26D	MK	⚡
1	Rim Exit Device, Storeroom	12 LC 43 5CH 56 8804 ETP 525	US32D	SA	⚡
1	Cylinder	Match Facility Standard		OT	
1	Door Closer	351 P10	EN	SA	
1	Kick Plate	K1050 10" BEV CSK	US32D	RO	
1	Wall Stop	409	US32D	RO	
1	Threshold	271A x FHSL14 (verify with details)	Al	PE	
1	Gasketing	S88BL		PE	
1	Sweep	315CN		PE	
1	Frame Harness	QC-C1500		MK	⚡
1	Door Harness	QC-C__ (as required)		MK	⚡
1	Position Switch	DPS-M-WH		SU	⚡
1	Power Supply	AQDx (fire relay as required)		SU	⚡

Notes: Card reader by integrator

Door normally closed and locked with free egress at all times. Valid credential will momentarily unlatch door. Door remains locked with loss of power.

Set: 19.0

Doors: 203

7	Hinge (heavy weight)	T4A3786	US26D	MK	
1	Hinge, Full Mortise, Hvy Wt	T4A3786 QCx	US26D	MK	⚡
1	Concealed Vert Rod Exit, Exit Only	NB 43 5CH WD8610 EO 525	US32D	SA	
1	Concealed Vert Rod Exit, Nightlatch	LC NB 43 5CH 56 WD8610 106 Less Pull 525	US32D	SA	⚡
1	Cylinder	Match Facility Standard		OT	
2	Pull	RM2120-84 Mtg-Type HD	US32D	RO	
1	Coordinator	2600 x FB x Mtg Brkts	US28	RO	
2	Door Closer	351 O/P9	EN	SA	
2	Kick Plate	K1050 10" BEV CSK	US32D	RO	
2	Wall Stop	409/441H as required	US32D	RO	
1	Astragal	357C		PE	
2	Silencer	608-RKW		RO	
1	Frame Harness	QC-C1500		MK	⚡

1	Door Harness	QC-C__ (as required)		MK
1	Position Switch	DPS-M-WH		SU
1	Power Supply	AQDx (fire relay as required)		SU

Notes: Card reader by integrator

Door normally closed and locked with free egress at all times. Valid credential will unlatch active door. Door remains locked with loss of power.

Set: 20.0

Doors: 103B, 104B, 108

3	Hinge (heavy weight)	T4A3786	US26D	MK
1	Hinge, Full Mortise, Hvy Wt	T4A3786 QCx	US26D	MK
1	Fail Secure Lock	LC RX 8271-24V LNP	US32D	SA
1	Cylinder	Match Facility Standard		OT
1	Door Closer	351 O/P9	EN	SA
1	Kick Plate	K1050 10" BEV CSK	US32D	RO
1	Wall Stop	409	US32D	RO
1	Gasketing	S88BL		PE
1	Frame Harness	QC-C1500		MK
1	Door Harness	QC-C__ (as required)		MK
1	Position Switch	DPS-M-WH		SU
1	Power Supply	AQDx (fire relay as required)		SU

Notes: Card reader by integrator

Door normally closed and locked with free egress at all times. Valid credential will unlock door. Door remains locked with loss of power.

Set: 21.0

Doors: 101, 102, 106A

7	Hinge (heavy weight)	T4A3786	US26D	MK
1	Hinge, Full Mortise, Hvy Wt	T4A3786 QCx	US26D	MK
1	Auto Flush Bolt top bolt only - Wood door	2940	US26D	RO
1	Fail Secure Lock	LC RX 8271-24V LNP	US32D	SA

1	Cylinder	Match Facility Standard		OT
1	Coordinator	2600 x FB x Mtg Brkts	US28	RO
2	Door Closer	351 O/P9	EN	SA
2	Kick Plate	K1050 10" BEV CSK	US32D	RO
2	Wall Stop	409/441H as required	US32D	RO
1	Astragal	357C		PE
2	Silencer	608-RKW		RO
1	Frame Harness	QC-C1500		MK
1	Door Harness	QC-C__ (as required)		MK
1	Power Supply	AQDx (fire relay as required)		SU

Notes:

Card reader by integrator

Door normally closed and locked with free egress at all times. Valid credential will unlock active door. Door remains locked with loss of power.

Set: 21.5

Doors: 113

7	Hinge (heavy weight)	T4A3786	US26D	MK
1	Auto Flush Bolt top bolt only - Wood door	2940	US26D	RO
1	Storeroom/Closet Lock	LC 8204 LNP	US32D	SA
1	Cylinder	Match Facility Standard		OT
1	Coordinator	2600 x FB x Mtg Brkts	US28	RO
2	Door Closer	351 O/P9	EN	SA
2	Kick Plate	K1050 10" BEV CSK	US32D	RO
2	Wall Stop	409/441H as required	US32D	RO
1	Astragal	357C		PE
2	Silencer	608-RKW		RO

Notes:

Set: 22.0

Doors: 105D

4	Hinge (heavy weight)	T4A3786	US26D	MK

1	Storeroom/Closet Lock	LC 8204 LNP	US32D	SA
1	Cylinder	Match Facility Standard		OT
1	Kick Plate	K1050 10" BEV CSK	US32D	RO
1	Wall Stop	409	US32D	RO
3	Silencer	608-RKW		RO

Set: 23.0

Doors: 107C, 205B, 208A, 208D

4	Hinge (heavy weight)	T4A3786	US26D	MK
1	Storeroom/Closet Lock	LC 8204 LNP	US32D	SA
1	Cylinder	Match Facility Standard		OT
1	Door Closer	351 O/P9	EN	SA
1	Kick Plate	K1050 10" BEV CSK	US32D	RO
1	Wall Stop	409/441H as required	US32D	RO
3	Silencer	608-RKW		RO

Set: 24.0

Doors: 101B

3	Hinge (heavy weight)	T4A3786	US26D	MK
1	Hinge, Full Mortise, Hvy Wt	T4A3786 QCx	US26D	MK
1	Fail Secure Lock	LC RX 8271-24V LNP	US32D	SA
1	Cylinder	Match Facility Standard		OT
1	Door Closer	351 CPS	EN	SA
1	Kick Plate	K1050 10" BEV CSK	US32D	RO
1	Wall Stop	409	US32D	RO
3	Silencer	608-RKW		RO
1	Frame Harness	QC-C1500		MK
1	Door Harness	QC-C__ (as required)		MK
1	Position Switch	DPS-M-WH		SU
1	Power Supply	AQDx (fire relay as required)		SU

Notes: Card reader by integrator

Door normally closed and locked with free egress at all times. Valid credential will unlock door. Door remains locked with loss of power.

Set: 25.0

Doors: 105A, 105B, 107A, 107B, 212A, 212B, 212C, 212D, 213A, 213B, 213C, 213D, 214A, 214B, 214C, 214D, 215, 215B

4	Hinge (heavy weight)	T4A3786	US26D	MK
1	Office/Entry Lock	LB LC 8205 LNP	US32D	SA
1	Door Closer	351 O/P9	EN	SA
1	Kick Plate	K1050 10" BEV CSK	US32D	RO
1	Wall Stop	409/441H as required	US32D	RO
1	Threshold	271A x FHSL14 (verify with details)	Al	PE
1	Gasketing	S88BL		PE
1	Sweep	315CN		PE
1	Coat Hook	RM802	US26D	RO

Set: 26.0

Doors: 105C, 105E, 105F

4	Hinge (heavy weight)	T4A3786	US26D	MK
1	Office/Entry Lock	LB LC 8205 LNP	US32D	SA
1	Cylinder	Match Facility Standard		OT
1	Door Closer	351 O/P9	EN	SA
1	Kick Plate	K1050 10" BEV CSK	US32D	RO
1	Wall Stop	409/441H as required	US32D	RO
3	Silencer	608-RKW		RO

Set: 26.5

Doors: 103, 104

4	Hinge (heavy weight)	T4A3786	US26D	MK
1	Office/Entry Lock	LB LC 8205 LNP	US32D	SA
1	Door Closer	351 O/P9	EN	SA
1	Kick Plate	K1050 10" BEV CSK	US32D	RO
1	Wall Stop	409/441H as required	US32D	RO
1	Threshold	271A x FHSL14 (verify with details)	Al	PE
1	Gasketing	S88BL		PE
1	Sweep	315CN		PE
1	Coat Hook	RM802	US26D	RO

Set: 27.0

Doors: 201A, 204B

4	Hinge (heavy weight)	T4A3786	US26D	MK
1	Privacy Lock	LB 49 8265 LNP	US32D	SA
1	Door Closer	351 O/P9	EN	SA
1	Kick Plate	K1050 10" BEV CSK	US32D	RO
1	Mop Plate	K1050 6" high CSK BEV	US32D	RO
1	Wall Stop	409/441H as required	US32D	RO
3	Silencer	608-RKW		RO

Set: 28.0

Doors: 112B

4	Hinge (heavy weight)	T4A3786	US26D	MK
1	Privacy Lock	LB 49 8265 LNP	US32D	SA
1	Door Closer	351 O/P9	EN	SA
1	Kick Plate	K1050 10" BEV CSK	US32D	RO
1	Wall Stop	409	US32D	RO
3	Silencer	608-RKW		RO

Set: 29.0

Doors: 103C, 104C, 204A, 205A, 217A, 217B

4	Hinge (heavy weight)	T4A3786	US26D	MK
1	Classroom Deadlock	LC 8203	US32D	SA
1	Cylinder	Match Facility Standard		OT
1	Push Pull Set	110x73C/73CL	US32D	RO
1	Door Closer	351 O/P9	EN	SA
1	Kick Plate	K1050 10" BEV CSK	US32D	RO
1	Wall Stop	409/441H as required	US32D	RO
3	Silencer	608-RKW		RO

Set: 30.0

Doors: 111A, 111B, 116, 117

4	Hinge (heavy weight)	T4A3786	US26D	MK
1	Classroom Deadlock	LC 8203	US32D	SA
1	Cylinder	Match Facility Standard		OT
1	Push Pull Set	110x73C/73CL	US32D	RO
1	Surface Closer	351 H	EN	SA
1	Kick Plate	K1050 10" BEV CSK	US32D	RO
1	Wall Stop	409/441H as required	US32D	RO

3	Silencer	608-RKW		RO

Set: 32.0

Doors: 115D, 209A

1	Note	All Hardware by Door Manufacturer		OT

Set: 33.0

Doors: PG2, PG3, PG5

3	Hinge (heavy weight)	T4A3386 NRP	US32D	MK
1	Weldable Gate Box	Keedex as required		OT
1	Rim Exit Device, Storeroom	LC 16 43 5CH 8804 Less Pull 525	US32D	SA
2	Cylinder	Match Facility Standard		OT
1	Pull	RM2120-12 Mtg-Type HD	US32D	RO
1	Door Closer	351 P10	EN	SA
1	Note	Balance of Hardware by Gate Manufacturer		OT

Set: 34.0

Doors: PG4

1	Note	Hardware by Gate Manufacturer		OT

Set: 35.0

Doors: PG1

6	Hinge (heavy weight)	T4A3386 NRP	US32D	MK
1	Weldable Gate Box	Keedex as required		OT
1	Rim Exit Device, Storeroom	LC 16 43 5CH 8804 Less Pull 525	US32D	SA
4	Cylinder	Match Facility Standard		OT
2	Pull	RM2120-84 Mtg-Type HD	US32D	RO
2	Door Closer	351 P10	EN	SA
1	Note	Balance of Hardware by Gate Manufacturer		OT
1	Note	Mullion by Gate Manufacturer		OT

Set: 36.0

Doors: GG1, GG10, GG2, GG3, GG4, GG5, GG6, GG7, GG8, GG9

1	Institutional Lock	LC 8252 LNP	US32D	SA
1	Weldable Gate Box	Keedex as required		OT
1	Note	Balance of Hardware by Gate Manufacturer		OT

Set: 37.0

Doors: GG11

1	Institutional Lock	LC 8252 LNP	US32D	SA
1	Weldable Gate Box	Keedex as required		OT
1	Note	Balance of Hardware by Gate Manufacturer		OT

Notes: Cane bolt by gate manufacturer

END OF SECTION 087100

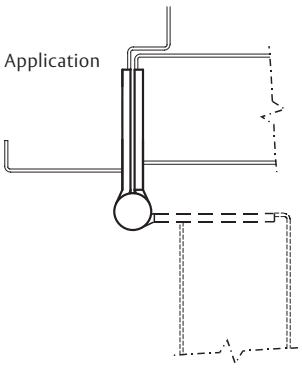
Five Knuckle Heavy Weight Full Mortise Series

Recommended for use on high frequency and/or heavy wood or metal doors in schools, hospitals or other public buildings where heavy traffic is experienced.

- Heavy weight hinges should be used on all extra heavy doors or those exposed to high frequency use
- T4A3386- Stainless steel base or available in brass base material polished
- T4A3786- Steel base material
- For Beveled Edge, where doors are beveled on hinge side, specify T4A4386 or T4A4786
- For available finishes see page 28

Note: 8" x 6" and 8" x 8" have six bearings. Specify T6B3386 or T6B3786.

T4A3386
T4A3786



No.	ANSI Cross Reference	Base Material	Weight
T4A3386	A5111	Stainless	HVY
T4A3386	A2111	Brass	HVY
T4A3786	A8111	Steel	HVY

Specifications

Inches	mm	Gauge	No. of Holes	Fasteners	
				Machine	Wood
4 1/2" x 4"	114.3 x 101.6	.180	8	1/2 x 12-24	1 1/4 x 12
4 1/2" x 4 1/2"	114.3 x 114.3	.180	8	1/2 x 12-24	1 1/4 x 12
5" x 4 1/2"	127 x 114.3	.190	8	1/2 x 12-24	1 1/4 x 12
5" x 5"*	127 x 127	.190	8	1/2 x 12-24	1 1/4 x 12
6" x 5"*	152.4 x 127	.203	10	1/2 x 1/4-20	1 1/2 x 14
6" x 6"*	152.4 x 152.4	.203	10	1/2 x 1/4-20	1 1/2 x 14
8" x 6"**	203.2 x 125.4	.203	16	1/2 x 1/4-20	1 1/2 x 14
8" x 8"***	203.2 x 203.2	.203	16	1/2 x 1/4-20	1 1/2 x 14

* Not available in brass base material.
** Available in steel only.
***Available in stainless steel only.
****FT tips not offered on 6" and 8" sizes, BT and ST not offered on 8" sizes.

Options:

Code	Description
NRP	Non-Removable Pin
T4B	Ball Bearing
TCA	Concealed Bearing
RC	Round Corner – 1/4" radius furnished unless specified otherwise
HT	Hospital Tip
BT**	Ball Tip
FT **	Flat Tip
ST**	Steeple Tip
SSF	Safety Stud Feature
RB	Raised Barrel*
QC	ElectroLynx® Hinge – 4, 8 or 12 wire available
CC	Concealed Circuit – 4, 8 or 12 wire available
CC-18	Concealed Circuit – 2, 4, 6, 8 or 10 wire available (2-18AWG wires and the remainder 28AWG wires)
MM	Magnetic Monitoring

* Refer to page SP-3 for Raised Barrel.

Hinge Pins

Pins, by design, are non-rising.

Two Knuckle

Pins on bearing hinges are furnished in stainless steel.

Three Knuckle

Pin stems in all non-ferrous bearing hinges are stainless steel.
Pins in all ferrous hinges are steel.

Five Knuckle

Pins on all non-ferrous bearing hinges are stainless steel with button tips.

Pins on all ferrous hinges are steel.

Non-Removable Pins

NRP

A set screw is driven into the barrel of the hinge that is inaccessible when the door is in the closed position. To order, add the suffix "NRP" to the hinge number.

NRD

Two knuckle hinges are available with a non-removable pin which features a dowel which is force fitted into the jamb leaf. When the door is hung, the pin is completely concealed and impossible to remove. One doweled hinge is usually furnished per set of three. To order, add the suffix "NRD" to the hinge number.

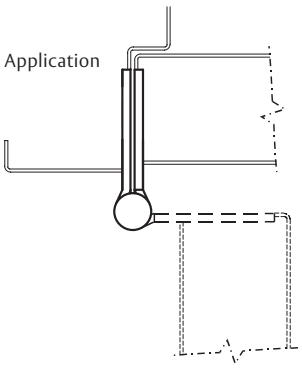
Five Knuckle Heavy Weight Full Mortise Series

Recommended for use on high frequency and/or heavy wood or metal doors in schools, hospitals or other public buildings where heavy traffic is experienced.

- Heavy weight hinges should be used on all extra heavy doors or those exposed to high frequency use
- T4A3386- Stainless steel base or available in brass base material polished
- T4A3786- Steel base material
- For Beveled Edge, where doors are beveled on hinge side, specify T4A4386 or T4A4786
- For available finishes see page 28

Note: 8" x 6" and 8" x 8" have six bearings. Specify T6B3386 or T6B3786.

T4A3386
T4A3786



No.	ANSI Cross Reference	Base Material	Weight
T4A3386	A5111	Stainless	HVY
T4A3386	A2111	Brass	HVY
T4A3786	A8111	Steel	HVY

Specifications

Inches	mm	Gauge	No. of Holes	Fasteners	
				Machine	Wood
4 1/2" x 4"	114.3 x 101.6	.180	8	1/2 x 12-24	1 1/4 x 12
4 1/2" x 4 1/2"	114.3 x 114.3	.180	8	1/2 x 12-24	1 1/4 x 12
5" x 4 1/2"	127 x 114.3	.190	8	1/2 x 12-24	1 1/4 x 12
5" x 5"*	127 x 127	.190	8	1/2 x 12-24	1 1/4 x 12
6" x 5"*	152.4 x 127	.203	10	1/2 x 1/4-20	1 1/2 x 14
6" x 6"*	152.4 x 152.4	.203	10	1/2 x 1/4-20	1 1/2 x 14
8" x 6"**	203.2 x 125.4	.203	16	1/2 x 1/4-20	1 1/2 x 14
8" x 8"***	203.2 x 203.2	.203	16	1/2 x 1/4-20	1 1/2 x 14

* Not available in brass base material.
** Available in steel only.
***Available in stainless steel only.
****FT tips not offered on 6" and 8" sizes, BT and ST not offered on 8" sizes.

Options:

Code	Description
NRP	Non-Removable Pin
T4B	Ball Bearing
TCA	Concealed Bearing
RC	Round Corner – 1/4" radius furnished unless specified otherwise
HT	Hospital Tip
BT**	Ball Tip
FT **	Flat Tip
ST**	Steeple Tip
SSF	Safety Stud Feature
RB	Raised Barrel*
QC	ElectroLynx® Hinge – 4, 8 or 12 wire available
CC	Concealed Circuit – 4, 8 or 12 wire available
CC-18	Concealed Circuit – 2, 4, 6, 8 or 10 wire available (2-18AWG wires and the remainder 28AWG wires)
MM	Magnetic Monitoring

* Refer to page SP-3 for Raised Barrel.

Markar 300 Series Pin & Barrel Type Continuous Stainless Steel Hinges

Short Form Architectural Specification:

Continuous hinges shall be full height piano-type hinge providing full height door support.

- Supports weights up to 600 lbs. 4' 0" maximum door width
- Material to be 14 gauge Stainless Steel
- .187" diameter Stainless Steel pin (rod)
- Exterior barrel diameter .438" ($^{7}/_{16}$")
- Each knuckle 2", including nylon bearing at each separation for a quiet, smooth, self-lubricating operation
- Finish: US32D Satin Stainless Steel (630)
  Optional Finish: US32 Bright Stainless Steel (629), Scratch-Resistant Powder Coated Paint.
- All hinges shall be furnished with manufacturer's recommended hardware pack per specific model application
- Must be able to carry Warnock Hersey Int. or UL for fire rated doors and frames up to 3 hours
- Hinges shall meet ANSI/BHMA Standard A 156.26 Grade 1
- Symmetrically templated hole pattern

Note: 25-Year Warranty on Continuous Pin & Barrel Hinges

Note: Fire label for doors and frames should be placed on the header and top rail of fire rated doors and frames

Markar FM300 Edge Mount Hinge

Standard Features

Barrel Type Hinge
.187" diameter Stainless Steel pin (rod)
Medical bearings
Stainless Steel end pins

Material
Heavy-duty 14 gauge Stainless Steel

Finishes
US32D Satin Stainless Steel (630)

Standards
ANSI/BHMA Standard A156.26 Grade 1

Hole Pattern
Symmetrically templated

Mounting Hardware
Fasteners concealed when door is closed
Custom 12-24 x $^{11}/_{16}$" S.S Phillips Flat Head Undercut TEK Screws

Capacity
Supports weights up to 600 lbs.
4'0" maximum door width

Standard Sizes
6'8", 7'0", 7'2", 8'0", 10'0"

Handing
Handing not required on standard hinges. Specify handing when ordering a hinge with modification.

Rating
3 hours- hollow metal doors
90 minutes- hollow metal and composite core wood fire doors
20 minutes- wood doors

Classified in accordance with UL10C for positive pressure

Fire-rated label

Windstorm
Evaluated in accordance with TAS 201-94, TAS 202-94, TAS 203-94, ASTM E330, ASTM E1886, ASTM E1996 and ANSI A250.13

Optional Features

Finishes
Scratch-Resistant Powder Coated Paint

Fasteners
Tamper-proof security screws

Other Features
Custom lengths- specify in inches
Custom hole pattern

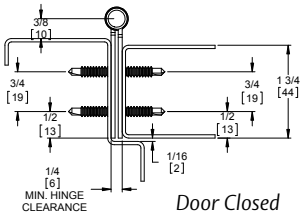
Dutch door hinges- suffix "DDP"
Hospital tips - suffix "HT"
Raised barrel - suffix "RB"
Welded end pins
Security studs.

Electrical Modifications
Adjustable Monitoring Switch - "AMS"

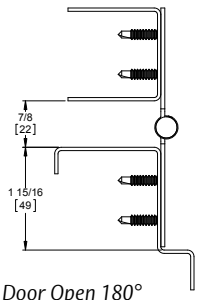
Current Transfer Prep - suffix "CTP"
Electrical Transfer Access Prep - suffix "ETAP"

ElectroLynx®
EL4 (4 wire), EL8 (8 wire), EL12 (12 wire)

This edge-mounted pin & barrel hinge is used on many of today's high traffic, high abuse doors. The hinge works well in locations that would normally call out for anchor hinges, pivot reinforcement hinges or thrust pivot unit and hinge sets. This hinge saves on special door and frame preparation charges and makes the installer's job easier. It can be used on both fire labeled and non-labeled openings.



Door Closed



Door Open 180°

ASSA ABLOY

The global leader in door opening solutions

POWER
»PRODUCTS

SECURITRON®
ASSA ABLOY

ASSA ABLOY, the global leader in door opening solutions

CEPT

Concealed Electrical Power Transfer

Beautifully Crafted, Compact, Secure Power Transfer

The heavy-duty, tamper-resistant Concealed Electrical Power Transfer (CEPT) securely transfers power and data from the hinge side of the frame to electrified hardware on the door. The unit is discreetly concealed between the frame and door when the door is closed. Available in three multi-wire configurations and four finishes, the CEPT complements any architectural setting.

PRODUCT FEATURES

- Mortises into the edges of the door and frame
- Direct retrofit for competitor products
- Tamper resistant
- All metal construction including back boxes
- 7/8" knockouts on back boxes accommodate EMF-type fittings
- Tested to 1,000,000 cycles
- Compatible with butt hinges up to 6" and continuous hinges with cutout
- MagnaCare® lifetime replacement, no fault warranty

PRODUCT OPTIONS

- CEPT-10 includes 8-22 AWG wires plus 2-18 AWG wires for higher-current devices
- CEPT-C5E includes CAT5E compatible with 9 - 22 AWG wire stranded conductor, Molex connectors
- EL-CEPT is ElectroLynx® compatible with 12-22 AWG wires, ElectroLynx® connectors

SPECIFICATIONS

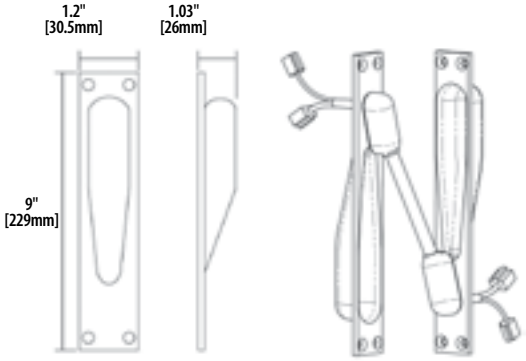
- ANSI/UL 10C Listed, 3 hour rated
- ULC-S318 Listed, 3 hour rated
- ANSI/SDI-BHMA A250.13 (+/- 150 psi) Windstorm Listed
- Florida Building Code Approved
- Patents: 8,448,382; 2,714,685 (Canada)

Dimensions:
CEPT Housing
9-1/16"L x 1-3/16"W x 1-7/16"D

Shipping Weight:
2.40 lbs [1.09kg]

Finishes:
US32D/630 - Stainless Steel
US04/606 - Dull Brass
US10/612 - Dull Bronze
US10B/613 - Oil Rubbed Bronze

MODELS	PART # | Description
CEPT-10	CEPT - US32D, Concealed, 10 Wires
CEPT-10-04	CEPT - US04/606, Concealed, 10 Wires
CEPT-10-10	CEPT - US10/612, Concealed, 10 Wires
CEPT-10-10B	CEPT - US10B/613, Concealed, 10 Wires
CEPT-C5E	CEPT - US32D, Concealed, CAT-5E
CEPT-C5E-04	CEPT - US04/606, Concealed, CAT-5E
CEPT-C5E-10	CEPT - US10/612, Concealed, CAT-5E
CEPT-C5E-10B	CEPT - US10B/613, Concealed, CAT-5E
EL-CEPT	CEPT - Concealed, US32D, ElectroLynx®
EL-CEPT-04	CEPT - Concealed, US04/606, ElectroLynx®
EL-CEPT-10	CEPT - Concealed, US10/612, ElectroLynx®
EL-CEPT-10B	CEPT - Concealed, US10B/613, ElectroLynx®
CEPT-NW	CEPT - Without Wires



Technical note:
- Not for use with center hung or balanced doors, pocket or offset pivots or swing clear hinges.
- Door swing ranges when installed with butt hinges are :

Hinge Size	Door Swing Range
5" or less	up to 180
5-1/2"	up to 130
6" Butt Hinge	up to 110

FIRE RATED

ANSI A250.13-2003 WINDSTORM RESISTANT

SECURITRON
ASSA ABLOY

Lynx

LIFE MAGNACARE WARRANTY

c UL us LISTED

Automatic Flush Bolt No. 2940 (Automatic Top Bolt Only) No. 2942 (Set) (replaces No. 1840 and No. 1842)

Material: Brass, stainless steel

Finishes: US3, US4, US10, US10B, US26, US26D, US32D

Fastener: No. 2940: 6 ea. #8 x 3/4" FH combo screws, 2 ea. #8 - 32 x 1/2" FH MS, 3 ea. #10 x 1" FH WS
NOTE: No plastic anchor required for top only.
No. 2942: 12 ea. #8 x 3/4" FH combo screws, 4 ea. #8 - 32 x 1/2" FH MS, 6 ea. #10 x 1" FH WS, 2 ea. #6 - 8 plastic anchors

Features:
- For Wood Doors labeled B, C, D & E up to 4'w x 8''h
- Non-handed
- Fully automatic—opening active door retracts top and bottom bolts
- Override feature prevents damage to doors or bolts if bolt heads are blocked from entering strikes
- Bolt head rods are adjustable up to 1/2"
- Thermal lock automatically locks the inactive door under high heat conditions due to fire

Options: No. 2942 can be used with the No. 570 Dust Proof Strike (shown on page E4).

No.	Size	Weight	ANSI A156.3
2940	1" x 8 1/2"	1.5 lbs.	Type 25
2942	1" x 8 1/2"	2.9 lbs.	Type 25

Combination Flush Bolts No. 2905 (Self Latching Top Bolt Only) No. 2945 (Set) (replaces No. 1905 and No. 1945)

Material: Brass, stainless steel

Finishes: US3, US4, US10, US10B, US26, US26D, US32D

Fastener: Top: 4 ea. #8 x 3/4" FH combo screws, 2 ea. #8 - 32 x 1/2" FH MS, 3 ea. #10 x 1" FH WS.
NOTE: No plastic anchor required for top only.
Bottom (No. 2945 only): 10 ea. #8 x 3/4" FH combo screws, 4 ea. #8 - 32 x 1/2" FH MS, 6 ea. #10 x 1" FH WS, 2 ea. #6 - 8 plastic anchors

Features:
- For Wood Doors labeled B, C, D & E up to 4'w x 8'h

Top Bolt
- Automatically engages when the inactive door closes. When the active door is opened, the inactive door stays latched at the top until the top bolt is released by pressing the plunger button on the bolt face

Bottom Bolt (No. 2945 only)
- Non-handed
- Fully automatic — opening active door retracts bottom bolt
- Override feature prevents damage to door or bolt if bolt head is blocked from entering strike
- Bolt head rod is adjustable up to 1/2"
- Thermal lock automatically locks the inactive door under high heat conditions due to fire

Options: No. 2945 can be used with the No. 570 Dust Proof Strike (shown on page E4).

No.	Size	Weight	ANSI A156.3
2905	1" x 8 1/2"	1.5 lbs.	Type 27
2945	1" x 8 1/2"	2.9 lbs.	Type 27

ASSA ABLOY

The global leader in door opening solutions

Automatic Flush Bolts No. 2840 (Automatic Top Bolt Only) No. 2842 (Set) (replaces the No. 1840 and No. 1842)

Material: Brass, stainless steel

Finishes: US3, US4, US10, US10B, US26, US26D, US32D

Fastener: No. 2842: 20 ea. #8 x 3/4" FH combo screws, 2 ea. #6 - 8 plastic anchors
No. 2840: 10 ea. #8 x 3/4" FH combo screws. NOTE: No plastic anchor required for top only

Features:
- For Fire Rated Metal Doors labeled A, B, C, D & E up to 4'w x 8'h
- Non-handed
- Fully automatic– opening active door retracts top and bottom bolts
- Override feature prevents damage to doors or bolts if bolt heads are blocked from entering strikes
- Bolt head rods are adjustable up to 1 1/2"
- Thermal lock automatically locks the inactive door under high heat conditions due to fire

Options: No. 2842 can be used with the No. 570 Dust Proof Strike (shown on page E4).

No.	Size	Weight	ANSI A156.3
2840	1" x 6 3/4"	1.2 lbs.	Type 25
2842	1" x 6 3/4"	2.4 lbs.	Type 25

Combination Flush Bolts No. 2805 (Self Latching Top Bolt Only) No. 2845 (Set) (replaces No. 1805 and No. 1845)

Material: Brass, stainless steel

Finishes: US3, US4, US10, US10B, US26, US26D, US32D

Fastener: Top: 8 ea. #8 x 3/4" FH combo screws. *NOTE: No plastic anchor required for top only.*
Bottom (No. 2845 only) 18 ea. #8 x 3/4" FH combo screws, 2 ea. #6 - 8 plastic anchors.

Features:
- For Fire Rated Metal Doors labeled A, B, C, D & E up to 4'w x 8'h

Top Bolt
- Automatically engages when the inactive door closes. When the active door is opened, the inactive door stays latched at the top until the top bolt is released by pressing the plunger button on the bolt face

Bottom Bolt (No. 2845 only)
- Non-handed
- Fully automatic — opening active door retracts bottom bolt
- Override feature prevents damage to door or bolt if bolt head is blocked from entering strike
- Bolt head rod is adjustable up to 1 1/2"
- Thermal lock automatically locks the inactive door under high heat conditions due to fire

Options: No. 2845 can be used with the No. 570 Dust Proof Strike (shown on page E4)

No.	Size	Weight	ANSI A156.3
2805	1" x 6 3/4"	1.2 lbs.	Type 27
2845	1" x 6 3/4"	2.4 lbs.	Type 27

Lever Extension Flush Bolt With Bottom Fire Bolt No. 557 x 19BFB

Material: Flush bolt – brass
Bottom fire bolt – stainless steel

Finishes: Available in standard architectural finishes (see page 9)

Fastener: 7 ea. #8 x 3/4" FH combo screws
4 ea. #8 - 32 x 1/2" FH MS
4 ea. #8 counter sunk washer

Features:
- For Fire Rated Plastic & Wood Covered Fire Doors measuring up to 4'w x 9'h rated up to 20 minutes
- 3/4" bolt throw, 3/4" backset; door strength maintained by corner reinforcing plate
- When door is subjected to 230°F the plug and black plastic cover will melt allowing the bolt to project, locking the leaves together
- Bottom fire bolt eliminates need for floor prep
- Oversize fire bolt strike hole allows for slight door misalignment

No.	Size	Weight
557 x 19BFB	Top bolt: 1" x 6 3/4" Bottom bolt: 13/16" dia.	0.9 lbs.

Dust Proof Strike No. 570

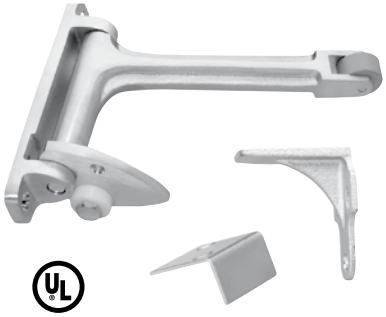
Material: Brass

Finishes: Available in standard architectural finishes (see page 9)

Fastener: Adjustment nut
Spanner wrench
2 ea. #8 x 1 OH SMS, 2 ea. plastic anchors
2 ea. #8 - 32 x 3/4" OH MS, 2 ea. lead anchors

Features:
- Works with all Rockwood manual and automatic flush bolts
- Removable face plate for use with thresholds
- Adjustable height for carpeted areas

No.	Size	Weight	ANSI A156.16
570	Face plate: 1 3/8" x 2 7/8" Barrel: 7/8" dia. x 2" depth	0.4 lbs.	L04021



Gravity Door Coordinator No. 576

Material: Cast brass

Finishes: Available in standard architectural finishes (see page 9).

Fastener: Body: 2 ea. #10 x 1" FH SMS, 2 ea. #10 - 24 x 1" FH MS
Strike: 5 ea. #8 x 1" FH SMS

Other:
- For use on door sizes:
  - with Astragal on active door – 18" to 48"
  - with Astragal on inactive door – 18" to 34"
  - with Astragal on both doors – 18" to 30"
- The overlap of the astragal is maximum 7/8" with door hung on standard hinges. Customer must contact the factory for all other astragal situations

Features: Non-handed reversible. Prevents the active door from closing until the inactive door is closed

No.	Size	Projection	Weight	ANSI A156.3
576	1" x 5 7/16"	7"	2.2 lbs.	Type 21

Product Catalog

SARGENT
ASSA ABLOY

7800/8200 Series
Mortise Locks

ASSA ABLOY, the global leader
in door opening solutions

Specifications & Certifications

8200/R8200/7800 Mortise Locks

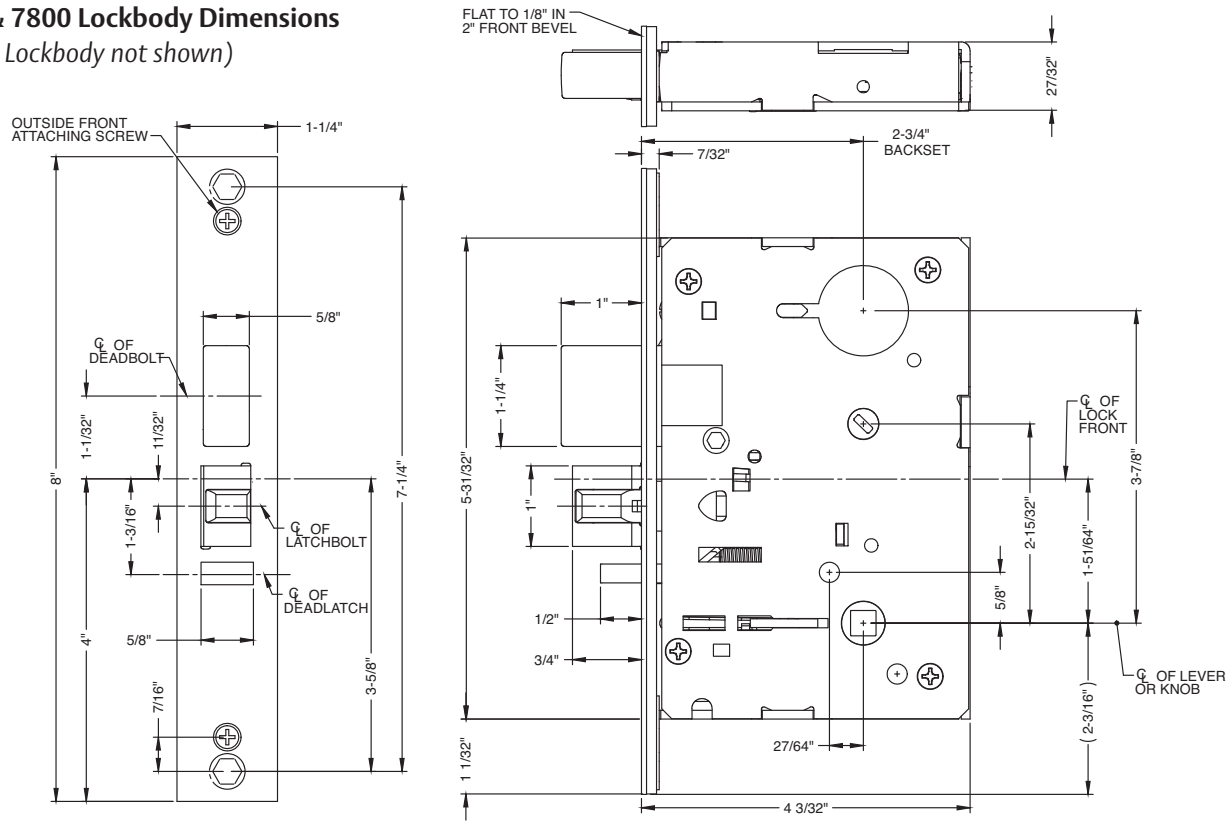
Certification Compliance

ANSI/BHMA	Certified to ANSI/BHMA A156.13 Series 1000 Operational Grade 1 and Security Grade 1 with all standard trims. ANSI/ASTM F476-84 Grade 40 with concealed mortise cylinder. **Note:** LFIC (Removable) Cylinders and SFIC Cylinders do not meet Security Grade 1 requirements.
ADA	Meets A117.1 Accessibility Code. Meets BOMA International 4.13.8 Complies with American Disability Act; Consult local authorities
UL-cUL	UL and cUL Listed to US and Canadian safety standards for A label 4 x 10 single and 8 x 10 double (3 hour fire door) and lesser class doors, stamped letter F and UL symbol on armored front indicate listing
Positive Pressure	Meets ANSI/UL 10C, Positive Pressure Fire Test of Door Assemblies
California	California State Reference Code (Formerly Title 19, California State Fire Marshal Standard) All levers with returns comply; levers return to within 1/2" (13mm) of door face
Tornado and Hurricane Codes	See page 4

Any retrofit or other field modification to a fire rated opening can potentially impact the fire rating of the opening, and Sargent Manufacturing Company makes no representations or warranties concerning what such impact may be in any specific situation. When retrofitting any portion of an existing fire rated opening, or specifying and installing a new fire-rated opening, please consult with a code specialist or local code official (Authority Having Jurisdiction) to ensure compliance with all applicable codes and ratings.

8200 & 7800 Lockbody Dimensions

(R8200 Lockbody not shown)



Note: R8200 and 8200 lockbodies are dimensionally the same except for the through-bolt locations

Explanation of the 8200/7800 Lockbody types:

Lockbody Type[1]	Trim Available x Lockbody type	Standard 8200 Door Prep	Through Bolted Trim	Multi-function lockbody available	How to order lockbody only
8200	Lever x Rose/Escutcheon	Yes	Yes	Yes	82 x Function x Finish[3]
7800	Knob x Rose/Escutcheon	Yes	Yes	Yes	78 x Function x Finish[3]
R8200	Simpli™ roseless trim	No	Yes[2]	Yes	R82 x Function x Finish[3]
8200 for ALP	ALP Push/Pull Trim	Yes	Yes	Yes	Six Digit Part # determined by function*
7800 PT	PT Push/Pull Trim	Yes	Yes	Yes	Six Digit Part # determined by function*

[1] Lockbodies can only be used with the specified trim
[2] Through Bolt locations are different from standard trim, special door prep required
[3] **Note:** Cylinder and trim not included. Outside front, strike and screw pack are included
* See Price book; **Note:** Outside Fronts, Strikes, Cylinders and Trim are NOT included

Windstorm Certifications

8200/R8200/7800 Mortise Locks

SARGENT
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Windstorm Certifications: Florida Building Codes & UL Listings

SARGENT Manufacturing's products meet building codes that require hurricane, windstorm and FEMA certifications, including some of the most stringent building codes as specified in the Florida Building Code, Miami Dade Code and the International Building Code. Listed below are certifications and standards met by the 7800/8200 lock.

Florida Building Code: FL2998
UL Certification Directory: ZHEM.R21744 – Latching Hardware

ANSI/SDI-BHMA A250.13	"Testing and Rating of Severe Windstorm Resistant Components for Swinging Door Assemblies"
ANSI/ASTM E330	"Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference"
ANSI/ASTM E1886	"Standard Test Method for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials"
ASTM E1996	"Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors and Impact Protective Systems Impacted by Windborne Debris in Hurricanes"
(TAS) 201	"Impact Test Procedures"*
(TAS) 202	"Criteria for Testing Impact and Non-Impact Resistant Building Envelope Components Using Uniform Static Air Pressure"
(TAS) 203	"Criteria for Testing Products Subject to Cyclic Wind Pressure Loading"*

* Published in the "Florida Building Code"

UL Certification Directory: ZHLL.R21744 – Products for Use in Windstorm-rated Assemblies

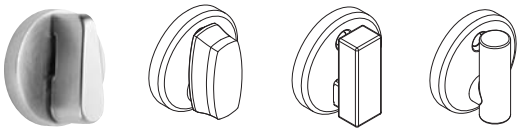
Certifications to meet assembly requirements are done in conjunction with doors from ASSA ABLOY Group companies CECO DOOR and CURRIES.

ASTM E330	"Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference"
ANSI/ASTM E1886	"Standard Test Method for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials"
ASTM E1996	"Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors and Impact Protective Systems Impacted by Windborne Debris in Hurricanes"
AAMA/WDMA/CSA 101/I.S.2/A440	"Standard/Specification for Windows, Doors, and Unit Skylights"

Thumbturn Designs

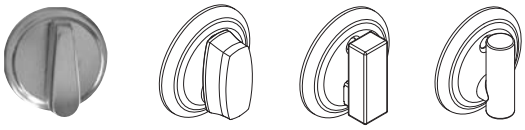
8200/R8200/7800 Mortise Locks

130KB Round Backplate
(Shown with Standard Turn)



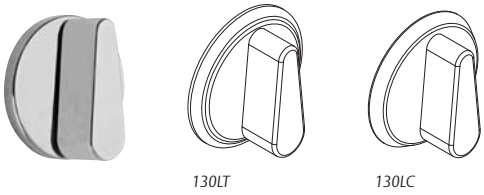
- Round backplate supplied standard with L, O, LN roses and R8200 roseless trim
- Standard turn automatically supplied with sectional trim for R8200 & 8200 locks
- Specify T1, T2 or T3 as an option for decorative turns
- 1-1/2" (38mm) round brass or stainless steel plate
- Meets ADA Requirements

130KT Traditional Backplate
(Shown with Standard Turn)



- Dual radii edge backplate supplied standard with TO and TR roses
- Standard turn automatically supplied with sectional trim for R8200 & 8200 locks
- Specify T1, T2 or T3 as an option for decorative turns
- 1-3/4" (44mm) round brass plate
- Meets ADA Requirements

130LB Large Round Backplate
(Shown with Large ADA Turn)

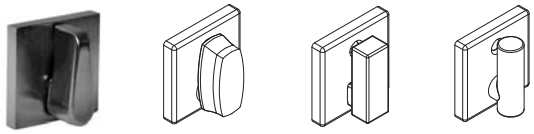


- Available with R8200 & 8200 with sectional trim
- 40% larger than standard thumbturn
- Specify LB as an option for ADA turn
- 2" (51mm) round brass, zinc, or stainless steel plate & turn
- 130LT - Traditional backplate, 130LC — Contemporary backplate
- Meets ADA Requirements

126 T-Turn
(7892 function only)

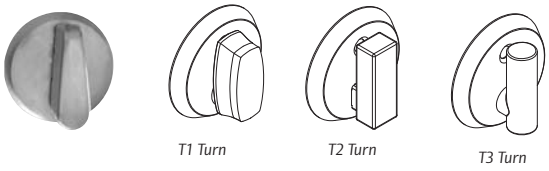
- 2-3/16" (56mm) round stainless steel backplate
- 2-3/8" (61mm) tall thumbturn
- Available in brass or bronze finishes only
- Surface mounted with three screws
- Order as "SST" trim with 7892 function

130KA Square Backplate
(Shown with Standard Turn)



- Square backplate supplied standard with E, E2, E3 or E4 roses
- Standard turn automatically supplied with sectional trim for R8200 & 8200 locks
- Specify T1, T2 or T3 as an option for decorative turns
- 1-1/2" (38mm) round brass or stainless steel plate
- Meets ADA Requirements

130KC Contemporary Backplate
(Shown with Standard Turn)



- Beveled edge backplate supplied standard with CO and CR roses
- Standard turn automatically supplied with sectional trim for R8200 & 8200 locks
- Specify T1, T2 or T3 as an option for decorative turns
- 1-3/4" (44mm) round brass or stainless steel plate
- Meets ADA Requirements

130KBHA Turn for use with 8200 Mortise BHW, ALP, BHL and BHD Trim

- 3-3/4" x 2-1/2" rectangular shape
- Stainless steel housing
- Meets ADA and OMH Requirements

130W Round Backplate
(Shown with Standard Turn)

- Used with 7800 with sectional trim
- 1-1/2" (38mm) round brass or stainless steel plate

Emergency Releases & Accessories

8200/R8200/7800 Mortise Locks

SARGENT
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Emergency Releases

184KB Emergency Release (used with R8200 & 8200 with sectional trim)

- 1-1/2" (38mm) round brass, bronze or stainless steel plate
- For 65, 66 and 68 functions only

Studio Collection Emergency Release

- 184KC Emergency Release Contemporary
- 184KT Emergency Release – Traditional

184W Emergency Release (used with 7800 with sectional trim)

- 1-1/2" (38mm) round brass, bronze or stainless steel plate
- For 65, 66 and 68 functions only

184KA Emergency Release (used with E rose)

- 1-1/2" (38mm) square brass, bronze or stainless steel plate
- For 65, 66 and 68 functions only

Emergency Key 14-0057

- Carbon steel
- For 65, 66 and 68 functions only
- Must be ordered separately

184KBHA Emergency Release (used with BHW, ALP, BHL and BHD trim)

- 3-3/4" x 2-1/2" rectangular shape
- Stainless steel housing
- Meets ADA and OMH Requirements

Accessories

130KBCVR Cap

- Thumbturn plate
- Covers hole in door when thumb turn is no longer needed

82-4023 Cap

- 2" round
- Covers hole for levers and roses

Door Thickness	Part Number
1-3/8"	82-4022
1-3/4"	82-4023
2"	82-4024
2-1/4"	82-4025

Trim One Side Kit

Refer to page 42 for a complete list of kits

Indicators and Escutcheon Engraving

8200/R8200/7800 Mortise Locks

SARGENT
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Sectional Trim - Indicators

49- Option Visual Status Indicator for Non Secure Applications

- Designed to work with Classroom security functions
- Red/White indicator plate standard
- Mounts on inside of door
- Functions and Roses available:
  – 30, 36 & 37 Functions with 7800, 8200 and R8200 locks, CR, L, LN, TR, E & O Roses
  – 26, 29, 38, 39, 40 and 41 Functions with 7800, 8200, and R8200 locks & LN Roses Only
- As retrofit, order 185C x finish

Inside Only

185C

49- Option Occupancy Indicator with Emergency Release

- Ideal for restrooms or conference rooms where easy determination of use needs to be made
- OCC/VAC indicator plate standard
- Mounts on outside of door
- Emergency coin operated release standard
- Functions and Roses available:
  – 65, 66, 68 Functions with 7800, 8200, and R8200 locks, CR, E, L, LN, O & TR Roses
- As retrofit, order 185P x finish

185P

50- Option Secured Indicator Rose

- Non-handed with lever and mounting posts field reversible
- VAC/OCC indicator plate standard
- Mounts on outside of door
- Available for the following functions: 24, 25, 26, 28, 29, 30, 36, 37, 38, 39, 40, 41, 43, 45, 50, 51, 52, 57, 58, 67 - with Rose Trim only
- Patent pending design
- Not available with Roseless trim (R8200)
- For retrofit, order 185S x suffix x finish:

Suffix	Door Thickness
-1	1-3/8" (35mm)
-2	1-3/4" (44mm)
-3	2" (51mm)
-4	2-1/4" (57mm)

Note: For 49- and 50- Options, key will not retract latch when used with 37 and 38 functions

Escutcheon Trim - Indicators

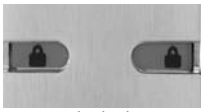
- Red/white plate with locked/unlocked icons
- Available with LE1/KE1 Escutcheons only
- Available finishes: 03, 04, 09, 10, 10B, 10BE, 10BL, 14, 15, 20D, 26, 26D, 32, 32D, BSP, WSP
- Available with MicroShield®
- Windows allow 180° view
- See chart for function availability

Options:

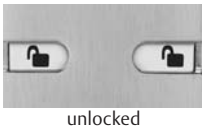
VNA - Indicator located on outside of door

VNB - Indicator located on inside of door

VNC - Indicator located on inside and outside of door



locked



unlocked

Escutcheon Trim - Engraving

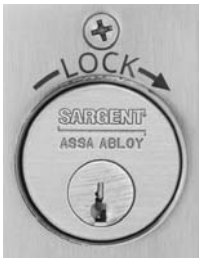
- Laser engraving with "LOCK" and directional arrow
- Available with LE1/KE1 Escutcheons only
- Available finishes: 03, 04, 14, 15, 26, 26D, 32, 32D
- Available with MicroShield®
- Door handing must be specified
- See chart for function availability

Options:

EMA - Engraving located on outside of door

EMB - Engraving located on inside of door

EMC - Engraving located on inside and outside of door



Note: If indicators and engraving are ordered together, finish offering is limited to 03, 04, 14, 15, 26, 26D, 32, 32D

		Function																									
		Single Cylinder w/o Deadbolt							Single Cylinder w/ Deadbolt									Double Cylinder w/o Deadbolt	Double Cylinder w/ Deadbolt							Deadbolt Only		
Option	**Description**	**05**	**36**	**37**	**56**	**57**	**58**	**67**	**24**	**25**	**28**	**30**	**43**	**45**	**47**	**50**	**51**	**38**	**26**	**29**	**39**	**40**	**41**	**46**	**52**	**20**	**21**	**22**
VNA	Outside Indicator	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
VNB	Inside Indicator			X														X	X	X	X	X	X	X	X			X
VNC	Indicator Both Sides			X														X	X	X	X	X	X	X	X			X
EMA	Outside Engraving	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
EMB	Inside Engraving																	X*	X	X	X	X	X	X	X			X
EMC	Engraving Both Sides																	X	X	X	X	X	X	X	X			X

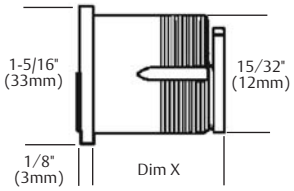
* Provided as standard. Inside engraving option (EMB) is not required when ordering this function. Handing must be specified.

Cylinder Lengths (Dim X)

Cylinder No.	41	42	43	44	46	48	50	52	54	56
Dim X Length Under Cylinder Head	1-1/8" (29mm)	1-1/4" (32mm)	1-3/8" (35mm)	1-1/2" (38mm)	1-3/4" (44mm)	2" (51mm)	2-1/4" (57mm)	2-1/2" (64mm)	2-3/4" (70mm)	3" (76mm)

40 Series Type Cylinder

- Cylinder body: Solid brass
- Cap: Brass, bronze or stainless steel
- All functions take a Standard Cam Functions
- Standard Cam 13-0664
- 16 & 92 Inside Cam -105
- 50 Hotel Cam -115 supplied standard with all Hotel Function Cylinders



7850/8250 Function Hotel Cylinder

- When door is locked by deadbolt, only emergency key is able to unlock
- Must request emergency key separately (14-0036 x keying info)
- Supplied with Cam suffix -115 for Hotel Functions

78- Option Exposed Barrel

- Standard for use only with SARGENT Escutcheon Trims KE3, KE4, LE3, LE4
- Available 6-Pin standard or 7-Pin optional
- NOT available with 50-, 60-, 70- or other specialty or higher security options
- See function table for cam required
- Not available in 50 function
- Plug finishes: 4, 15 (similar to 26 finish)

124 Series Mortise Cylinder Turn Lever

- Turn lever: Brass, bronze or aluminum
- Cap: Brass, bronze or stainless steel
- Must be ordered separately

10- Option Signature Series

- The protected system offers the building owner full control over duplication of keys. Highly pick-resistant cylinders
- 10-63- Option — Signature cylinder with Large Format Interchangeable Cores

F1-82- and 82- Option KESO

- The system offers the building owner full control over duplication of keys
- Highly pick-resistant cylinders
- Expanded levels of masterkeying
- F1-83- & 83- Option — Keso removable core
- 84- Option — Keso construction core cylinder

11- Option XC Key System

- Patented system works with existing SARGENT keyway adding increased security
- 11- XC standard cylinder
- 11-63- Large format interchangeable core
- 11-73- Small format interchangeable core

DG1, DG2, DG3 - Degree Series

- Utility patented, bump resistant and requires the use of a patented key
- All three locking mechanisms within the same system to be operated with just one key
- See Degree Key System Catalog for available options

For complete cylinder information, see Cylinders & Components, Degree, Signature, Keso, Keso F1 or XC catalogs.

51- Option Old Style Removable Core

- Available for **existing systems only** Permanent Removable Cores
- Control key used to remove core, must request control key separately

60- or 70- Option Plastic Construction Core

- For doors that do not require key locking during the construction period
- Operate with coin or flat screw driver
- For use with LFIC (removable) (60- Option) or SFIC (70- Option) core

63- Option Large Format Interchangeable (Removable) Core

- Allows immediate removal of the core. Virtually unlimited key changes
- Available 10-63-, 11-60-, 11-63- & 11-64-
- For disposable core, see 60- Option
- 64- Option- LFIC 6-Pin construction core
- Control key used to remove core, must request control key separately

7300B Interchangeable Core

- Small Format Interchangeable Core
- SARGENT Interchangeable Core cylinders and MasterKey Systems are available for increased security through quick change of keying. It is unnecessary to remove a cylinder
- SARGENT 7300B Interchangeable Cores are available in SARGENT 4A and 4B keyways, as well as the following standard competitor keyways: A, B, C, D, E, F, G, H, J, K, L, M
- For disposable core, see 70- Option
- 65-73 Option — 6-Pin Small Format Interchangeable Cores-uncombinated
- 65-73-7P Option — 7-Pin Small Format Interchangeable Cores-uncombinated
- 70- Option — Small Format Interchangeable disposable core
- 72- Option — Small Format Interchangeable construction core
- 11-72- Construction core provided for use with 11-7300 cylinder housing

  11-70- temporary plastic core prepared to accept 11-7300 core
- 73- Option — 6-Pin Small Format Interchangeable core, SARGENT 4A, 4B keyways
- 73-7P Option — 7-Pin Small Format Interchangeable core, SARGENT 4A, 4B keyways
- Control key used to remove core (provided separately)

1SB Cylinder Collar

- Standard for 7800 BHD, 8200 BHL & BHW mortise locks
- Stainless steel
- 1-29/32" diameter
- Finishes: 32, 32D
- Available in 4 sizes. See page 36 for specifics on collar sizes and measurements

21- Option Lost Ball Construction System

- The SARGENT construction keying system protects the building owner by providing temporary masterkeying during the construction period

1KB Rosette with 8200 & R8200 sectional trim

- Used with mortise cylinders and No. 90 blocking rings when cylinders project from door
- Furnished standard with L, O, LN, CO, CR, TO and TR roses
- Brass, bronze or stainless steel
- 1-1/2" (38mm) diameter, includes compression spring
- Finishes: 3, 4, 10, 10B, 10BE, 10BL, 20D, 26, 26D, 32, 32D, BSP, WSP
- Projection from door:

1KB-1	5/16" (8mm) — Standard
1KB-2	7/16" (11mm)
1KB-3	9/16" (14mm)

IKA Rosette with 8200 sectional trim

- Used with mortise cylinders
- Furnished standard with the E, E2, E3 and E4 roses
- Brass, bronze or stainless steel
- 1-1/2" (38mm) Square, includes compression spring
- Projection from door:

1KA-1	5/16" (8mm) — Standard
1KA-2	7/16" (11mm)
1KA-3	9/16" (14mm)
1KA-4	11/16" (16mm)

- Finishes: 3, 4, 10, 10B, 10BE, 10BL, 20D, 26, 26D, 32, 32D, BSP, WSP

No. 97 Rosette

- Standard for cylinders ordered separately from hardware
- Standard for 7800 knob mortise & 4870 deadbolt
- Brass, bronze or stainless steel
- 1-11/16" diameter (43mm), 9/32" (7mm) projection, includes compression spring
- Finishes: 3, 4, 10, 10B, 10BE, 10BL, 20D, 32, 32D, BSP, WSP

No. 90 Blocking Ring

- Used with 1KB rosettes as spacer when mortise cylinder projects from face of door
- Brass, bronze or stainless steel
- Finishes: 3, 4, 10, 10B, 10BE, 10BL, 20D, 26, 26D, 32, 32D, BSP, WSP

1KB-5 Cylinder Retaining Cap

- Required for double cylinder functions on KS and LS Escutcheon *only*
- Steel or stainless steel
- 1-15/32" (37mm) diameter
- 9/16" (14mm) projection
- Finishes: 3, 4, 9, 10, 10B, 10BE, 10BL, 20D, 26, 26D, 32, 32D, BSP, WSP

Cylinders Requirements & Cams

8200/R8200/7800 Mortise Locks

SARGENT®
ASSA ABLOY

Single Cylinder

Sectional Trim (CO, CR, L, LN, O, PT, SL, SN, TO, TR)

Cylinder Size	Door Thickness			
	1-3/8"	1-3/4"	2"	2-1/4"
41	1KB-2	1KB-1	1KB-1	1KB-1
42	1KB-3	1KB-2	1KB-2	1KB-1
43	1KB-4	1KB-3	1KB-3	1KB-3

Sectional Trim (E, E2, E3, E4)

Cylinder Size	Door Thickness			
	1-3/8"	1-3/4"	2"	2-1/4"
41	1KA-2	1KA-1	1KA-1	1KA-1
42	1KA-3	1KA-2	1KA-2	1KA-1
43	1KA-4	1KA-3	1KA-3	1KA-3

Escutcheon Trim (CE, KE1, KE2, KW1, LE1, LE2, LW1, TE)

Cylinder Size	Door Thickness			
	1-3/8"	1-3/4"	2"	2-1/4"
41	1KB-1	Cylinder Only	Cylinder Only	Cylinder Only
42	1KB-2	1KB-1	Cylinder Only	Cylinder Only
43	1KB-3	1KB-1	1KB-1	Cylinder Only

Escutcheon Trim (WT)

Cylinder Size	Door Thickness			
	1-3/8"	1-3/4"	2"	2-1/4"
41	97	Cylinder Only	Cylinder Only	Cylinder Only
42	1SB-2	97	Cylinder Only	Cylinder Only
43	1SB-3	97	97	Cylinder Only

Specialty Hardware (BHW, BHL, BHD, ALP)

Cylinder Size	Door Thickness			
	1-3/8"	1-3/4"	2"	2-1/4"
41	1SB-2	1SB-1	1SB-1	1SB-1
42	1SB-3	1SB-2	1SB-2	1SB-1
43	1SB-4	1SB-3	1SB-3	1SB-3

Double Cylinder

Cylinder Size	Door Thickness			
	1-3/8"	1-3/4"	2"	2-1/4"
41	1KB-3	1KB-2	1KB-1	1KB-1
42	1KB-4	1KB-3	1KB-2	1KB-1
43	97-0352	1KB-4	1KB-3	1KB-2

Cylinder Size	Door Thickness			
	1-3/8"	1-3/4"	2"	2-1/4"
41	1KA-3	1KA-2	1KA-1	1KA-1
42	1KA-4	1KA-3	1KA-2	1KA-1
43		1KA-4	1KA-3	1KA-2

Cylinder Size	Door Thickness			
	1-3/8"	1-3/4"	2"	2-1/4"
41	1KB-2	90 1/8	Cylinder Only	Cylinder Only
42	1KB-3	1KB-2	1KB-1	Cylinder Only
43	1KB-4	1KB-3	1KB-2	90 1/8

Cylinder Size	Door Thickness			
	1-3/8"	1-3/4"	2"	2-1/4"
41	1SB-2	97	Cylinder Only	Cylinder Only
42	1SB-3	1SB-2	97	Cylinder Only
43	1SB-4	1SB-2	1SB-2	97

Cylinder Size	Door Thickness			
	1-3/8"	1-3/4"	2"	2-1/4"
41	1SB-3	1SB-2	1SB-1	1SB-1
42	1SB-4	1SB-3	1SB-2	1SB-1
43	1SB-4	1SB-4	1SB-3	1SB-2

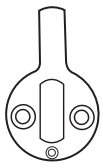
Cylinder Cams For Mortise Locks

SARGENT Conventional Cylinders

- Standard

Std Cam (13-0664) for all functions except for 50 and the Inside cam for 16 & 92 function locks

-105 Cam (13-0665) 16 & 92 Function Inside Cylinder Cam



-115 Cam (13-2045) 50 Function Hotel Cam, supplied with 50 function cylinders

See Cylinder catalogs for additional information

SARGENT Large Format Interchangeable Core Cylinders

- 6300 Cams are factory installed and are not removable
- 6300 Cams are not sold separately
- Specify required Cam as a suffix: 63-44-105 cam
- For Standard Cam: no suffix is required

Std 6300 Cam for all functions except for 50 and the Inside cam for 16 & 92 function locks

-105 Cam for 6300 Series 16 & 92 function I/S Cylinder

-115 Cam for 6300 Series 50 (Hotel) function, supplied with 50 function cylinders

Mechanical Options

8200/R8200/7800 Mortise Locks

SARGENT®
ASSA ABLOY

Mechanical Options:

Available mechanical options by lock type

Categories	How to Specify	Detailed Description	8200	R8200	7800
1-3/8" Door	1-	1-1/16" (27mm) wide front for 1-3/8" (35mm) doors (not available with RX-Option) (1- for 93 + 94 function is a special order)	X	-	X
Add Strength	3-	Stainless steel hubs with in the mortise lock	X	-	
Strike Option	23-	4-7/8" (124mm) ANSI flat lip strike	X	X	X
	OBS-	Open back strike	X	X	X
	WBS-	Wrought box strike	X	X	X
Thick Doors	31-	For doors 1-7/8" (48mm) to 2-1/4" (57mm) thick — see cylinder options for limitations on door thickness. When ordering the following information is required: Location of lock within the door, door thickness -IF PANELED -must specify panel thickness & panel location (inside or outside of the door) For doors thicker than 2-1/4" — consult factory.	X	X	X
Security Fasteners	36-	6 Lobe head security screws (Torx® type)	X	-	X
	37-	Spanner head security screw (not available with Studio levers)	X	-	X
Visual Indicators	49-	Visual Status Indicator or Occupancy indicator with emergency release (not available with escutcheon trim; see page 16 for details)	X	X	X
	50-	Secured indicator rose (available with rose trim only; see page 16)	X	-	X
	EMA	Engraving, Outside (Engraved with "LOCK" and directional arrow. Available with escutcheon trim LE1/KE1 only)	X	-	X
	EMB	Engraving, Inside (Engraved with "LOCK" and directional arrow. Available with escutcheon trim LE1/KE1 only)	X	-	X
	EMC	Engraving, Both Sides (Engraved with "LOCK" and directional arrow. Available with escutcheon trim LE1/KE1 only)	X	-	X
	VNA	Visual Status Indicator, Outside (Escutcheon trim LE1/KE1 only)	X	-	X
	VNB	Visual Status Indicator, Inside (Escutcheon trim LE1/KE1 only)	X	-	X
	VNC	Visual Status Indicator, Both Sides (Escutcheon trim LE1/KE1 only)	X	-	X
Electrical Options	DX-	Deadbolt monitoring — Monitor deadbolt position (not available with LX-)	X	X	X
	LX-	Latchbolt monitor — Monitors latchbolt position (not available with deadbolt functions)	X	X	X
	RX-**	Request to Exit — Monitors each lever independently (not available with LB-option)	X	X	X
	TL-	SARGuide illuminated inside WT trim with the word EXIT illuminated (4-1/2" pocket depth required)	X	-	-
Lever/Knob Combination	68-	8200 Lock furnished w/lever handle outside x knob inside (not available with the AV-Option or FE Trim)	X	-	-
	69-	8200 Lock furnished w/lever handle inside x knob outside (not available with the AV-Option or FE Trim)	X	-	-
Lead Lining	74-**	Lead lining or wrapping available with sectional trim only (not available with DX-or LX- Options)	X	-	X
Tactile Warnings	75-	Tactile Warning — Milled levers or knurled knobs. Inside trim only (not available with Studio & Coastal levers, the A lever & K, N & D knobs)	X	-	X
	76-	Tactile Warning — Milled levers or knurled knobs. Outside trim only (not available with Studio & Coastal levers, the A lever & K, N & D knobs)	X	-	X
	77-	Tactile Warning — Milled levers or knurled knobs. Inside & outside trim (not available with Studio & Coastal levers, the A lever & K, N & D knobs)	X	-	X
	85-	Tactile Warning — Abrasive coating inside trim only (not available with D knobs)	X	X	X
	86-	Tactile Warning — Abrasive coating outside trim only (not available with D knobs)	X	X	X
	87-	Tactile Warning — Abrasive coating inside & outside trim (not available with D knobs)	X	X	X
Anti-Vandal Trim	AV-	Anti-Vandal pull trim (not available with LS & FE trim and Options 1-, 31-, 49-, 50-, 68-, 69-, 76-, 77-, 86-, 87-, DX-or SG-)	X	-	X
Finish Protection	CPC-	Clear Powder Coat (available for 32 & 32D finishes)	X	X	X
	SG-*	MicroShield® antimicrobial clear powder coat	X	X	X
Thumbturns (See page 14)	LB-	ADA Extra large thumbturn; backplate matches rose design chosen	X	X	X
	T1-	Decorative thumbturn; backplate matches rose design chosen	X	X	-
	T2-	Decorative square thumbturn; backplate matches rose design chosen	X	X	-
	T3-	Decorative cylinder thumbturn; backplate matches rose design chosen	X	X	-

* Available on 15, 26D, and 32D Finishes only

** Not available in combination

Cylinder Options

8200/R8200/7800 Mortise Locks

SARGENT®
ASSA ABLOY

Cylinder Options:

Categories	How to Specify	Detailed Description	Cylinder Sizes Available
Conventional Cylinder		SARGENT Conventional Cylinders supplied standard	41-44,46,48,50,52,54,56
Degree Key System	**DG1-**	SARGENT Degree Key System Level 1 (bump resistant with patented keys)	41-44, 46
	DG1-21-*	Degree Level 1 Construction Master Keying	41-44, 46
	DG1-60-	Degree Level 1 Removable Disposable Construction Core	41-44, 46
	DG1-63-	Degree Level 1 Removable Core	41-44, 46
	DG1-64-	Degree Level 1 Removable Construction Keyed LFIC	41-44, 46
	DG1-65-*	Degree Level 1 Unassembled/Uncombined Core	41-44, 46
	DG1-78-*	Degree Level 1 Exposed Plug (for use with LE3/LE4 escutcheons only)	41-43
	DG2-*+	SARGENT Degree Key System Level 2 (geographically exclusive; bump and pick resistant)	41-44, 46
	DG2-21-*	Degree Level 2 Construction Master Keying	41-44, 46
	DG2-60-*	Degree Level 2 Removable Disposable Construction Core	41-44, 46
	DG2-63-*	Degree Level 2 Removable Core	41-44, 46
	DG2-64-*	Degree Level 2 Removable Construction Keyed LFIC	41-44, 46
	DG2-65-*	Degree Level 2 Unassembled/Uncombined Core	41-44, 46
	DG3-*+	SARGENT Degree Key System Level 3 (geographically exclusive; UL437 certified; bump and pick resistant)	41-44, 46
	DG3-21-*	Degree Level 3 Construction Master Keying	41-44, 46
	DG3-60-*	Degree Level 3 Removable Disposable Construction Core	41-44, 46
	DG3-63-*	Degree Level 3 Removable Core	41-44, 46
	DG3-64-*	Degree Level 3 Removable Construction Keyed LFIC	41-44, 46
Signature Key System	**10-***	SARGENT Signature Key System (not available with other key systems)	41-44,46,48,50,52,54,56
	10-21-*	SARGENT Signature Construction Key System (Lost Ball)	41-44,46,48,50,52,54,56
Signature Large Format Interchangeable Core (Removable Core)	**10-63-***	SARGENT Signature LFIC (removable) Core Cylinder	42, 43, 44 & 46
XC- Key System	**11-***	XC Key System (not available with other key systems, unless specified)	41-44,46,48,50,52,54,56
	11-21-*	XC- Construction Key System (Lost Ball)	41-44,46,48,50,52,54,56
XC- Large Format Interchangeable Core (Removable Core)	**11-60-***	Hardware to accept XC- Permanent LFIC (removable core), disposable plastic core provided	42, 43, 44 & 46
	11-63-*	Hardware provided with XC- LFIC (removable core) cylinder — (Includes masterkeying, grand masterkeying)	42, 43, 44 & 46
	11-64-*	Hardware provided with keyed construction core to accept XC- LFIC (removable) permanent core ordered separately	42, 43, 44 & 46
XC- Small Format Interchangeable Cores	**11-70-7P-***	Hardware to accept XC- SFIC (7-Pin) XC- permanent cores, disposable plastic core provided	43 & 46
	11-72-7P-*	Hardware to accept XC- SFIC (7-Pin keyed construction core provided) cylinder permanent core ordered separately	43 & 46
	11-73-7P-*	Hardware provided with XC- Small format 7-Pin interchangeable core (Includes masterkeying, grand masterkeying)	43 & 46
	11-65-73-7P-*	Hardware provided to accept XC- Uncombinated 7-Pin SFIC (permanent) core — (packed loose)	43 & 46
Construction Key System	**21-***	SARGENT Lost Ball Construction keying for conventional, XC and Signature Series (N/A with 63- or 73-)	–
	22-*	SARGENT Construction Split Key System for conventional cylinders (existing systems only) (N/A with 10-, 11-, 63- or 73-)	–
Old Style Removable Core	**51-***	Removable core cylinder (Old style) provided (existing systems only)	142,143,144,146
	52-*	Removable construction core (Old style) permanent core ordered separately (existing systems only)	142,143,144,146

* Options not available with 50 function lockout cylinder

+ Not available with R8200 Series

Note: Interchangeable core and removable core cylinders do not meet Security Grade 1 requirements

Cylinder Options

8200/R8200/7800 Mortise Locks

SARGENT®
ASSA ABLOY

Cylinder Options:

Categories	How to Specify	Detailed Description	Cylinder Sizes Available
Large Format Interchangeable Core	**60-**	Hardware to accept SARGENT permanent LFIC (removable core), disposable plastic core provided (permanent cores ordered separately)	42, 43, 44 & 46
	63-	Hardware provided with LFIC (removable core) cylinder - (Includes masterkeying, grand masterkeying)	42, 43, 44 & 46
	64-	Hardware provided with Keyed construction core to accept LFIC (removable) permanent core (ordered separately)	42, 43, 44 & 46
Small Format Interchangeable Cores	**70-***	Hardware to accept 6- or 7-Pin SFIC permanent cores, disposable plastic core provided	43 & 46
	72-*	Hardware to accept 6- or 7-Pin SFIC (keyed construction core provided) cylinder (permanent core ordered separately)	43 & 46
	73-*	Hardware provided with 6-Pin SFIC (Includes masterkeying, grand masterkeying)	43 & 46
	65-73-*	Hardware provided to accept uncombinated 6-Pin SFIC (permanent) core — (packed loose for field keying)	43 & 46
	65-73-7P-*	Hardware provided to accept uncombinated 7-Pin SFIC (permanent) core — (packed loose for field keying)	43 & 46
	73-7P-*	Hardware provided with Small Format 7-Pin interchangeable core (Includes masterkeying, grand masterkeying)	43 & 46
Keso & Keso F1	**81-***	Hardware provided with housings to accept Keso (83) & Keso F1 (F1-83-) removable cores (permanent cores ordered separately)	172-174,176
	82-	Hardware provided with SARGENT Keso security cylinder	71-74,76
	F1-82-	Hardware provided with SARGENT Keso F1 security cylinder (patented)	71-74,76
	83-*	Hardware provided with SARGENT Keso security removable core cylinder	172-174,176
	F1-83-*	Hardware provided with SARGENT Keso F1 security removable core cylinder (patented)	172-174,176
	84-*	Hardware provided with SARGENT Keso construction cores (permanent cores ordered separately)	172-174,176
Additional Security	**BR-**	Bump resistant cylinder (available with conventional & conventional XC cylinders only)	–
Less Cylinder	**LC-**	Less cylinder – SARGENT supplies standard blocking rings for 1-1/8" cylinders (for longer cylinders order collars/rings separately)	–
Schlage Keyways	**SC-*^**	Schlage C keyway cylinder, 0 bitted	#41 Only
	SE-*^	Schlage E keyway cylinder, 0 bitted	#41 Only
Note: For V-10 Cylinders and information contact ASSA			

^ Options not available with Freewheeling Trim

* Options not available with 50 function lockout cylinder

Note: When using Interchangeable Core Cylinders, the ANSI/BHMA Cylinder Grade determines the grade of the lock, even if the lock is certified ANSI/BHMA Grade 1 with a standard cylinder

Cylinder Length	SARGENT Cylinder Sizes	Keso Cylinder Sizes	Keso R/C Cylinder Sizes
1-1/8"	#41	#71	N/A
1-1/4"	#42	#72	#172
1-3/8"	#43	#73	#173
1-1/2"	#44	#74	#174
1-3/4"	#46	#76	#176
2"	#48	N/A	N/A
2-1/4"	#50	N/A	N/A
2-1/2"	#52	N/A	N/A
2-3/4"	#54	N/A	N/A
3"	#56	N/A	N/A

How To Order, Finishes, Packaging & Security Screw Chart

8200/R8200/7800 Mortise Locks

SARGENT
ASSA ABLOY

How to Order 8200, R8200 & 7800 Mortise Locks

10-	82	71	12VDC	TR	MJ	15	RHR
Options*	**Series**	**Function**	**Voltage**	**Roses/ Escutcheons**	**Trim**	**Finish**	**Hand**
For all available options see Pages 36-38	82 R82 78 Mortise Lock	Pages 21-27 for Details	12VDC 24VDC	Pages 9-14 (With R8200, specify "R" for roseless design)	Levers — Pages 7-8, 10 FW Trim — Page 15, Push/Pull Trim — Page 16-17, Knobs — Page 20	Page 41	RHR
							RH
			Must be specified for Functions 70, 71, 72 & 73				LHR
							LH

* Multiple options can be selected

Finishes

Standard Levers & Knobs	BHW Trim	BHL Trim	BHD Trim	Studio Collection Lever Trim	8200 Coastal Series™ Trim and 8200 Freewheeling Trim	7800 Push/Pull Trim	Description	ANSI/BHMA
03				03	03	03	Polished brass, clear coated	605
04				04	04	04	Satin brass, clear coated	606
09				09	09	09	Polished bronze, clear coated	611
10				10	10	10	Satin bronze, clear coated	612
10B				10B	10B	10B	Oxidized bronze, oil rubbed	613
10BE				10BE	10BE		Dark oxidized satin bronze, equivalent	(613E)
10BL				10BL	10BL		Oxidized satin, bronze, clear coated	614
14				14	14		Polished nickel, clear coated	618
15 *				15 *	15 *		Satin nickel, clear coated	619
20D				20D	20D		Statuary dark bronze, clear coated	624
26				26	26		Polished chrome	625
26D *				26D *	26D *		Satin chrome	626
32	32	32	32	32		32	Polished stainless steel	629
32D *	32D *	32D *	32D *	32D *		32D *	Satin stainless steel	630
BSP				BSP	BSP		Black suede powder coat	—
WSP				WSP	WSP		White suede powder coat	—

* MicroShield® — optional designate SG- option (Available on 15, 26D, and 32D Finishes only)
Split Finishes — specify outside finish first, then inside finish example: US26D (outside) / US04 (inside)

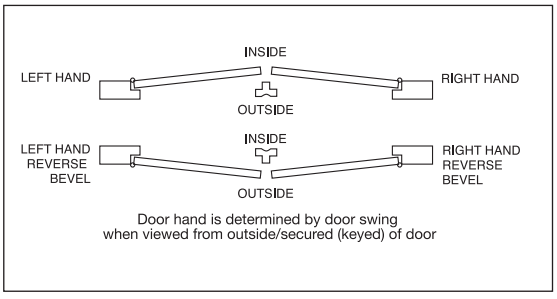
6 Lobe & Spanner Bit packs

Part Number	Descriptions
82-3855	6 Lobe Bit Pack 6 bits
82-3856	(sizes- T8, T9, T10, T15, T20, T25, T27) 9/32" Driver Spanner Bit Pack 5 bits (sizes- 6, 8, 10, 12, 14) 1/4" Driver

Packaging

8205 x LNL	approx. 6.1 lbs. (2.7kg)/box	6 boxes/case
8205 x WTL	approx. 7.2 lbs. (3.1kg)/box	6 boxes/case

Door Handing



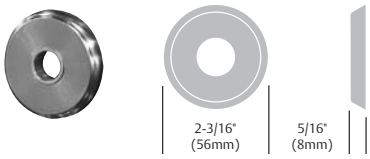
Door hand is determined by door swing when viewed from outside/secured (keyed) of door

* Multiple options available
Wrought Box Strike optional — must order with lockset as WBS- option

Coastal Series Roses & Escutcheons

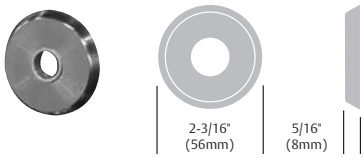
TR Traditional Rose

- Dual radii edge



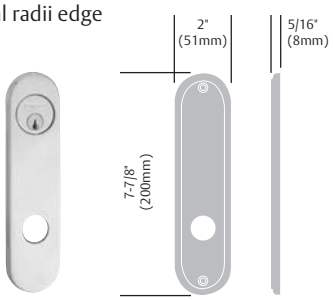
CR Contemporary Rose

- Beveled edge



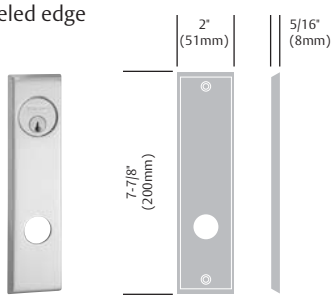
TE Traditional Escutcheon

- Dual radii edge



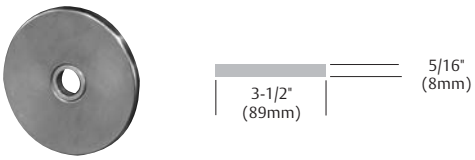
CE Contemporary Escutcheon

- Beveled edge

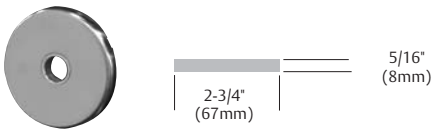


Standard Roses

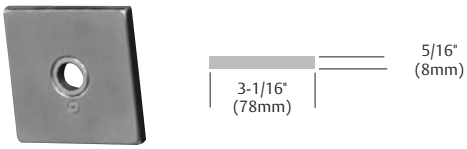
L Rose



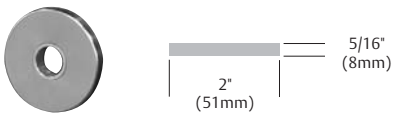
O Rose



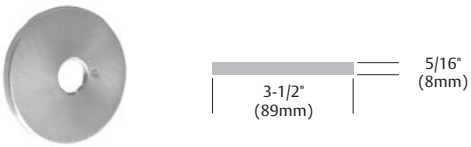
E Rose



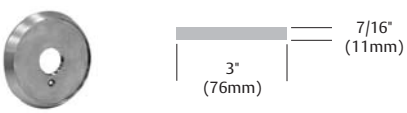
LN Rose



SL Rose

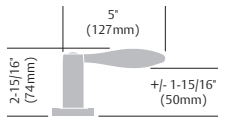
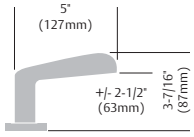
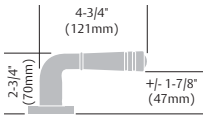
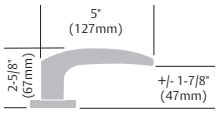


BH Rose



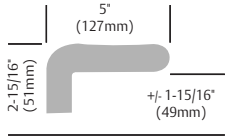
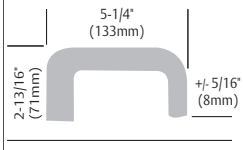
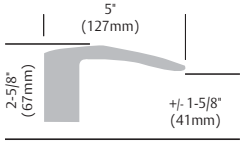
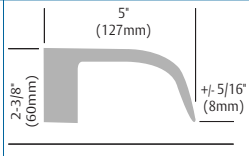
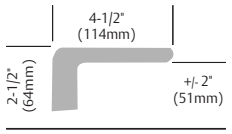
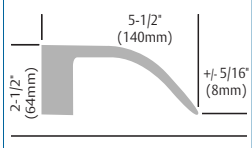
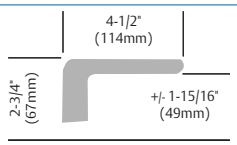
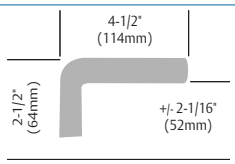
Coastal Series
(8200 & R8200 Series)

Features
- All levers meet ADA compliance for national codes
- Not available with CO and TO roses
- Levers are solid cast brass
- Finishes available – 3, 4, 9, 10, 10B, 10BE, 10BL, 14, 15, 20D, 26, 26D, BSP, WSP
- All lever height (+/- 1/16") measurements represent total distance from door face

G - Gulfport™ (Handed)			S - Sanibel™ (Handed)		
R - Rockport™			Y - Yarmouth™ (Handed)		

Standard Levers
(8200 Series Only)

Features
- All levers meet ADA compliance for national codes
- Solid forged or cast
- Lever designs J, L and P have lever returns within 1/2" (13mm) or less of door face and meet California State Reference Fire Code
- All lever height (+/- 1/16") measurements represent total distance from door face

A (Handed)			J		
B			L		
E			P		
F			W		

Electrical Functions & Monitoring Options

8200/R8200/7800 Mortise Locks

SARGENT 8200 Electromechanical Mortise locks are designed to handle single opening, stand alone applications, or can be readily integrated into sophisticated access control systems. They meet ANSI/BHMA A156.13 Grade 1 requirements, are UL listed on fire doors, and satisfy industry standards for operating temperature, shock and fire hazard.

Featuring EcoFlex® Technology*

- **Reduces energy consumption up to 96%, as certified by GreenCircle**
  - Lower operating costs
  - Assists with load reduction in optimizing energy performance credit in LEED
  - Reduces number of power supplies required
- **Field configurable to fail-safe or fail-secure**
- **Operates from 12-24VDC, offering greater flexibility in system design**
- **Innovative actuator design provides superior reliability**
  - Higher performance and reduced maintenance
  - Ability to have longer cable runs without negatively impacting lock function
  - Reduces risk of voltage drops and eliminates inductive kickback
  - Lower total cost of ownership

**Patent pending*

Electrical Requirements for electromechanical functions:

Voltage: Operates from 12-24VDC Regulated. Full wave rectification installed inside the lockbody.

Current:

- Actuator draw = .015 Amp continuous
- Maximum (2) locks per 1 Amp power supply (1/2 Amp peak current draw)

Operating Temp.: Max. 151°F (66°C), Min –31°F (-35°C)

UL and CUL listed for use on Fire Doors

Note: Repeated operation at voltage exceeding +/- 10% is not recommended

Warning:

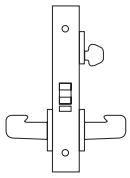
- **Do not** connect locks to a circuit sharing an additional electromagnetic device as the lock may be damaged
- Transient voltage must be suppressed at the source or before connecting with the lock
- Varistor rated at 35 volts (peak) may be used for transient voltage protection

Note: Opening the lockbody or the actuator replacement in the field by non-authorized personnel voids UL label and lock warranty

Electromechanical Functions

70 Electrical (Fail Safe)
71 Electrical (Fail Secure)

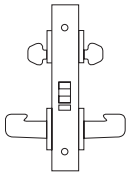
8200 & R8200



- 70 function — Power ON, locks outside lever
- 71 function — Power ON, unlocks outside lever
- Specify voltage: 12VDC or 24VDC (operates from 12-24VDC)
- Key outside retracts latchbolt
- Lever outside retracts latchbolt, except when locked
- Lever outside can only be locked electronically
- Lever inside always retracts latchbolt
- Auxiliary deadlatch

72 Electrical (Fail Safe)
✦73 Electrical (Fail Secure)

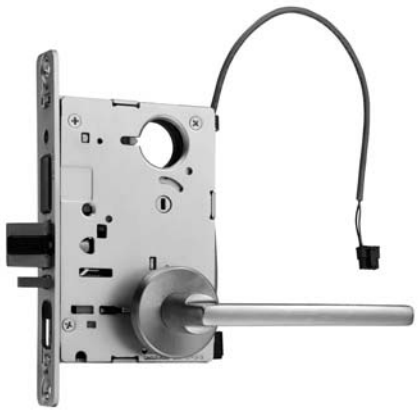
8200 & R8200



- 72 function — Power ON, locks both levers
- 73 function — Power ON, unlocks both levers
- Specify voltage: 12VDC or 24VDC (operates from 12-24VDC)
- Key on either side retracts latchbolt
- Lever from either side retracts latchbolt, except when levers are locked
- Both Levers can only be locked & unlocked electronically
- Levers can not be locked separately, only together
- Auxiliary deadlatch

Electrified Mortise Locks with Standard Monitoring Options

- Single Pole Double Throw (SPDT) type C switches
- **RX- option — Request-to-Exit or Enter Signaling Switch**
  - Two switches mounted internally in lockbody that provide independent monitoring of inside and outside lever rotation
  - Available in all functions with non rigid levers
  - Not available for the following options: 1-, 3P, 74
  - Not available for the following trims: LS or FE
- **LX- option — Latchbolt Monitor**
  - Single switch mounted within lockbody signaling latchbolt position
  - Available for all non deadbolt functions
  - Not available with DX
- **DX- option — Deadbolt Monitor**
  - Switch mounted internally in lockbody that indicates deadbolt position
  - Not available for the following options: 3P-, 74 or LX
  - Available in all deadbolt functions

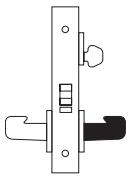


✦**CAUTION**: Not recommended for use on any door used for Life Safety egress

Single Cylinder without Deadbolt

*‡04 Storeroom or Closet

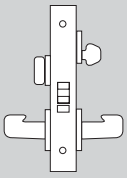
8200, R8200 & 7800



- Key outside retracts latchbolt
- Trim outside locked at all times
- Trim inside always retracts latchbolt
- Auxiliary deadlatch
- A Multi-Function 8200/R8200/7800 Lockbody
- **ANSI F07**

*05 Office or Entry

8200, R8200 & 7800



- Key outside retracts latchbolt, also locks & unlocks outside trim
- Trim inside always retracts latchbolt, trim outside remains locked
- Thumbturn inside locks & unlocks outside trim
- Auxiliary deadlatch
- A Multi-Function 8200/R8200/7800 Lockbody
- **ANSI F04**

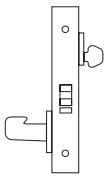
The Multi-Function Advantage with rose trim:

1. Lock will accommodate 04, 05, 15 & 37 functions without additional parts.
2. By adding an additional cylinder, lock will accommodate 38 function.
3. By adding a Trim One Side Kit, lock will accommodate 06, 13, 31 & 36 functions.

NOTE: Office/Entry Function with toggle is a 55 function.

06 Storeroom or Service

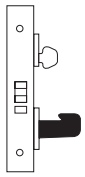
8200, R8200 & 7800



- No trim outside, cylinder only
- Key outside retracts latchbolt
- Trim inside always retracts latchbolt
- Auxiliary deadlatch
- A Multi-Function 8200/R8200/7800 Lockbody
- Same as 04 Function without trim outside

✦*31 Utility

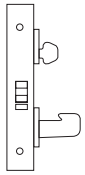
8200, R8200 & 7800



- Key outside retracts latchbolt
- Trim outside is always locked
- No inside trim or cylinder
- A Multi-Function 8200/R8200/7800 Lockbody
- Auxiliary deadlatch

*✦36 Closet

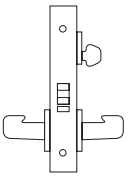
8200, R8200 & 7800



- Key locks and unlocks trim
- No inside trim or cylinder
- A Multi-Function 8200/R8200/7800 Lockbody
- Auxiliary dead latch

*‡37 Classroom

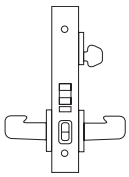
8200, R8200 & 7800



- Key outside retracts latchbolt, also locks & unlocks outside trim
- Trim inside always retracts latchbolt
- Auxiliary deadlatch
- A Multi-Function 8200/R8200/7800 Lockbody
- **ANSI F05**

55 Office or Entry

8200, R8200 & 7800



- Key outside retracts latchbolt
- Trim inside always retracts latchbolt, outside trim remains locked
- Trim outside is locked & unlocked by the toggle only
- Auxiliary deadlatch

*8200 Available with Freewheeling Trim
‡ 7800 Available with Push/Pull Trim

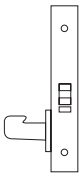
If shaded, knob or lever rigid at all times

✦**CAUTION**: Not recommended for use on any door used for Life Safety egress

Non-Keyed

13 Exit Latch

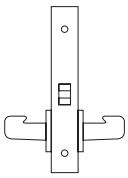
8200, R8200 & 7800



- No outside trim or cylinder
- Trim inside retracts latchbolt
- A Multi-Function 8200/R8200/7800 Lockbody
- Auxiliary deadlatch
- **ANSI F31**

‡15 Passage or Closet

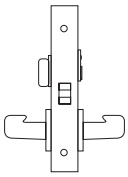
8200, R8200 & 7800



- Trim from either side retracts latchbolt at all times
- **ANSI F01**

*‡ 65 Privacy Bath/Bedroom

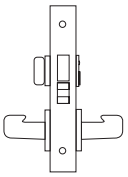
8200, R8200 & 7800



- Trim outside retracts latchbolt except when locked by thumbturn
- Trim inside retracts latchbolt and unlocks outside trim
- Emergency Release locks/unlocks trim outside- by coin, screwdriver or Emergency key (14-0057) ordered separately
- Thumbturn locks and unlocks trim outside
- Closing the door will unlock outside trim
- **ANSI F22**

*66 Privacy Bath/Bedroom

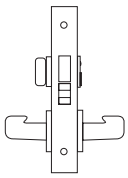
8200, R8200 & 7800



- Trim outside retracts latchbolt except when deadbolt is projected
- Trim inside retracts both latchbolt and deadbolt simultaneously, unlocking the outside trim
- Emergency Release retracts and projects deadbolt — by coin, screw driver or Emergency key (14-0057) ordered separately
- Thumbturn retracts and projects deadbolt
- **ANSI F19**

✦68 Privacy Bath/Bedroom

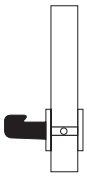
8200, R8200 & 7800



- Trim from either side retracts latchbolt at all times
- Thumbturn retracts and projects deadbolt
- Emergency release retracts and projects deadbolt — by coin, screwdriver or Emergency key (14-0057) ordered separately
- Latchbolt and deadbolt are independent of each other
- **ANSI F02**

93 Trim Dummy

8200, R8200 & 7800



- Trim on inside of door is always rigid
- Trim only used as door pull
- For double door applications, installed on the inactive door, use template #4298 to accept latchbolt from active door

Note: Lever is through-bolted

*8200 Available with Freewheeling Trim
‡ 7800 Available with Push/Pull Trim

If shaded, knob or lever rigid at all times

✦**CAUTION**: Not recommended for use on any door used for Life Safety egress

Product Catalog

SARGENT
ASSA ABLOY

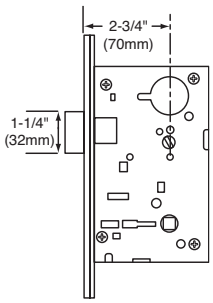
Auxiliary Locks

ASSA ABLOY, the global leader
in door opening solutions

Specifications

For Doors	Door thickness 1-3/4" (44mm) standard (For thicker doors, consult factory)
Backset	2-3/4" only
Strike	4-7/8" (124mm), ANSI Standard A115.1. Available finishes 03, 04, 09, 10, 10BE, 10BL, 15, 20D, 32, 32D
Deadbolt	One piece hardened stainless steel deadbolt with 1" (25mm) throw
Cylinder	Brass, 6 pin. 2 keys per lock. Also available with the SARGENT Signature and Keso and Keso F1 security systems **NOTE: See 8200 Mortise Lock catalog (page 25) for details on cylinder requirements.**
Masterkeying	Can be masterkeyed. Construction key systems available
Case	12 gauge heavy duty wrought steel, zinc dichromate plated
Outside Front Plate	Brass, bronze and stainless steel. 8" (203mm) x 1-1/4" (32mm), ANSI Standard 115.1. Adjustable at any angle from flat to beveled 1/8" (3mm) in 2" (51mm)
Hand	Non-handed
Mechanical Options	Cylinder Options see page 11-12 1- For 1-3/8" thick doors; front 1-1/16" wide 23- 4-7/8" (124mm) ANSI Strike with 1-1/8" (29mm) Flat Lip 31- 2-1/4"- 2-1/2" thick doors, centered in door prep, no paneling. Consult factory for other door thicknesses available by special application. 36- 6 Lobe Torx® Security Screws 37- Spanner head security screws 74- Lock case wrapped in lead (specify hand) SG- MicroShield® antimicrobial clear powder coat (only available with 32D) WBS- Wrought Box Strike
Finishes	03, 04, 09, 10, 10B, 10BE, 10BL, 15, 20D, 26, 26D, 32, 32D, BSP, WSP For other finishes consult factory

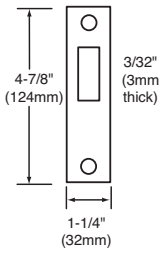
8200 Deadlock



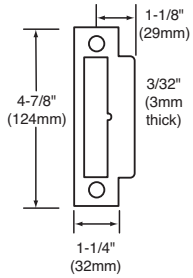
How To Order

10-28-	8230	26D
Options	Series x Function	Finish
Mechanical Options this page	8203	03, 04, 09, 10, 10B, 10BE, 10BL, 20D, 32 & 32D
	8220	
Cylinder Options page 11-12	8221	
	8222	
	8223	

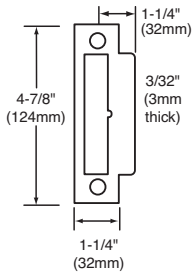
7730 Strike (Standard)



82-0229 Strike Flat Lip Alternative (23- Option)

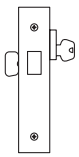


82-0109 Strike Curved Lip Alternative (Specify as 82-0109)



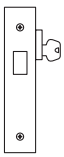
Functions

03 Classroom



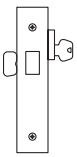
- Key outside operates deadbolt
- Thumb turn inside retracts deadbolt, but will not project it

20 Deadlock

*** 

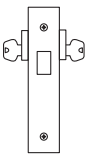
- Key outside operates deadbolt
- No inside operation
- **ANSI F18**

21 Deadlock



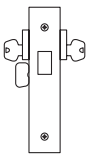
- Key outside operates deadbolt
- Thumb turn inside operates deadbolt
- **ANSI F17**

22 Deadlock

*** 

- Key from either side operates deadbolt
- **ANSI F16**

23 Classroom



- Key from either side operates deadbolt
- Thumb turn inside will retract deadbolt, but will not project it

***** For use only on rooms with more than one exit**

NOTE: For deadbolt function locks with levers see the 8200 Mortise Lock Catalog

Cylinder Options by Product Line

Auxiliary Locks

SARGENT®
ASSA ABLOY

Cylinder Type	Option	Description	8200 & 4870 Dead Bolt	480 Dead Bolt	470 Dead Bolt	758 & 858 Padlocks	856 & 857 Padlocks	1655 Locker Lock	4141-4143 Utility & Cabinet Locks	4152, 4153, 4253 Utility Locks
Conventional Cylinder	Std	SARGENT Conventional Cylinders	Yes	Yes	Yes	Yes	N/A	N/A	N/A	N/A
Degree Key System	DG1-	SARGENT Degree Key System Level 1	Yes	Yes	Yes	Yes	N/A	N/A	N/A	N/A
	DG1-21-	Degree Level 1 Construction Master Keying	Yes	Yes	Yes	Yes	N/A	N/A	N/A	N/A
	DG1-60-	Degree Level 1 Removable Disposable Construction Core	Yes	Yes	N/A	Yes	N/A	N/A	N/A	N/A
	DG1-63-	Degree Level 1 Removable Core	Yes	Yes	N/A	Yes	N/A	N/A	N/A	N/A
	DG1-64-	Degree Level 1 Removable Construction Keyed LFIC	Yes	Yes	N/A	Yes	N/A	N/A	N/A	N/A
	DG1-65-	Degree Level 1 Unassembled/Uncombined Core	Yes	Yes	N/A	Yes	N/A	N/A	N/A	N/A
	DG2-	SARGENT Degree Key System Level 2	Yes	Yes	Yes	Yes	N/A	N/A	N/A	N/A
	DG2-21-	Degree Level 2 Construction Master Keying	Yes	Yes	Yes	Yes	N/A	N/A	N/A	N/A
	DG2-60-	Degree Level 2 Removable Disposable Construction Core	Yes	Yes	N/A	Yes	N/A	N/A	N/A	N/A
	DG2-63-	Degree Level 2 Removable Core	Yes	Yes	N/A	Yes	N/A	N/A	N/A	N/A
	DG2-64-	Degree Level 2 Removable Construction Keyed LFIC	Yes	Yes	N/A	Yes	N/A	N/A	N/A	N/A
	DG2-65-	Degree Level 2 Unassembled/Uncombined Core	Yes	Yes	N/A	Yes	N/A	N/A	N/A	N/A
	DG3-	SARGENT Degree Key System Level 3	Yes	Yes	Yes	Yes	N/A	N/A	N/A	N/A
	DG3-21-	Degree Level 3 Construction Master Keying	Yes	Yes	Yes	Yes	N/A	N/A	N/A	N/A
	DG3-60-	Degree Level 3 Removable Disposable Construction Core	Yes	Yes	N/A	Yes	N/A	N/A	N/A	N/A
	DG3-63-	Degree Level 3 Removable Core	Yes	Yes	N/A	Yes	N/A	N/A	N/A	N/A
	DG3-64-	Degree Level 3 Removable Construction Keyed LFIC	Yes	Yes	N/A	Yes	N/A	N/A	N/A	N/A
Signature Key System	10-	SARGENT Signature Key System (Not Available with other Key Systems)	Yes	Yes	Yes	Yes	N/A	Yes	N/A	N/A
	10-21-	SARGENT Signature Construction Key System (Lost Ball)	Yes	Yes	Yes	Yes	N/A	Yes	N/A	N/A
Signature: Large Format Interchangeable Core (Removable Core)	10-63-	SARGENT Signature LFIC (Removable Core) Cylinder	Yes	Yes	N/A	Yes	N/A	N/A	N/A	N/A
XC- Key System	11-	XC Key System (Not Available with other Key Systems, Unless specified)	Yes	Yes	Yes	Yes	N/A	Yes	N/A	N/A
	11-21-	XC- Construction Key System (Lost Ball)	Yes	Yes	Yes	Yes	N/A	Yes	Yes	N/A
XC- Large Format Interchangeable Core + (Removable Core)	11-60-	Hardware to accept XC- Permanent LFIC (Removable Core), Disposable plastic Core- provided	Yes	Yes	N/A	Yes	N/A	N/A	N/A	N/A
	11-63-	Hardware provided with XC- LFIC (Removable Core) Cylinder - (Includes masterkeying, grand masterkeying)	Yes	Yes	N/A	Yes	N/A	N/A	N/A	N/A
	11-64-	Hardware provided with Keyed construction core to accept XC-LFIC (Removable) Permanent Core (ordered Separately)	Yes	Yes	N/A	Yes	N/A	N/A	N/A	N/A
XC- Small Format Interchangeable Cores+	11-70-7P-	Hardware to accept XC- SFIC (7 pin) XC- Permanent Cores, plastic disposable core provided	Yes	Yes	N/A	N/A	N/A	N/A	N/A	N/A
	11-72-7P-	Hardware to accept XC- SFIC (7 pin Keyed Construction Core provided) cylinder, Permanent core ordered separately	Yes	Yes	N/A	N/A	N/A	N/A	N/A	N/A
	11-73-7P-	Hardware supplied with XC- Small Format 7 pin interchangeable core (Includes masterkeying, grand masterkeying)	Yes	Yes	N/A	N/A	N/A	N/A	N/A	N/A
	11-65-73-7P-	Hardware to accept XC- Uncombinated 7 pin SFIC (Permanent) Core - (Packed Loose)	Yes	Yes	N/A	N/A	N/A	N/A	N/A	N/A
Construction Key Systems	21-	SARGENT Lost Ball Construction Keying for Conventional, XC and Signature Series (N/A with 63-, 73-, 82-, SC- & SE-)	Yes	Yes	Yes	Yes	N/A	Yes	Yes	N/A
	22-	SARGENT Construction Split Key System for Conventional Cylinders (Existing Systems) (N/A with 10-, 11-, 63-, 73-, 82-, SC- & SE-)	Yes	Yes	Yes	Yes	N/A	Yes	Yes	N/A
Old Style Removable Core	51-	Removable Core Cylinder (Old Style) provided (Existing systems only)	Yes	N/A	N/A	Yes	N/A	N/A	N/A	N/A
	52-	Removable Construction Core (Old Style) Permanent core ordered separately (existing systems only)	Yes	N/A	N/A	Yes	N/A	N/A	N/A	N/A

NOTE: For V-10 Cylinder and information, contact ASSA
NOTE: When tying into existing key systems contact Key Records for compatibility
+ For use in SARGENT hardware ordered to accept XC- option

Cylinder Options by Product Line

Auxiliary Locks

SARGENT®
ASSA ABLOY

Cylinder Type	Option	Description	8200 & 4870 Deadbolt	480 Dead Bolt	470 Dead Bolt	758 & 858 Padlocks	856 & 857 Padlocks	1655 Locker Lock	4141-4143 Utility & Cabinet Locks	4152, 4153, 4253 Utility Locks
Large Format Interchangeable Core (Removable Core)	60-	Hardware to accept Permanent LFIC (Removable Core), Disposable plastic Core provided (Permanent Cores Ordered Separately)	Yes	Yes	N/A	Yes	N/A	N/A	N/A	N/A
	63-	6 pin LFIC permanent core provided	Yes	Yes	N/A	Yes	N/A	N/A	N/A	N/A
	64-	Hardware supplied with Keyed LFIC construction core to accept Permanent LFIC Core (ordered Separately)	Yes	Yes	N/A	Yes	N/A	N/A	N/A	N/A
Small Format Interchangeable Cores	70-	Hardware to accept 6 or 7 Pin SFIC Permanent Cores (ordered separately), plastic disposable core provided	Yes	Yes	N/A	N/A	N/A	N/A	N/A	N/A
	72-	Hardware to accept 6 or 7 Pin SFIC supplied with Keyed Construction Core. (Permanent Core Ordered separately)	Yes	Yes	N/A	N/A	N/A	N/A	N/A	N/A
	73-	Hardware supplied with 6 pin SFIC (Includes masterkeying, grand masterkeying)	Yes	Yes	N/A	N/A	N/A	N/A	N/A	N/A
	65-73-	Hardware provided to accept Uncombinated 6 pin SFIC (Permanent) Core - (Packed Loose for field keying)	Yes	Yes	N/A	N/A	N/A	N/A	N/A	N/A
	65-73-7P-	Hardware provided to accept Uncombinated 7 pin SFIC (Permanent) Core - (Packed Loose for field keying)	Yes	Yes	N/A	N/A	N/A	N/A	N/A	N/A
	73-7P-	Hardware supplied with Small Format 7 Pin Interchangeable Core (Includes masterkeying, grand masterkeying)	Yes	Yes	N/A	N/A	N/A	N/A	N/A	N/A
Keso F1 & Keso	81-	Hardware provided with housings to accept Keso (83) & Keso F1 (F1-83-) removable cores. (Permanent Cores Ordered Separately)	Yes	N/A	N/A	N/A	N/A	N/A	N/A	Std.
	82-	Hardware provided with standard Keso Security Cylinder	Yes	N/A	N/A	N/A	Std	N/A	N/A	N/A
	F1-82-	Hardware provided with standard Keso F1 Security Cylinder (Patented)	Yes	N/A	N/A	N/A	Specify F1-	N/A	N/A	Specify F1-
	83-	Hardware supplied with SARGENT Keso Security Removable Core cylinder	Yes	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	F1-83-	Hardware supplied with SARGENT Keso F1 Security Removable Core cylinder (Patented)	Yes	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	84-	Hardware provided with SARGENT Keso Construction Cores (Permanent Removable Cores ordered separately)	Yes	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Bump Resistant	BR-	Bump Resistant Cylinder (Available with Conventional & Conventional XC Cylinders Only)	Yes	Yes	Yes	Yes	N/A	N/A	N/A	N/A
Less Cylinder	LC-	Less Cylinder	Yes	Yes	Yes	N/A	N/A	N/A	N/A	N/A
Schlage Keyways	SC-	Schlage C keyway cylinder, 0 bitted	Yes	Yes	Yes	Yes	N/A	N/A	N/A	N/A
	SE-	Schlage E keyway cylinder, 0 bitted	Yes	Yes	Yes	Yes	N/A	N/A	N/A	N/A

NOTE: For V-10 Cylinder and information, contact ASSA
NOTE: When tying into existing key systems contact Key Records for compatibility
+ For use in SARGENT hardware ordered to accept XC- option

Product Catalog

SARGENT
ASSA ABLOY

80 Series
Exit Device

ASSA ABLOY, the global leader
in door opening solutions

Windstorm Certifications

80 Series

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Windstorm Certifications: Florida Building Codes & UL Listings

SARGENT Manufacturing's products meet building codes that require hurricane, windstorm and FEMA certifications, including some of the most stringent building codes as specified in the Florida Building Code, Miami Dade Code and the International Building Code. Listed below are certifications and standards met by the 80 Series lock.

Florida Building Code: FL2998
UL Certification Directory: ZHEM.R21744 – Latching Hardware

ANSI/SDI-BHMA A250.13	"Testing and Rating of Severe Windstorm Resistant Components for Swinging Door Assemblies"
ANSI/ASTM E330	"Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference"
ANSI/ASTM E1886	"Standard Test Method for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials"
ASTM E1996	"Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors and Impact Protective Systems Impacted by Windborne Debris in Hurricanes"
(TAS) 201	"Impact Test Procedures"*
(TAS) 202	"Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference"
(TAS) 203	"Criteria for Testing Products Subject to Cyclic Wind Pressure Loading"*

* Published in the "Florida Building Code"

Any retrofit or other field modification to a fire rated opening can potentially impact the fire rating of the opening, and Sargent Manufacturing Company makes no representations or warranties concerning what such impact may be in any specific situation. When retrofitting any portion of an existing fire rated opening, or specifying and installing a new fire-rated opening, please consult with a code specialist or local code official (Authority Having Jurisdiction) to ensure compliance with all applicable codes and ratings.

UL Certification Directory: ZHLL.R21744 – Products for Use in Windstorm-rated Assemblies

Certifications to meet assembly requirements are done in conjunction with doors from ASSA ABLOY Group companies CECO DOOR and CURRIES.

ASTM E330	"Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference"
ANSI/ASTM E1886	"Standard Test Method for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials"
ASTM E1996	"Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors and Impact Protective Systems Impacted by Windborne Debris in Hurricanes"
AAMA/WDMA/CSA 101/I.S.2/A440	"Standard/Specification for Windows, Doors, and Unit Skylights"
FEMA Publication 320 (2014)	"Taking Shelter From the Storm: Building a Safe Room for Your Home or Small Business", investigated with respect to impact and pressure requirements only.
FEMA Publication 361 (2015)	"Design and Construction Guidance for Community Safe Rooms", investigated with respect to impact and pressure requirements only.
ICC 500 (2014)	"ICC/NSSA Standard for the Design and Construction of Storm Shelters", investigated with respect to impact and pressure testing. Minimum missile impact speeds vary with the design wind speed desired for a particular product. The information below correlates design wind speed to the minimum missile speeds as discussed in Table 305.1.1 of ICC 500

Any retrofit or other field modification to a fire rated opening can potentially impact the fire rating of the opening, and Sargent Manufacturing Company makes no representations or warranties concerning what such impact may be in any specific situation. When retrofitting any portion of an existing fire rated opening, or specifying and installing a new fire-rated opening, please consult with a code specialist or local code official (Authority Having Jurisdiction) to ensure compliance with all applicable codes and ratings.

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Cylinder Information for Exit Devices

Cylinder Chart: Exit Device Series x Function	Door Thickness	ET Trim (700 Series Auxiliary Control) 1-3/4" (44mm)	ET Trim (700 Series Auxiliary Control) 2-1/4" (57mm)	PTB, PSB, STS, MAL, MSL, FLL, FSL, FLW, FSW 1-3/4" (44mm)	PTB, PSB, STS, MAL, MSL, FLL, FSL, FLW, FSW 2-1/4" (57mm)
Narrow Stile Mortise Exit Device	8304	46	48	41	43
	8313/8343	41	41	Not Available	
	8344	46	48	Not Available	
	8363	Not Available		41	43
	8375/8376	46	48	Not Available	
Narrow Stile CVR Exit Device	All 8400	41	41	Not Available	
Narrow Stile Rim Exit	8504	34	34	Not Available	
	8513/8543	41	41	Not Available	
Concealed Vertical Rod Exit Devices	All LP/LR/LS8600	41	Not Available		
	All SP/PP/PR8600	41	Not Available		
	All AD, MD & WD8600	41	41	Not Available	
Surface Vertical Rod Exit Devices	8706/8713/8743/8746	41	41	Not Available	
	8762/8763	Not Available		34	34
	All SP/PP/PR8700	41	N/A	Not Available	
Rim Exit Devices	8804	34	34	34	34
	8806/8813/8843/8846	41	41	Not Available	
	8816	34/*44	34/*44	Not Available	
	8844	34	34	Not Available	
	8863	Not Available		34	34
	8866	Not Available		34/*44	34/*44
	8875/8876/8877	34	34	Not Available	
Mortise Lock Exit Devices	8904	46	48	41	43
	8913/8943	41	41	Not Available	
	8916	*34/46	*34/48	Not Available	
	8944	46	48	Not Available	
	8963	Not Available		41	43
	8966	Not Available		*41/34	*43/34
	8975/8976	46	48	Not Available	

* Inside Cylinders
Chart shows cylinder type and size for conventional SARGENT cylinders.
Note: Cylinder sizes & types are limited, as noted: SC- & SE- cylinders are available in size 41
60-, 63- & 64- cylinders are available in sizes 42, 43, 44 & 46
70-, 11-70-, 72-, 11-72-, 73- & 11-73 cylinders are available in sizes 43 & 46
Note: The 8888's Lever & Rose Trim cylinder standard is the standard SARGENT 10 Line cylinder (13-3266)
Note: 41 Cylinder is 1-1/8" in length; For each additional digit, the cylinder is a 1/8" longer. Example: 42 is 1-1/4"; 43 is 1-3/8" and 46 is 1-3/4"
Note: SARGENT supplies standard blocking rings. Specify if using competitor cylinders

Mullions: Aluminum, Steel and Electrified

80 Series

SARGENT®
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Aluminum Mullions

Product Designation	650A	980	L980
Description	Removable	Removable	Lockable
Material	Aluminum	Aluminum	Aluminum
Standard Finish	US28/Satin Anodized Aluminum	Prime Coat	Aluminum Prime Coat
Options	Specify "650A x 10B" for 313AN to match 10B	Specify "980A" for Anodized US28/ Satin Aluminum	Specify: "L980A" Anodized Aluminum Specify: "L980A x10B" for 313AN to match 10B
Stk Size	96"	96"	96"
Max Stk Height	120"	120"	120"
Pre-prepped	658 Strikes Included	No	No
Cylinder Size	Not Required	Not Required	#41
Shape	1-1/2" x 2-1/2"	T Shaped 2-1/2" x 3"	T Shaped 2-1/2" x 3"
Misc. Information and Accessories	Includes 651 Stabilizers and imbedded Weather Stripping Top Retainer 94-2050 Bottom Retainer 94-2051	Top Retainer - 511 Bottom Retainer - 502 Adapter for narrow transom: 507 - Aluminum Prime Coated 507A - Anodized Aluminum	All Cylinder Options Available Wall Mount Kit 98-2578 Top Ret Pack 98-2526 Bottom Ret Pack 98-2525 Cylinder Kit 980C1*

Electrified

EL980
Electrical Lockable
Steel
Gray Paint
Wall Mounting Kit: 98-2580 Top Ret Pack :98-2559
96"
120"
No
#46 Only
Rectangular 2" x 3"
For use with Electric Strikes and Monitoring, Quick Connect Wiring Supplied Cylinder Kit 980C2*

***Note:** Cylinder Kits must be ordered separately

Steel Mullions

Product Designations	HC980	980S	L980S	HCL980	12-HD980
Description	Hurricane Code	Standard Mullion	Lockable	Lockable Hurricane Code	Heavy Duty
Material	Steel	Steel	Steel	Steel	Steel
Fire Rated	Specify 12-HC980	Specify 12-980	Specify 12-L980	Specify 12-HCL980	Specify 12-HD980
Fire Rated Max Height	96"	96"	96"	96"	120"
Finish	Gray Paint	Gray Paint	Gray Paint	Gray Paint	Gray Paint
Stk Size	96"	96"	96"	96"	120"
Max Stk Height	96"	120"	120"	96"	120"
Pre-prepped	No	No	No	No	No
Cylinder Size	Not Required	Not Required	#41 Std (#42 & #43 available)	#41 Std (#42 & #43 available)	Not Required
Shape	Rectangular 2' x 3"	Rectangular 2" x 3"	Rectangular 2" x 3"	Rectangular 2" x 3"	Rectangular 2" x 3"
Misc. Information	Designed for severe wind load conditions due to hurricanes or windstorms. Tested to Dade County Protocols & ASTM Standards	For 12-8800 - Channel Iron & Malleable iron top & bottom retainers.	Fire rated for 8'0" x 8'0" paired openings	See Notes Below	12-HD980 is for pair of doors over 8'0" to 10'0" for use with 2-8800 Rim Exits includes two piece strikes
Accessories	Top Ret Pack - 98-2599 Bottom Ret Pack - 98-2600 Top Retainer Shim Kit - 601	Top Ret Pack - 98-2190 Bottom Ret Pack - 98-2191 Top Retainer Shim Kit - 601	Wall Mounting Kit - 98-2579 Top Ret Pack - 98-2559 Bottom Ret Pack - 98-2556 Top Retainer Shim Kit - 601 Cylinder Kit - 980C1*	- Top Retainer Pack: 98-2593 - Bottom Retainer Pack: 98-2594 - Top Retainer Shim Kit - 601 Cylinder Kit - 980C1*	Top Ret Pack - 98-2599 ottom Ret Pack - 98-2600 op Retainer Shim Kit - 601

***Note:** Cylinder Kits must be ordered separately

Note for HC980/12-HC980 Mullions:

- Designed for severe wind load conditions due to hurricanes or tornadoes
- Tested to Dade County protocols and ANSI 250.13 ASTM Standards and FEMA 361
- 12- Fire labeled version
- Replacement lock kits are available for lockable mullions Part numbers for each model are listed in the price book

HCL980 Mullion Information

- Model 12-HC-L980 may be supplied for doors UL fire rated up to and including 3 hrs not exceeding 8 ft in width and height
- Meets the following standards: ANSI 250.13, ASTM E330, ASTM 1886, ASTM 1996, TAS 201, TAS 202 & TAS 203
- Designed for use with UL Classified HC8810, HC8800 and 12-HC8800 rim exit devices

Mullion Accessories and Stabilizers

80 Series

SARGENT
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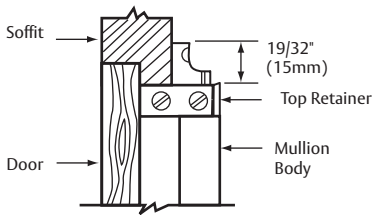
Mullion Accessories

RK980
Latchbolt assembly retrofit kit with top and bottom retainers for 980 aluminum mullion

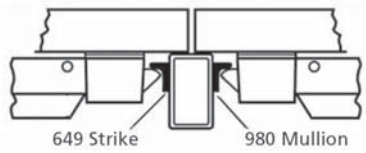
507 Narrow Transom Bars Adapter

- Available with 980 and 980A
- Required when soffit is 1-1/4" (32mm) to 2" (51mm) wide
- Order as a: 507 for 980 mullion or 507A for 980A mullion



980S Mullion Application

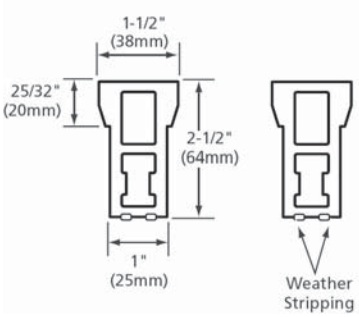
- All steel mullions are 2" x 3"



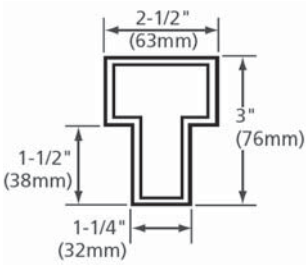
651 Mullion Stabilizer Kit

- Stabilizer block
- Furnished standard w/650A Mullion
- Order as a 651 Kit

650A Mullion



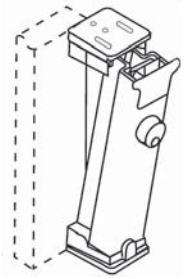
980 Mullion & L980 Lockable Mullion



980C1 Cylinder Mullion Kit

- Lockable mullions only
- Aluminum and steel
- Includes cylinder and collar
- Available in 26D & 10B finish

Lockable Mullion



Lockable Mullion Cylinder Kit Options*

L980, L980A, L980S & HC-L980 mullions are available with these options: 10, 10-21-, 10-63-, 11-, 11-21-, 11-60, 11-63-, 11-64-, 11-72-7P-, 11-65-73-7P-, 11-73-7P-, 21-, 22-, 60-, 63-, 64-, 70, 72-, 73-, 65-73-, 65-73-7P-, 73-7P-, 81-, 82-, F1-82-, 83-, F1-83-, 84-, SC- & SE-.

EL980 mullion is available with these options: 10, 10-21-, 10-63-, 11-, 11-21-, 11-60, 11-63-, 11-64-, 11-72-7P-, 11-65-73-7P-, 11-73-7P-, 21-, 22-, 60-, 63-, 64-, 70, 72-, 73-, 65-73-, 65-73-7P-, 73-7P-, 81-, 82- & F1-82-.

*Lockable mullions are shipped without cylinders. Order Cylinder Mullion Kit separately.

980C2 Cylinder Mullion Kit

- Lockable mullions
- Electrified only
- Includes cylinder and collar
- Available in 26D finish only

Mullion Weights & Packaging

Product	Avg Wt	Case
Exit Device with Trim	15 lbs	1 ea
980 Mullion	18 lbs	1 ea
12-980 Mullion	40 lbs	1 ea
650A Mullion	18 lbs	1 ea

Mechanical Options and Descriptions

80 Series

SARGENT®
ASSA ABLOY

Mechanical Options:

Categories	How to Specify	Detailed Description
Fire Rated	**12-**	UL Fire Label Exit hardware (not available with 16- & HK-)
SVR Bolt	**14-**	Sliding bolt bottom case for 8700
Cylinder Dogging	**16-**	Cylinder lockdown with # 41 Cylinder & # 97 Ring (not available with 12-, 57, 59-, AL- or BT- Option)
	LD-	Less dogging for non fire rated devices
Less Touch Pad	**19-**	Pushbar without Lexan touchpad (not available TL-)
8900/8300 Strike	**23-**	4-7/8" (124mm) ANSI flat lip strike (for 8900 & 8300 Series Mortise Lock Exit Devices)
Thick Doors	**31-**	Doors over 1-3/4" and/or Panels (Specify door thickness, panel thickness & location as required) Not available for HC8700, FM8700, PP, PR & SP8700, PP, PR & SP8600, LP, LR & LP8700 Extended lip strike supplied for 8300 & 8900 Series
Security Fasteners	**36-**	Six lobe security head screws
	37-	Spanner head screws
Flush End cap	**43-**	Flush End Cap (Not available with LP, LR & LS Devices)
Indicator	**49-**	Indicator (Available on 8816 and 8866 functions only)
Electrical Options	**53-**	Latchbolt monitoring switch (not available with 59-, GL-, HC-, WS- or on FM8700, PP/PR/SP8600 & LP/LR/LS8600 Exit Devices)
	54-	Monitors ET Lever movement with Internal micro switch in ET Control
	55-	Request to Exit - Signal Switch in Rail (not available with 59- & FM8700)
	56-	Remote Latch Retraction (not available 57-, 58-, 59-, AL- or BT- Option)
	56-HK-	Remote Latch Retraction with manual Hex Key dogging (not available 12-, 57-, 58-, 59-, AL- or BT- Option)
	57-	Delayed Egress (Electromagnetic Lock required & purchased separately) (not available 16-, 53-, 56-, 56-HK, 58-, 59-, AL, Bc-59 - or BT, GL, TL Prefixes) (NB, 54- are available on request)
	58-	Electric Rail Dogging (Not available 56- & 59-)
	59-	Electroguard® Self Contained Delayed Egress Device (not available with 16-, 53-, 55-, 56-, 57-, 58-, AL-, BT-, GL-, HC- & WS Option Prefixes, PP/PR/SP8600, LP/LR/LS8600 Exit Devices) (NB, 54- are available upon request)
	AL-	Alarmed Exit (Not available 16-, 56-, 57-, 59-, BT-, GL-, HC- & WS-)
	BC-59-	Electroguard® Boca Code (Door Status Switch required) (not available with 16-, 55-, 56-, 57-, 58-, AL-, BT-, GL-, HC- & WS-Options and on NB8700, PP/PR/SP8600 & LP/LR/LS8600 Exit Devices)
	TL-	SARGuide Electro-Luminescent Touchpad (not available 19-, 85-, 87- & PL-)
Tactile Warning Options	**76-**	Tactile Warning - Milled Outside Lever (not available with Studio & Coastal Levers and the A Lever)
	85-	Tactile Warning - Abrasive strip on Push Rail (Not available with PL- & TL-)
	86-	Tactile Warning - Abrasive coating on Outside Lever
	87-	Tactile Warning - Abrasive strip on Push Rail & Abrasive coating on Outside Lever (not available with PL- & TL-)
Finish Protection	**CPC-**	Clear Powder Coat (Available for 32 & 32D Finishes)
	SG-	MicroShield® antimicrobial clear powder coat (only available with 15, 26D and 32D finishes)
Top Rod Only	**NB-**	Less Bottom Rod & Bolt (for SVR & CVR Devices)
Guarded Latch	**GL-**	Guarded Latch for Rim Exit Devices (not available 53-, 56-, 59-, AL-, HC- & WS-)
SARGuide	**PL-**	SARGuide™ PL – Photoluminescent Coated Push Rail – (Touchpad eliminated) (not available 85, 87 & TL-)
Through Bolts	**TB-**	Through Bolts for 8300, 8500, 8600, 8700, 8800 & 8900 Devices
Rail Force	**5CH-**	5lb. Pressure Release (8800 only)

Cylinder Options and Descriptions

80 Series

SARGENT®
ASSA ABLOY

Cylinder Options:

Conventional Cylinder	-	SARGENT Conventional Cylinders Supplied Standard (Unless Otherwise Specified)
Degree Key System	**DG1-**	SARGENT Degree Key System Level 1 (bump resistant with patented keys)
	DG1-21-	Degree Level 1 Construction Master Keying
	DG1-60-	Degree Level 1 Removable Disposable Construction Core
	DG1-63-	Degree Level 1 Removable Core
	DG1-64-	Degree Level 1 Removable Construction Keyed LFIC
	DG1-65-	Degree Level 1 Unassembled/Uncombined Core
	DG2-	SARGENT Degree Key System Level 2 (geographically exclusive; bump and pick resistant)
	DG2-21-	Degree Level 2 Construction Master Keying
	DG2-60-	Degree Level 2 Removable Disposable Construction Core
	DG2-63-	Degree Level 2 Removable Core
	DG2-64-	Degree Level 2 Removable Construction Keyed LFIC
	DG2-65-	Degree Level 2 Unassembled/Uncombined Core
	DG3-	SARGENT Degree Key System Level 3 (geographically exclusive; UL437 certified; bump and pick resistant)
	DG3-21-	Degree Level 3 Construction Master Keying
	DG3-60-	Degree Level 3 Removable Disposable Construction Core
	DG3-63-	Degree Level 3 Removable Core
	DG3-64-	Degree Level 3 Removable Construction Keyed LFIC
	DG3-65	Degree Level 3 Unassembled/Uncombined Core
Signature Key System	**10-**	SARGENT Signature Key System (Not Available with other Key Systems)
	10-21-	SARGENT Signature Construction Key System (Lost Ball)
Signature- LFIC	**10-63-**	SARGENT Signature Large Format Interchangeable Core Cylinder (Removable)
XC- Key System	**11-**	XC Key System (Not available with other Key systems unless specified)
	11-21-	XC- Construction Key System (Lost Ball)
XC- Large Format Interchangeable Core (Removable Core)	**11-60-**	Device to accept XC- Permanent Large Format Interchangeable Core, Disposable plastic Core- provided
	11-63-	Device provided with XC- Large Format Interchangeable Core Cylinder - (Includes masterkeying, grand masterkeying)
	11-64-	Device provided with Keyed construction core to accept XC- Permanent Large Format Interchangeable Core (ordered separately)
XC- Small Format Interchangeable Core	**11-70-7P-**	Device to accept XC- SFIC (7-Pin) XC- Permanent Cores, plastic disposable core provided
	11-72-7P-	Device to accept XC- SFIC (7-Pin Keyed Construction Core provided) cylinder Permanent core ordered separately
	11-73-7P-	Device provided with XC- Small Format 7-Pin interchangeable core (Includes masterkeying, grand masterkeying)
	11-65-73-7P-	Device provided to accept XC- Uncombinated 7-Pin SFIC (Permanent) Core - (Packed Loose)
Construction Key Systems	**21-**	SARGENT Lost Ball Construction Keying for Conventional, XC and Signature Series (N/A with 63- or 73-)
	22-	SARGENT Construction Split Key System for Conventional Cylinders (Existing Systems Only) (N/A with 10-, 11-, 63- or 73-)
Old Style Removable Core	**51-**	Removable Core Cylinder (Old Style) provided (existing systems only)
	52-	Removable Construction Core (Old Style) Permanent core ordered separately (existing systems only)
Large Format Interchangeable Core (Removable Core)	**60-**	Device to accept SARGENT Permanent Large Format Interchangeable Core, Disposable plastic Core provided (Permanent Cores ordered separately)
	63-	Device provided with Large Format Interchangeable Core Cylinder - (Includes masterkeying, grand masterkeying)
	64-	Device provided with Keyed construction core to accept Permanent Large Format Interchangeable Core (ordered separately)
Small Format Interchangeable Core	**70-**	Device to accept 6- or 7-Pin SFIC Permanent Cores, plastic disposable core provided
	72-	Device to accept 6- or 7-Pin SFIC (6-Pin Keyed Construction Core provided) Cylinder (Permanent Core ordered separately)
	73-	Device provided with 6-Pin SFIC (Includes masterkeying, grand masterkeying)
	65-73-	Device provided to accept Uncombinated 6-Pin SFIC (Permanent) Core - (Packed Loose for field keying)
	65-73-7P-	Device provided to accept Uncombinated 7-Pin SFIC (Permanent) Core - (Packed Loose for field keying)
	73-7P-	Device provided with Small Format 7-Pin Interchangeable Core (Includes masterkeying, grand masterkeying)
Keso & Keso F1	**81-**	Device provided with housings to accept Keso (83) & Keso F1 (F1-83-) removable cores. (Permanent Cores ordered separately)
	82-	Device provided with SARGENT Keso Security Cylinder
	F1-82-	Device provided with SARGENT Keso F1 Security Cylinder (Patented)
	83-	Device provided with SARGENT Keso Security Removable Core cylinder
	F1-83-	Device provided with SARGENT Keso F1 Security Removable Core cylinder (Patented)
	84-	Device provided with SARGENT Keso Construction Cores (Permanent Cores ordered separately)
Added Security	**BR-**	Bump Resistant Cylinder (Available with Conventional & Conventional XC Cylinders Only)
Less Cylinder	**LC-**	Less Cylinder - SARGENT supplies standard blocking rings for 1-1/8" Cylinders (For longer cylinders order collars/rings separately)
Schlage Keyways	**SC-**	Schlage C keyway cylinder, 0 bitted (not available with: 8904, 8916, 8944, 8975, 8976, 8866, 8304, 8344, 8375 & 8376)
	SE-	Schlage E keyway cylinder, 0 bitted (not available with: 8904, 8916, 8944, 8975, 8976, 8866, 8304, 8344, 8375 & 8376)
Lever to Accept Schlage	**SF-**	L Lever to accept MEDECO KeyMark Large Format Interchangeable and Schlage Full Size Interchangeable Core (Supplied Less Cylinder, but with tailpiece needed) (Available for 88-KLL & 88-CLL)

Note: For V-10 Cylinders and information, contact ASSA

8800 Rim Exit Device

80 Series

SARGENT®

ASSA ABLOY

8800 Series
Rim Exit Device

8800 Features

- Designed for standard width stile applications on wood and metal doors
- Also available as an HC8800 or WS8800 for hurricane-resistant applications, see Hurricane-Resistant section of this catalog
- Single point rim latching device
- Single door & double door applications with mullions
- Quiet operation and solid security
- ANSI/BHMA A156.3 - Grade 1
- UL10C (Fire) and UL305 (Panic) Listed

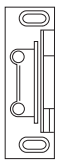
Specifications — 8800 Series Rim Exit Device

Door Type	Metal Doors
Door Thickness	1-3/4" (44mm) minimum thickness. For doors over 1-3/4" to 2 1/4" thick, specify thickness and order as 31-
Rail sizes as determined by door width	Rails are available in 4 sizes, use door width to determine size needed. Rails will be factory cut to size, if door width is supplied • E Rail for 24" to 32" door widths, No cutting required for 32" door • F Rail for 33" to 36" door widths, No cutting required for 36" door • J Rail for 37" to 42" door widths, No cutting required for 42" door • G Rail for 43" to 48" door widths, No cutting required for 48" door
Strike	649 Standard Black Nylon Coated
Optional Strikes	642, 644 and 613
Dogging Feature	Hex key dogging standard on non fired rated devices; specify 16- for cylinder dogging (#41 cylinder supplied)
Electric Options	AL- Alarm PL- SARGuide Photoluminescent Coated TL- SARGuide Illuminated Touchpad
	49- Indicator 53- LX Latchbolt Monitor 54- Outside Lever Monitoring 55- Request-to-Exit Signal - Rail Monitoring 56- Remote Latch Retraction 57- Delay Egress & Electromagnets 58- Electric Dogging 59- Electroguard – Self Contained Delayed Egress
Mounting Fasteners	Supplied standard with wood and machine screws Available with through-bolts and mortise (sex) nuts
Latch Bolt	Stainless steel, 3/4" (19mm) throw
Device Centerline from Finished Floor	41" (1041 mm) for Standard Applications
Center Case Dimensions	8-3/8" (213mm) x 2-5/8" (67mm)
Projection	Pushbar Neutral – 3" (76 mm) Pushbar Depressed – 2-1/8" (54 mm)
Fire Exit Hardware	See Chart – Page 6

49- Lock/Unlock Indicator Option

- Displays whether the door has been secured by the inside cylinder.
- Red icon indicates locked
- White icon indicates unlocked
- Dogging overrides 49- functionality (must order less dogging)
- Available on 8816 and 8866 functions only

649 Strike



- Supplied standard for panic & fire rated openings
- Surface applied
- Black nylon coated

688 Trim Retrofit Kit

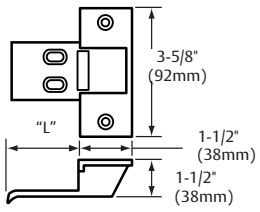
- 688 Trim Retrofit kit allows an 8800* Series rim exit with an ET to replace Von Duprin's 98/99 Series exit with trim with minimal door prep.

* Except for 16 function

- Order as: 688 Kit

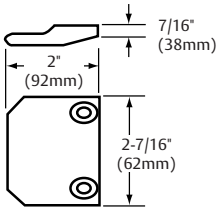
Alternate Strikes For 8800 Rim Devices

642 Strike



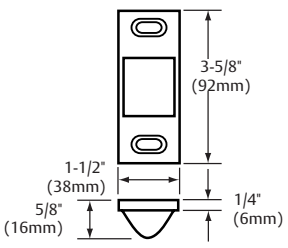
- Mortised. Dimension "L" equals door thickness plus 1/2" (13mm). Black nylon coated on lip only

644 Strike



- Surface applied. For use on pairs of doors without mullion. Ductile Iron. Black nylon coated

613 Strike



- Half mortised. Black nylon coated

8800 Functions and Trims

80 Series

SARGENT®
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Options	Series	Function	Rail Lgth	Trim	Hand	Outside Finish	Inside Finish	Door Width
F1-83-56	88	13	F	ETL	RHR	26D	32D	36"

700 Series ET Trim

Exits with ET Trim, specify lever design after the ET designation (e.g., ETL)

Lever Designs for ET Controls

A, B, E, F, J, L, P, W

Also available with Coastal Series & Studio Collection Levers

ET Designation with Suffix (Used to order ET without device)

8800 Series: 704, 706-8, 710, 713-8, 715-8, 716, 740, 743-8, 744, 746-8, 773-8, 774-8, 775-8 & 776-8

Freewheeling Trim

The lever rotates when the door is locked preventing excessive force from being applied to the horizontal lever

Electrified ET Trim

Voltage must be specified for the following functions: 73, 74, 75 and 76. Specify: 12VDC or 24VDC

SARGENT Function Numbers	ANSI Function Numbers	Description & Cylinder Info (1-3/4" Door)	ANSI Type 1 8800 Panic & Fire
04	03	Night Latch Key Retracts Latch #34 Cylinder Supplied	8804 x ET_
06	09	Key unlocks Trim, Trim retracts latch/ Trim relocks when key is removed #41 Cylinder Supplied	8806 x ET_
10	01	No outside operation (No Cylinder)	8810
10	02	No outside operation (No Cylinder) ET Control is used as Pull Only	8810 x ET_
13	08	Key Outside Unlocks/locks Trim #41 Cylinder Supplied	8813 x ET_
15	14	Passage Only (No cylinder)	8815 x ET_
16	10	Key Outside Retracts Latch; Key Inside Unlocks/Locks O/S Trim O/S #34 Cylinder & I/S #44 Cylinder Supplied	8816 x ET_
40	02	Freewheeling Trim - No outside operation (No Cylinder) Dummy Trim	8840 x ET_
43	08	Freewheeling Trim - Key Outside Unlocks/locks Trim #41 Cylinder Supplied	8843 x ET_
44	03	Freewheeling Trim - Key Retracts Latch #34 Cylinder Supplied	8844 x ET_
46	09	Freewheeling Trim - Key unlocks Trim, Trim retracts latch/ Trim relocks when key is removed #41 Cylinder Supplied	8846 x ET_
73		Electrified ET Trim - Fail Safe Power Off, Unlocks Lever (No Cylinder)	8873 x ET_
74		Electrified ET Trim - Fail Secure Power Off, Locks Lever (No Cylinder)	8874 x ET_
75		Electrified ET Trim - Fail Safe Power Off, Unlocks Lever, Key Retracts Latch #34 Cylinder Supplied	8875 x ET_
76		Electrified ET Trim - Fail Secure Power Off, Locks Lever, Key Retracts Latch #34 Cylinder Supplied	8876 x ET_

Note: Exit devices are available in all standard finishes, except 14, 15, 26 & 26D. With these finishes, exit devices are supplied in 32 or 32D to match accordingly. 32 or 32D is automatically supplied when 26 or 26D is specified. For nickel finishes, specify 14/32 or 15/32D to receive nickel finished trims and stainless exit devices

Options

8800

Mechanical Options:
12-
16-
19-
31-
36-
37-
43-
53-
54-
55-
56-
56-HK-
57-
58-
59-
5CH-
BC-59-
76-
85-
86-
87-
AL-
BT-
CPC-
GL-
LD-
PL-
** SG-
TB-
TL-

Cylinder Options:
10-
10-21-
10-63-
11-
11-21-
11-60-
11-63-
11-64-
11-70-7P-
11-72-7P-
11-73-7P-
11-65-73-7P-
21-
22-
51-
52-
60-
63-
64-
70-
72-
73-
65-73-
65-73-7P-
73-7P-
81-
82-
F1-82-
83-
F1-83-
84-
BR-
LC-
*SC-
*SE-

* Options are not available with 8816
** Only available with 15, 26D and 32D finishes

Pull & Thumbpiece Trim Section

Trim Designations

- Use three letter designations (Ex "PTB") when ordering the Exit Device with trim
- Use the six digit designation (Ex "866-MAL") when ordering trim without an Exit Device, always specify finish

Series

8800
Panic & Fire

SARGENT Function Numbers	ANSI Function Numbers	Description & Cylinder Info. (1-3/4" Door)	814-FSL*	814-FSW*	814-MSL*	814-PSB*	814-STS	862 Pull	8804 x Trim Designation
04	03	Night Latch Key Retracts Latch #34 Cylinder Supplied							
10	02	No O/S Operation or Cylinder (Pull Only)	810-FLL	810-FLW	810-MAL	810-PTB	810-STS	862 Pull	8810 x Trim Designation
28	15	Passage Only (No cylinder)	828-FLL	828-FLW	828-MAL	828-PTB	828-STS	N/A	8828 x Trim Designation
63	05	Key Outside Unlocks/ Locks Thumbpiece #34 Cylinder Supplied	866-FLL	866-FLW	866-MAL	866-PTB	866-STS	N/A	8863 x Trim Designation
66	07	Key Outside Retracts Latch; Key Inside Unlocks/Locks O/S Trim O/S #34 & I/S #44	866-FLL	866-FLW	866-MAL	866-PTB	866-STS	N/A	8866 x Trim Designation

* FSL, FSW, MSL and PSB trims are used with (HC-& 12-) 8888 and 8804 only and are the same as FLL, FLW, MAL and PTB pulls except for cylinder hole located 3/8" (9mm) lower.
Note: Thumbpiece trims for 63 and 66 function devices are identical and are identified as 66 function when trim is ordered separately.
Note: FLW & FSW trims are not available in 32(629) or 32D(630).
Note: Pulls and thumb piece trims are not available in 14, 15, 26 or 26D.

Available Finishes

SARGENT Finishes	BHMA Finishes
03	605
04	606
09	611
10	612
10B	613
10BE	613E
10BL	614
14	618
15	619
20D	624
26	625
26D	626
32	629
32D	630
BSP	—
WSP	

Product Catalog

SARGENT
ASSA ABLOY

80 Series
Exit Device

ASSA ABLOY, the global leader
in door opening solutions

Windstorm Certifications

80 Series

SARGENT
ASSA ABLOY

Windstorm Certifications: Florida Building Codes & UL Listings

SARGENT Manufacturing's products meet building codes that require hurricane, windstorm and FEMA certifications, including some of the most stringent building codes as specified in the Florida Building Code, Miami Dade Code and the International Building Code. Listed below are certifications and standards met by the 80 Series lock.

Florida Building Code: FL2998
UL Certification Directory: ZHEM.R21744 – Latching Hardware

ANSI/SDI-BHMA A250.13	"Testing and Rating of Severe Windstorm Resistant Components for Swinging Door Assemblies"
ANSI/ASTM E330	"Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference"
ANSI/ASTM E1886	"Standard Test Method for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials"
ASTM E1996	"Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors and Impact Protective Systems Impacted by Windborne Debris in Hurricanes"
(TAS) 201	"Impact Test Procedures"*
(TAS) 202	"Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference"
(TAS) 203	"Criteria for Testing Products Subject to Cyclic Wind Pressure Loading"*

* Published in the "Florida Building Code"

Any retrofit or other field modification to a fire rated opening can potentially impact the fire rating of the opening, and Sargent Manufacturing Company makes no representations or warranties concerning what such impact may be in any specific situation. When retrofitting any portion of an existing fire rated opening, or specifying and installing a new fire-rated opening, please consult with a code specialist or local code official (Authority Having Jurisdiction) to ensure compliance with all applicable codes and ratings.

UL Certification Directory: ZHLL.R21744 – Products for Use in Windstorm-rated Assemblies

Certifications to meet assembly requirements are done in conjunction with doors from ASSA ABLOY Group companies CECO DOOR and CURRIES.

ASTM E330	"Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference"
ANSI/ASTM E1886	"Standard Test Method for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials"
ASTM E1996	"Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors and Impact Protective Systems Impacted by Windborne Debris in Hurricanes"
AAMA/WDMA/CSA 101/I.S.2/A440	"Standard/Specification for Windows, Doors, and Unit Skylights"
FEMA Publication 320 (2014)	"Taking Shelter From the Storm: Building a Safe Room for Your Home or Small Business", investigated with respect to impact and pressure requirements only.
FEMA Publication 361 (2015)	"Design and Construction Guidance for Community Safe Rooms", investigated with respect to impact and pressure requirements only.
ICC 500 (2014)	"ICC/NSSA Standard for the Design and Construction of Storm Shelters", investigated with respect to impact and pressure testing. Minimum missile impact speeds vary with the design wind speed desired for a particular product. The information below correlates design wind speed to the minimum missile speeds as discussed in Table 305.1.1 of ICC 500

Any retrofit or other field modification to a fire rated opening can potentially impact the fire rating of the opening, and Sargent Manufacturing Company makes no representations or warranties concerning what such impact may be in any specific situation. When retrofitting any portion of an existing fire rated opening, or specifying and installing a new fire-rated opening, please consult with a code specialist or local code official (Authority Having Jurisdiction) to ensure compliance with all applicable codes and ratings.

SARGENT
ASSA ABLOY

Cylinder Information for Exit Devices

Cylinder Chart: Exit Device Series x Function	Door Thickness	ET Trim (700 Series Auxiliary Control) 1-3/4" (44mm)	ET Trim (700 Series Auxiliary Control) 2-1/4" (57mm)	PTB, PSB, STS, MAL, MSL, FLL, FSL, FLW, FSW 1-3/4" (44mm)	PTB, PSB, STS, MAL, MSL, FLL, FSL, FLW, FSW 2-1/4" (57mm)
Narrow Stile Mortise Exit Device	8304	46	48	41	43
	8313/8343	41	41	Not Available	
	8344	46	48	Not Available	
	8363	Not Available		41	43
	8375/8376	46	48	Not Available	
Narrow Stile CVR Exit Device	All 8400	41	41	Not Available	
Narrow Stile Rim Exit	8504	34	34	Not Available	
	8513/8543	41	41	Not Available	
Concealed Vertical Rod Exit Devices	All LP/LR/LS8600	41	Not Available		
	All SP/PP/PR8600	41	Not Available		
	All AD, MD & WD8600	41	41	Not Available	
Surface Vertical Rod Exit Devices	8706/8713/8743/8746	41	41	Not Available	
	8762/8763	Not Available		34	34
	All SP/PP/PR8700	41	N/A	Not Available	
Rim Exit Devices	8804	34	34	34	34
	8806/8813/8843/8846	41	41	Not Available	
	8816	34/*44	34/*44	Not Available	
	8844	34	34	Not Available	
	8863	Not Available		34	34
	8866	Not Available		34/*44	34/*44
	8875/8876/8877	34	34	Not Available	
Mortise Lock Exit Devices	8904	46	48	41	43
	8913/8943	41	41	Not Available	
	8916	*34/46	*34/48	Not Available	
	8944	46	48	Not Available	
	8963	Not Available		41	43
	8966	Not Available		*41/34	*43/34
	8975/8976	46	48	Not Available	

* Inside Cylinders
Chart shows cylinder type and size for conventional SARGENT cylinders.
Note: Cylinder sizes & types are limited, as noted: SC- & SE- cylinders are available in size 41
60-, 63- & 64- cylinders are available in sizes 42, 43, 44 & 46
70-, 11-70-, 72-, 11-72-, 73- & 11-73 cylinders are available in sizes 43 & 46
Note: The 8888's Lever & Rose Trim cylinder standard is the standard SARGENT 10 Line cylinder (13-3266)
Note: 41 Cylinder is 1-1/8" in length; For each additional digit, the cylinder is a 1/8" longer. Example: 42 is 1-1/4"; 43 is 1-3/8" and 46 is 1-3/4"
Note: SARGENT supplies standard blocking rings. Specify if using competitor cylinders

Mullions: Aluminum, Steel and Electrified

80 Series

SARGENT®
ASSA ABLOY

Aluminum Mullions

Product Designation	650A	980	L980
Description	Removable	Removable	Lockable
Material	Aluminum	Aluminum	Aluminum
Standard Finish	US28/Satin Anodized Aluminum	Prime Coat	Aluminum Prime Coat
Options	Specify "650A x 10B" for 313AN to match 10B	Specify "980A" for Anodized US28/ Satin Aluminum	Specify: "L980A" Anodized Aluminum Specify: "L980A x10B" for 313AN to match 10B
Stk Size	96"	96"	96"
Max Stk Height	120"	120"	120"
Pre-prepped	658 Strikes Included	No	No
Cylinder Size	Not Required	Not Required	#41
Shape	1-1/2" x 2-1/2"	T Shaped 2-1/2" x 3"	T Shaped 2-1/2" x 3"
Misc. Information and Accessories	Includes 651 Stabilizers and imbedded Weather Stripping Top Retainer 94-2050 Bottom Retainer 94-2051	Top Retainer - 511 Bottom Retainer - 502 Adapter for narrow transom: 507 - Aluminum Prime Coated 507A - Anodized Aluminum	All Cylinder Options Available Wall Mount Kit 98-2578 Top Ret Pack 98-2526 Bottom Ret Pack 98-2525 Cylinder Kit 980C1*

Electrified

EL980
Electrical Lockable
Steel
Gray Paint
Wall Mounting Kit: 98-2580 Top Ret Pack :98-2559
96"
120"
No
#46 Only
Rectangular 2" x 3"
For use with Electric Strikes and Monitoring, Quick Connect Wiring Supplied Cylinder Kit 980C2*

***Note:** Cylinder Kits must be ordered separately

Steel Mullions

Product Designations	HC980	980S	L980S	HCL980	12-HD980
Description	Hurricane Code	Standard Mullion	Lockable	Lockable Hurricane Code	Heavy Duty
Material	Steel	Steel	Steel	Steel	Steel
Fire Rated	Specify 12-HC980	Specify 12-980	Specify 12-L980	Specify 12-HCL980	Specify 12-HD980
Fire Rated Max Height	96"	96"	96"	96"	120"
Finish	Gray Paint	Gray Paint	Gray Paint	Gray Paint	Gray Paint
Stk Size	96"	96"	96"	96"	120"
Max Stk Height	96"	120"	120"	96"	120"
Pre-prepped	No	No	No	No	No
Cylinder Size	Not Required	Not Required	#41 Std (#42 & #43 available)	#41 Std (#42 & #43 available)	Not Required
Shape	Rectangular 2' x 3"	Rectangular 2" x 3"	Rectangular 2" x 3"	Rectangular 2" x 3"	Rectangular 2" x 3"
Misc. Information	Designed for severe wind load conditions due to hurricanes or windstorms. Tested to Dade County Protocols & ASTM Standards	For 12-8800 - Channel Iron & Malleable iron top & bottom retainers.	Fire rated for 8'0" x 8'0" paired openings	See Notes Below	12-HD980 is for pair of doors over 8'0" to 10'0" for use with 2-8800 Rim Exits includes two piece strikes
Accessories	Top Ret Pack - 98-2599 Bottom Ret Pack - 98-2600 Top Retainer Shim Kit - 601	Top Ret Pack - 98-2190 Bottom Ret Pack - 98-2191 Top Retainer Shim Kit - 601	Wall Mounting Kit - 98-2579 Top Ret Pack - 98-2559 Bottom Ret Pack - 98-2556 Top Retainer Shim Kit - 601 Cylinder Kit - 980C1*	- Top Retainer Pack: 98-2593 - Bottom Retainer Pack: 98-2594 - Top Retainer Shim Kit - 601 Cylinder Kit - 980C1*	Top Ret Pack - 98-2599 ottom Ret Pack - 98-2600 op Retainer Shim Kit - 601

***Note:** Cylinder Kits must be ordered separately

Note for HC980/12-HC980 Mullions:

- Designed for severe wind load conditions due to hurricanes or tornadoes
- Tested to Dade County protocols and ANSI 250.13 ASTM Standards and FEMA 361
- 12- Fire labeled version
- Replacement lock kits are available for lockable mullions Part numbers for each model are listed in the price book

HCL980 Mullion Information

- Model 12-HC-L980 may be supplied for doors UL fire rated up to and including 3 hrs not exceeding 8 ft in width and height
- Meets the following standards: ANSI 250.13, ASTM E330, ASTM 1886, ASTM 1996, TAS 201, TAS 202 & TAS 203
- Designed for use with UL Classified HC8810, HC8800 and 12-HC8800 rim exit devices

Mullion Accessories and Stabilizers

80 Series

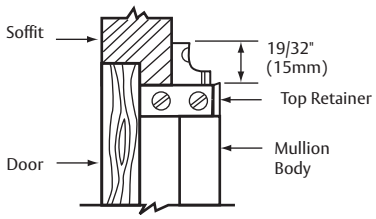
SARGENT
ASSA ABLOY

Mullion Accessories

RK980
Latchbolt assembly retrofit kit with top and bottom retainers for 980 aluminum mullion

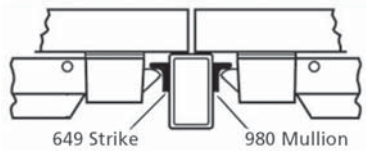
507 Narrow Transom Bars Adapter

- Available with 980 and 980A
- Required when soffit is 1-1/4" (32mm) to 2" (51mm) wide
- Order as a: 507 for 980 mullion or 507A for 980A mullion



980S Mullion Application

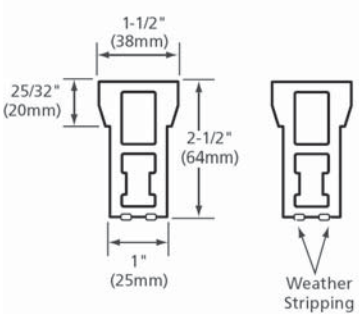
- All steel mullions are 2" x 3"



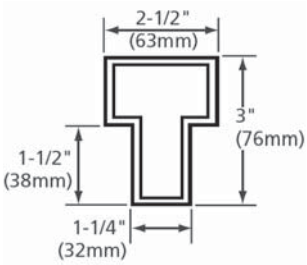
651 Mullion Stabilizer Kit

- Stabilizer block
- Furnished standard w/650A Mullion
- Order as a 651 Kit

650A Mullion



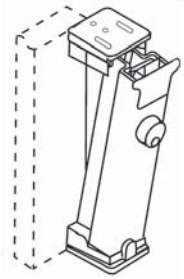
980 Mullion & L980 Lockable Mullion



980C1 Cylinder Mullion Kit

- Lockable mullions only
- Aluminum and steel
- Includes cylinder and collar
- Available in 26D & 10B finish

Lockable Mullion



Lockable Mullion Cylinder Kit Options*

L980, L980A, L980S & HC-L980 mullions are available with these options: 10, 10-21-, 10-63-, 11-, 11-21-, 11-60, 11-63-, 11-64-, 11-72-7P-, 11-65-73-7P-, 11-73-7P-, 21-, 22-, 60-, 63-, 64-, 70, 72-, 73-, 65-73-, 65-73-7P-, 73-7P-, 81-, 82-, F1-82-, 83-, F1-83-, 84-, SC- & SE-.

EL980 mullion is available with these options: 10, 10-21-, 10-63-, 11-, 11-21-, 11-60, 11-63-, 11-64-, 11-72-7P-, 11-65-73-7P-, 11-73-7P-, 21-, 22-, 60-, 63-, 64-, 70, 72-, 73-, 65-73-, 65-73-7P-, 73-7P-, 81-, 82- & F1-82-.

*Lockable mullions are shipped without cylinders. Order Cylinder Mullion Kit separately.

980C2 Cylinder Mullion Kit

- Lockable mullions
- Electrified only
- Includes cylinder and collar
- Available in 26D finish only

Mullion Weights & Packaging

Product	Avg Wt	Case
Exit Device with Trim	15 lbs	1 ea
980 Mullion	18 lbs	1 ea
12-980 Mullion	40 lbs	1 ea
650A Mullion	18 lbs	1 ea

Mechanical Options and Descriptions

80 Series

SARGENT®
ASSA ABLOY

Mechanical Options:

Categories	How to Specify	Detailed Description
Fire Rated	**12-**	UL Fire Label Exit hardware (not available with 16- & HK-)
SVR Bolt	**14-**	Sliding bolt bottom case for 8700
Cylinder Dogging	**16-**	Cylinder lockdown with # 41 Cylinder & # 97 Ring (not available with 12-, 57, 59-, AL- or BT- Option)
	LD-	Less dogging for non fire rated devices
Less Touch Pad	**19-**	Pushbar without Lexan touchpad (not available TL-)
8900/8300 Strike	**23-**	4-7/8" (124mm) ANSI flat lip strike (for 8900 & 8300 Series Mortise Lock Exit Devices)
Thick Doors	**31-**	Doors over 1-3/4" and/or Panels (Specify door thickness, panel thickness & location as required) Not available for HC8700, FM8700, PP, PR & SP8700, PP, PR & SP8600, LP, LR & LP8700 Extended lip strike supplied for 8300 & 8900 Series
Security Fasteners	**36-**	Six lobe security head screws
	37-	Spanner head screws
Flush End cap	**43-**	Flush End Cap (Not available with LP, LR & LS Devices)
Indicator	**49-**	Indicator (Available on 8816 and 8866 functions only)
Electrical Options	**53-**	Latchbolt monitoring switch (not available with 59-, GL-, HC-, WS- or on FM8700, PP/PR/SP8600 & LP/LR/LS8600 Exit Devices)
	54-	Monitors ET Lever movement with Internal micro switch in ET Control
	55-	Request to Exit - Signal Switch in Rail (not available with 59- & FM8700)
	56-	Remote Latch Retraction (not available 57-, 58-, 59-, AL- or BT- Option)
	56-HK-	Remote Latch Retraction with manual Hex Key dogging (not available 12-, 57-, 58-, 59-, AL- or BT- Option)
	57-	Delayed Egress (Electromagnetic Lock required & purchased separately) (not available 16-, 53-, 56-, 56-HK, 58-, 59-, AL, Bc-59 - or BT, GL, TL Prefixes) (NB, 54- are available on request)
	58-	Electric Rail Dogging (Not available 56- & 59-)
	59-	Electroguard® Self Contained Delayed Egress Device (not available with 16-, 53-, 55-, 56-, 57-, 58-, AL-, BT-, GL-, HC- & WS Option Prefixes, PP/PR/SP8600, LP/LR/LS8600 Exit Devices) (NB, 54- are available upon request)
	AL-	Alarmed Exit (Not available 16-, 56-, 57-, 59-, BT-, GL-, HC- & WS-)
	BC-59-	Electroguard® Boca Code (Door Status Switch required) (not available with 16-, 55-, 56-, 57-, 58-, AL-, BT-, GL-, HC- & WS-Options and on NB8700, PP/PR/SP8600 & LP/LR/LS8600 Exit Devices)
	TL-	SARGuide Electro-Luminescent Touchpad (not available 19-, 85-, 87- & PL-)
Tactile Warning Options	**76-**	Tactile Warning - Milled Outside Lever (not available with Studio & Coastal Levers and the A Lever)
	85-	Tactile Warning - Abrasive strip on Push Rail (Not available with PL- & TL-)
	86-	Tactile Warning - Abrasive coating on Outside Lever
	87-	Tactile Warning - Abrasive strip on Push Rail & Abrasive coating on Outside Lever (not available with PL- & TL-)
Finish Protection	**CPC-**	Clear Powder Coat (Available for 32 & 32D Finishes)
	SG-	MicroShield® antimicrobial clear powder coat (only available with 15, 26D and 32D finishes)
Top Rod Only	**NB-**	Less Bottom Rod & Bolt (for SVR & CVR Devices)
Guarded Latch	**GL-**	Guarded Latch for Rim Exit Devices (not available 53-, 56-, 59-, AL-, HC- & WS-)
SARGuide	**PL-**	SARGuide™ PL – Photoluminescent Coated Push Rail – (Touchpad eliminated) (not available 85, 87 & TL-)
Through Bolts	**TB-**	Through Bolts for 8300, 8500, 8600, 8700, 8800 & 8900 Devices
Rail Force	**5CH-**	5lb. Pressure Release (8800 only)

Cylinder Options and Descriptions

80 Series

SARGENT®
ASSA ABLOY

Cylinder Options:

Conventional Cylinder	-	SARGENT Conventional Cylinders Supplied Standard (Unless Otherwise Specified)
Degree Key System	**DG1-**	SARGENT Degree Key System Level 1 (bump resistant with patented keys)
	DG1-21-	Degree Level 1 Construction Master Keying
	DG1-60-	Degree Level 1 Removable Disposable Construction Core
	DG1-63-	Degree Level 1 Removable Core
	DG1-64-	Degree Level 1 Removable Construction Keyed LFIC
	DG1-65-	Degree Level 1 Unassembled/Uncombined Core
	DG2-	SARGENT Degree Key System Level 2 (geographically exclusive; bump and pick resistant)
	DG2-21-	Degree Level 2 Construction Master Keying
	DG2-60-	Degree Level 2 Removable Disposable Construction Core
	DG2-63-	Degree Level 2 Removable Core
	DG2-64-	Degree Level 2 Removable Construction Keyed LFIC
	DG2-65-	Degree Level 2 Unassembled/Uncombined Core
	DG3-	SARGENT Degree Key System Level 3 (geographically exclusive; UL437 certified; bump and pick resistant)
	DG3-21-	Degree Level 3 Construction Master Keying
	DG3-60-	Degree Level 3 Removable Disposable Construction Core
	DG3-63-	Degree Level 3 Removable Core
	DG3-64-	Degree Level 3 Removable Construction Keyed LFIC
	DG3-65	Degree Level 3 Unassembled/Uncombined Core
Signature Key System	**10-**	SARGENT Signature Key System (Not Available with other Key Systems)
	10-21-	SARGENT Signature Construction Key System (Lost Ball)
Signature- LFIC	**10-63-**	SARGENT Signature Large Format Interchangeable Core Cylinder (Removable)
XC- Key System	**11-**	XC Key System (Not available with other Key systems unless specified)
	11-21-	XC- Construction Key System (Lost Ball)
XC- Large Format Interchangeable Core (Removable Core)	**11-60-**	Device to accept XC- Permanent Large Format Interchangeable Core, Disposable plastic Core- provided
	11-63-	Device provided with XC- Large Format Interchangeable Core Cylinder - (Includes masterkeying, grand masterkeying)
	11-64-	Device provided with Keyed construction core to accept XC- Permanent Large Format Interchangeable Core (ordered separately)
XC- Small Format Interchangeable Core	**11-70-7P-**	Device to accept XC- SFIC (7-Pin) XC- Permanent Cores, plastic disposable core provided
	11-72-7P-	Device to accept XC- SFIC (7-Pin Keyed Construction Core provided) cylinder Permanent core ordered separately
	11-73-7P-	Device provided with XC- Small Format 7-Pin interchangeable core (Includes masterkeying, grand masterkeying)
	11-65-73-7P-	Device provided to accept XC- Uncombinated 7-Pin SFIC (Permanent) Core - (Packed Loose)
Construction Key Systems	**21-**	SARGENT Lost Ball Construction Keying for Conventional, XC and Signature Series (N/A with 63- or 73-)
	22-	SARGENT Construction Split Key System for Conventional Cylinders (Existing Systems Only) (N/A with 10-, 11-, 63- or 73-)
Old Style Removable Core	**51-**	Removable Core Cylinder (Old Style) provided (existing systems only)
	52-	Removable Construction Core (Old Style) Permanent core ordered separately (existing systems only)
Large Format Interchangeable Core (Removable Core)	**60-**	Device to accept SARGENT Permanent Large Format Interchangeable Core, Disposable plastic Core provided (Permanent Cores ordered separately)
	63-	Device provided with Large Format Interchangeable Core Cylinder - (Includes masterkeying, grand masterkeying)
	64-	Device provided with Keyed construction core to accept Permanent Large Format Interchangeable Core (ordered separately)
Small Format Interchangeable Core	**70-**	Device to accept 6- or 7-Pin SFIC Permanent Cores, plastic disposable core provided
	72-	Device to accept 6- or 7-Pin SFIC (6-Pin Keyed Construction Core provided) Cylinder (Permanent Core ordered separately)
	73-	Device provided with 6-Pin SFIC (Includes masterkeying, grand masterkeying)
	65-73-	Device provided to accept Uncombinated 6-Pin SFIC (Permanent) Core - (Packed Loose for field keying)
	65-73-7P-	Device provided to accept Uncombinated 7-Pin SFIC (Permanent) Core - (Packed Loose for field keying)
	73-7P-	Device provided with Small Format 7-Pin Interchangeable Core (Includes masterkeying, grand masterkeying)
Keso & Keso F1	**81-**	Device provided with housings to accept Keso (83) & Keso F1 (F1-83-) removable cores. (Permanent Cores ordered separately)
	82-	Device provided with SARGENT Keso Security Cylinder
	F1-82-	Device provided with SARGENT Keso F1 Security Cylinder (Patented)
	83-	Device provided with SARGENT Keso Security Removable Core cylinder
	F1-83-	Device provided with SARGENT Keso F1 Security Removable Core cylinder (Patented)
	84-	Device provided with SARGENT Keso Construction Cores (Permanent Cores ordered separately)
Added Security	**BR-**	Bump Resistant Cylinder (Available with Conventional & Conventional XC Cylinders Only)
Less Cylinder	**LC-**	Less Cylinder - SARGENT supplies standard blocking rings for 1-1/8" Cylinders (For longer cylinders order collars/rings separately)
Schlage Keyways	**SC-**	Schlage C keyway cylinder, 0 bitted (not available with: 8904, 8916, 8944, 8975, 8976, 8866, 8304, 8344, 8375 & 8376)
	SE-	Schlage E keyway cylinder, 0 bitted (not available with: 8904, 8916, 8944, 8975, 8976, 8866, 8304, 8344, 8375 & 8376)
Lever to Accept Schlage	**SF-**	L Lever to accept MEDECO KeyMark Large Format Interchangeable and Schlage Full Size Interchangeable Core (Supplied Less Cylinder, but with tailpiece needed) (Available for 88-KLL & 88-CLL)

Note: For V-10 Cylinders and information, contact ASSA

MD8600(Windstorm Rated) and NB-MD8600 Concealed Vertical Rod Exit Device for Metal Doors

80 Series

SARGENT®
ASSA ABLOY

MD8600 Series

Concealed Vertical Rod Exit Device for Metal Doors

Features

- Designed for standard width stile applications on hollow metal doors
- Concealed rods for security and aesthetics
- Single and double door applications
- Specify NB- for less bottom rod
  – NB not available with HC and WS options
- Devices are ANSI A156.3 - Grade 1
- UL Fire and Panic listed

Specifications for MD8600 & NB-MD8600 Series Exit

Door Type	Metal Doors
Door Thickness	1-3/4" (44mm) minimum thickness. For doors over 1-3/4" to 2-1/4" thick, specify thickness and order as 31-
Cladding	Available for 1/4" on 1/2" panels. Specify 31- and panel thickness on order. Only available on 1-3/4" door thickness. Must be noted separately from door thickness on order string.
Stile	4-1/2" (114mm) minimum stile width
Rail sizes as determined by door width	Rails are available in 4 sizes, use door width to determine size needed. Rails will be factory cut to size, if door width is supplied • E Rail for 24" to 32" door widths, No cutting required for 32" door • F Rail for 33" to 36" door widths, No cutting required for 36" door • J Rail for 37" to 42" door widths, No cutting required for 42" door • G Rail for 43" to 48" door widths, No cutting required for 48" door
Strike	650 Top Strike & 606 Bottom Strike (Panic and Fire Rated)
Dogging Feature	Hex key dogging standard on non fired rated devices; specify 16- for cylinder dogging (#41 cylinder supplied)
Electric Options	AL- Alarm PL- SARGuide™ Photoluminescent Coated TL- SARGuide™ Illuminated Touchpad 53- LX Latchbolt Monitor 54- Outside Lever Monitoring 55- Request-to-Exit Signal - Rail Monitoring 56- Remote Latch Retraction 57- Delay Egress & Electromagnets 58- Electric Dogging 59- Electroguard – Self Contained Delayed Egress
Mounting Fasteners	Supplied standard with machine screws
Top Bolt	Stainless steel
Device Centerline from Finished Floor	41" (1041mm) for Standard Applications 38" (965mm) for elementary schools
Door/Opening Height	**Must be specified** - 120" (3048mm) Max Door Opening 96" max door height for HC and WS options
Center Case Dimensions	8-3/8" (213mm) x 2-5/8" (67mm)
Projection	Pushbar Neutral – 3" (76mm) Pushbar Depressed – 2-1/8" (54mm)
Fire Exit Hardware	See Chart – Page 6

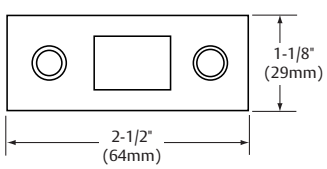
Note: MD8600 & 12-MD8600 can be used as NB- Device by simply not installing the bottom rod/bolt
Note: 12-NB Applications require thermal pin. Thermal Pin supplied when ordered as a 12-NB Device.

100 Series Aux Control

- Available as an 06 or 13 function
- Supplied with a SARGENT #41 Mortise Cylinder
- Can be used with any SARGENT Mortise Key System

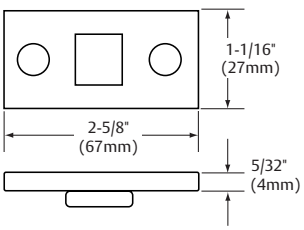
650 Top Strike

- For application in hollow metal frames
- Stainless steel nylon coated



606 Bottom Strike

- Furnished with expansion shields
- Mortised into floor
- Stainless steel



MD8600 (Hurricane-Resistant) Concealed Vertical Rod Exit Device for Metal Doors

80 Series

SARGENT®
ASSA ABLOY

MD8600 Series

Concealed Vertical Rod Exit Device for Metal Doors

Features

- Designed for standard width stile applications on hollow metal doors
- Concealed rods for security and aesthetics
- Single and double door applications
- Devices are ANSI/BHMA A156.3 - Grade 1
- UL10C (Fire) and UL305 (Panic) listed

Specifications for MD8600 & NB-MD8600 Series Exit

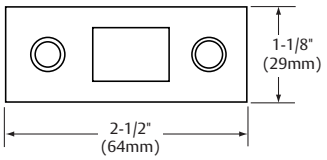
Door Type	Metal Doors
Door Thickness	1-3/4" (44mm) minimum thickness. For doors over 1-3/4" to 2-1/4" thick, specify thickness and order as 31-
Stile	4-1/2" (114mm) minimum stile width
Rail sizes as determined by door width	Rails are available in 4 sizes, use door width to determine size needed. Rails will be factory cut to size, if door width is supplied • E Rail for 24" to 32" door widths, No cutting required for 32" door • F Rail for 33" to 36" door widths, No cutting required for 36" door • J Rail for 37" to 42" door widths, No cutting required for 42" door • G Rail for 43" to 48" door widths, No cutting required for 48" door
Strike	650 Top Strike & 606 Bottom Strike (Panic and Fire Rated)
Dogging Feature	Hex key dogging standard on non fired rated devices; specify 16- for cylinder dogging (#41 cylinder supplied)
Electric Options	AL- Alarm PL- SARGuide™ Photoluminescent Coated TL- SARGuide™ Illuminated Touchpad 53- LX Latchbolt Monitor 54- Outside Lever Monitoring 55- Request-to-Exit Signal - Rail Monitoring 56- Remote Latch Retraction 57- Delay Egress & Electromagnets 58- Electric Dogging 59- Electroguard – Self Contained Delayed Egress
Mounting Fasteners	Supplied standard with machine screws
Top Bolt	Stainless steel
Device Centerline from Finished Floor	41" (1041mm) for Standard Applications 38" (965mm) for elementary schools
Door/Opening Height	**Must be specified** - 120" (3048mm) Max Door Opening 96" max door height for HC and WS options
Center Case Dimensions	8-3/8" (213mm) x 2-5/8" (67mm)
Projection	Pushbar Neutral – 3" (76mm) Pushbar Depressed – 2-1/8" (54mm)
Fire Exit Hardware	See Chart – Page 6

Note: MD8600 & 12-MD8600 can be used as NB- Device by simply not installing the bottom rod/bolt
Note: 12-NB Applications require thermal pin. Thermal Pin supplied when ordered as a 12-NB Device

100 Series Aux Control

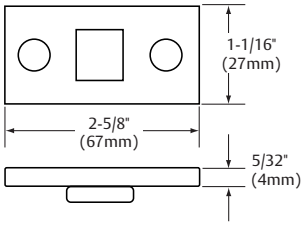
- Available as an 06 or 13 function
- Supplied with a SARGENT #41 Mortise Cylinder
- Can be used with any SARGENT Mortise Key System

650 Top Strike



- For application in hollow metal frames
- Stainless steel nylon coated

606 Bottom Strike



- Furnished with expansion shields
- Mortised into floor
- Stainless steel

MD8600 and NB-MD8600 Functions and Trims for Metal Doors

80 Series

SARGENT
ASSA ABLOY

How to order:	Options	Series	Function	Rail Lgth	Trim	Hand	Outside Finish	Inside Finish	Door Width	Door Height	AFF
	57-NB-	MD86	13	F	ETL	RHR	03	03	36"	84"	41"

700 Series ET Trim

Exits with ET Trim, specify lever design after the ET designation (e.g., ETL)

Lever Designs for ET Controls

A, B, E, F, J, L, P, W
Also available with Coastal Series & Studio Collection Levers

ET Designation with Suffix (Used to order ET without device)

MD8600 & NB-MD8600 Series:
706-4, 710-4, 713-4, 715-4, 740-4, 743-4, 746-4, 773-4, & 774-4

Freewheeling Trim

The lever rotates when the door is locked preventing excessive force from being applied to the horizontal lever

Electrified ET Trim

Voltage must be specified for the following functions: 73 and 74. Specify: 12VDC or 24VDC

SARGENT Function Numbers	ANSI Function Numbers	Description & Cylinder Info (1-3/4" Door)	ANSI Type 8 MD8600 Panic & Fire
06	09	Key unlocks Trim, Trim retracts latch/ Trim relocks when key is removed #41 Cylinder Supplied	MD8606 x ET_
10	01	No outside operation (No Cylinder)*	MD8610
10	02	No outside operation (No Cylinder)* ET Control is used as Pull Only	MD8610 x ET_
13	08	Key Outside Unlocks/locks Trim #41 Cylinder Supplied	MD8613 x ET_
15	14	Passage Only (No cylinder)	MD8615 x ET_
40	02	Freewheeling Trim - No outside Operation (No Cylinder)* Dummy Trim	MD8640 x ET_
43	08	Freewheeling Trim - Key Outside Unlocks/locks Trim #41 Cylinder Supplied	MD8643 x ET_
46	09	Freewheeling Trim - Key unlocks Trim, Trim retracts latch/ Trim relocks when key is removed #41 Cylinder Supplied	MD8646 x ET_
73		Electrified ET Trim - Fail Safe Power Off, Unlocks Lever (No Cylinder)*	MD8673 x ET_
74		Electrified ET Trim - Fail Secure Power Off, Locks Lever (No Cylinder)*	MD8674 x ET_

Note: Exit devices are available in all standard finishes, except 14, 15, 26 & 26D. With these finishes, exit devices are supplied in 32 or 32D to match accordingly. 32 or 32D is automatically supplied when 26 or 26D is specified. For nickel finishes, specify 14/32 or 15/32D to receive nickel finished trims and stainless exit devices
Note: AFF means Above Finished Floor, center line of rail Above Finished Floor
* Cylinder Override is available with a 106 Aux Control
Example Order: MD8673F 12V x ETMG x 106 x RHR x 32D x 36"w x 84"h

100 Series Auxiliary Control* & 862 Pull

100 Series Aux. Control

862 Pull

SARGENT Function Numbers	ANSI Function Numbers	Description & Cylinder Info (1-3/4" Door)	MD8600 Panic & Fire
06	12	Key unlocks Turn, Turn retracts latch/ Turn relocks when key is removed #41 Cylinder Supplied	MD8610 x 106
10	02	862 Pull Only (Optional Pulls: 863 & 864)	MD8610 x 862 Pull
13	11	Key Outside Unlocks/locks Turn #41 Cylinder Supplied	MD8610 x 113

Note: When ordering MD8600/NB-MD8600 Series Exit Device x 100 Series Aux. Control, specify 10 Function for the exit.
Example: MD8610F x 106 x RHR x 32D x 42" x 90"

Options

MD8600

Mechanical Options:
12-
16-
19-
31-
36-
37-
43-
53-
54-
55-
56-
56-HK-
57-
58-
59-
5CH-
BC-59-
76-
85-
86-
87-
AL-
BT-
CPC-
HC-
LD-
NB-
PL-
* SG-
TL-
WS-

Cylinder Options:
10-
10-21-
10-63-
11-
11-21-
11-60-
11-63-
11-64-
11-70-7P-
11-72-7P-
11-73-7P-
11-65-73-7P-
21-
22-
51-
52-
60-
63-
64-
70-
72-
73-
65-73-
65-73-7P-
73-7P-
81-
82-
F1-82-
83-
F1-83-
84-
BR-
LC-
SC-
SE-

* Only available with 15, 26D and 32D finishes

Available Finishes

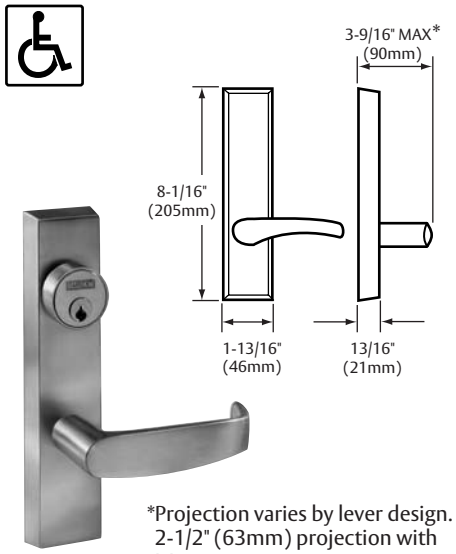
SARGENT Finishes	BHMA Finishes
03	605
04	606
09	611
10	612
10B	613
10BE	613E
10BL	614
14	618
15	619
20D	624
26	625
26D	626
32	629
32D	630
BSP	—
WSP	

ET Trim, Levers and Pulls

80 Series

SARGENT®
ASSA ABLOY

ET Lever Controls

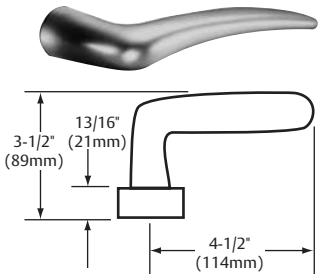


*Projection varies by lever design. 2-1/2" (63mm) projection with L Lever

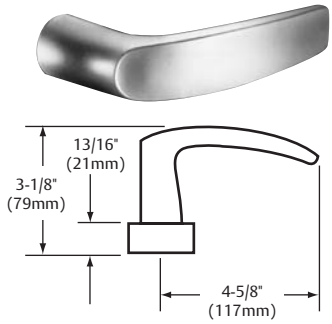
Note: ET suffixes required when ordering ET trim without an exit device, see page 74 for complete details

A Lever

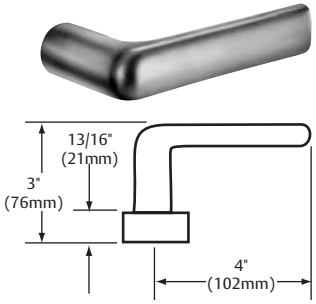
- Handed



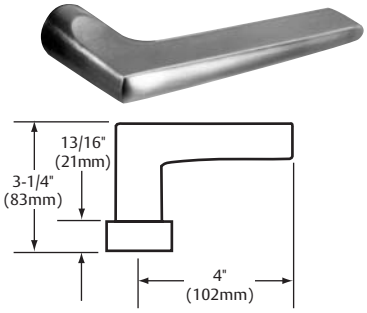
B Lever



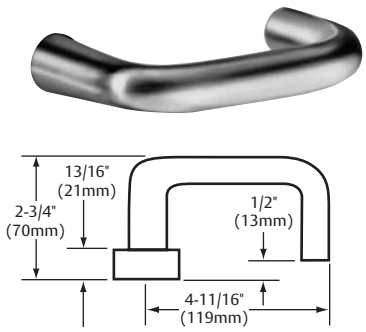
E Lever



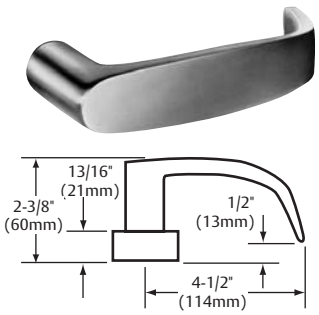
F Lever



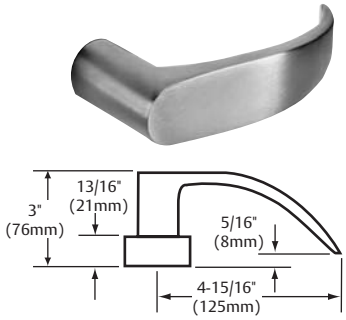
J Lever*



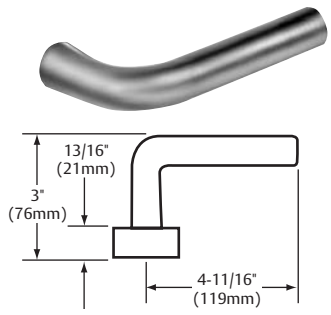
L Lever*



P Lever*

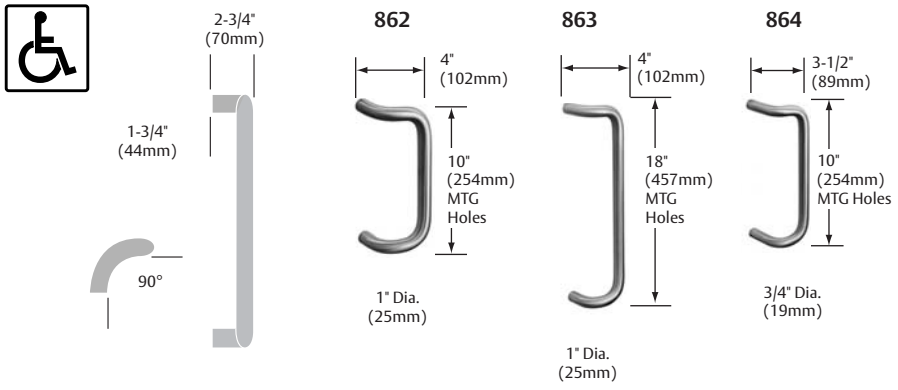


W Lever



* Lever returns within 1/2" (13mm) of door face

Pulls



MD8600(Windstorm Rated) and NB-MD8600 Concealed Vertical Rod Exit Device for Metal Doors

80 Series

SARGENT®
ASSA ABLOY

MD8600 Series

Concealed Vertical Rod Exit Device for Metal Doors

Features

- Designed for standard width stile applications on hollow metal doors
- Concealed rods for security and aesthetics
- Single and double door applications
- Specify NB- for less bottom rod
  – NB not available with HC and WS options
- Devices are ANSI A156.3 - Grade 1
- UL Fire and Panic listed

Specifications for MD8600 & NB-MD8600 Series Exit

Door Type	Metal Doors
Door Thickness	1-3/4" (44mm) minimum thickness. For doors over 1-3/4" to 2-1/4" thick, specify thickness and order as 31-
Cladding	Available for 1/4" on 1/2" panels. Specify 31- and panel thickness on order. Only available on 1-3/4" door thickness. Must be noted separately from door thickness on order string.
Stile	4-1/2" (114mm) minimum stile width
Rail sizes as determined by door width	Rails are available in 4 sizes, use door width to determine size needed. Rails will be factory cut to size, if door width is supplied • E Rail for 24" to 32" door widths, No cutting required for 32" door • F Rail for 33" to 36" door widths, No cutting required for 36" door • J Rail for 37" to 42" door widths, No cutting required for 42" door • G Rail for 43" to 48" door widths, No cutting required for 48" door
Strike	650 Top Strike & 606 Bottom Strike (Panic and Fire Rated)
Dogging Feature	Hex key dogging standard on non fired rated devices; specify 16- for cylinder dogging (#41 cylinder supplied)
Electric Options	AL- Alarm PL- SARGuide™ Photoluminescent Coated TL- SARGuide™ Illuminated Touchpad 53- LX Latchbolt Monitor 54- Outside Lever Monitoring 55- Request-to-Exit Signal - Rail Monitoring 56- Remote Latch Retraction 57- Delay Egress & Electromagnets 58- Electric Dogging 59- Electroguard – Self Contained Delayed Egress
Mounting Fasteners	Supplied standard with machine screws
Top Bolt	Stainless steel
Device Centerline from Finished Floor	41" (1041mm) for Standard Applications 38" (965mm) for elementary schools
Door/Opening Height	**Must be specified** - 120" (3048mm) Max Door Opening 96" max door height for HC and WS options
Center Case Dimensions	8-3/8" (213mm) x 2-5/8" (67mm)
Projection	Pushbar Neutral – 3" (76mm) Pushbar Depressed – 2-1/8" (54mm)
Fire Exit Hardware	See Chart – Page 6

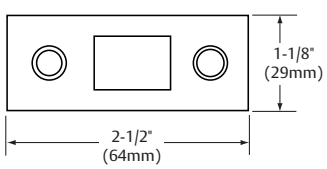
Note: MD8600 & 12-MD8600 can be used as NB- Device by simply not installing the bottom rod/bolt
Note: 12-NB Applications require thermal pin. Thermal Pin supplied when ordered as a 12-NB Device.

100 Series Aux Control

- Available as an 06 or 13 function
- Supplied with a SARGENT #41 Mortise Cylinder
- Can be used with any SARGENT Mortise Key System

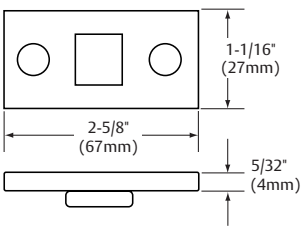
650 Top Strike

- For application in hollow metal frames
- Stainless steel nylon coated



606 Bottom Strike

- Furnished with expansion shields
- Mortised into floor
- Stainless steel



MD8600 (Hurricane-Resistant) Concealed Vertical Rod Exit Device for Metal Doors

80 Series

SARGENT®
ASSA ABLOY

MD8600 Series

Concealed Vertical Rod Exit Device for Metal Doors

Features

- Designed for standard width stile applications on hollow metal doors
- Concealed rods for security and aesthetics
- Single and double door applications
- Devices are ANSI/BHMA A156.3 - Grade 1
- UL10C (Fire) and UL305 (Panic) listed

Specifications for MD8600 & NB-MD8600 Series Exit

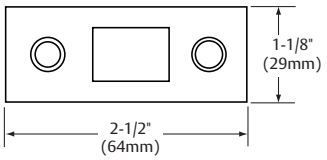
Door Type	Metal Doors
Door Thickness	1-3/4" (44mm) minimum thickness. For doors over 1-3/4" to 2-1/4" thick, specify thickness and order as 31-
Stile	4-1/2" (114mm) minimum stile width
Rail sizes as determined by door width	Rails are available in 4 sizes, use door width to determine size needed. Rails will be factory cut to size, if door width is supplied • E Rail for 24" to 32" door widths, No cutting required for 32" door • F Rail for 33" to 36" door widths, No cutting required for 36" door • J Rail for 37" to 42" door widths, No cutting required for 42" door • G Rail for 43" to 48" door widths, No cutting required for 48" door
Strike	650 Top Strike & 606 Bottom Strike (Panic and Fire Rated)
Dogging Feature	Hex key dogging standard on non fired rated devices; specify 16- for cylinder dogging (#41 cylinder supplied)
Electric Options	AL- Alarm PL- SARGuide™ Photoluminescent Coated TL- SARGuide™ Illuminated Touchpad 53- LX Latchbolt Monitor 54- Outside Lever Monitoring 55- Request-to-Exit Signal - Rail Monitoring 56- Remote Latch Retraction 57- Delay Egress & Electromagnets 58- Electric Dogging 59- Electroguard – Self Contained Delayed Egress
Mounting Fasteners	Supplied standard with machine screws
Top Bolt	Stainless steel
Device Centerline from Finished Floor	41" (1041mm) for Standard Applications 38" (965mm) for elementary schools
Door/Opening Height	**Must be specified** - 120" (3048mm) Max Door Opening 96" max door height for HC and WS options
Center Case Dimensions	8-3/8" (213mm) x 2-5/8" (67mm)
Projection	Pushbar Neutral – 3" (76mm) Pushbar Depressed – 2-1/8" (54mm)
Fire Exit Hardware	See Chart – Page 6

Note: MD8600 & 12-MD8600 can be used as NB- Device by simply not installing the bottom rod/bolt
Note: 12-NB Applications require thermal pin. Thermal Pin supplied when ordered as a 12-NB Device

100 Series Aux Control

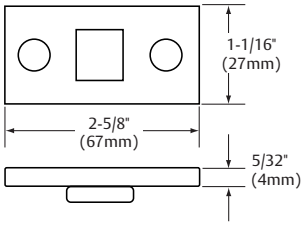
- Available as an 06 or 13 function
- Supplied with a SARGENT #41 Mortise Cylinder
- Can be used with any SARGENT Mortise Key System

650 Top Strike



- For application in hollow metal frames
- Stainless steel nylon coated

606 Bottom Strike



- Furnished with expansion shields
- Mortised into floor
- Stainless steel

MD8600 and NB-MD8600 Functions and Trims for Metal Doors

80 Series

SARGENT
ASSA ABLOY

How to order:	Options	Series	Function	Rail Lgth	Trim	Hand	Outside Finish	Inside Finish	Door Width	Door Height	AFF
	57-NB-	MD86	13	F	ETL	RHR	03	03	36"	84"	41"

700 Series ET Trim

Exits with ET Trim, specify lever design after the ET designation (e.g., ETL)

Lever Designs for ET Controls

A, B, E, F, J, L, P, W
Also available with Coastal Series & Studio Collection Levers

ET Designation with Suffix (Used to order ET without device)

MD8600 & NB-MD8600 Series:
706-4, 710-4, 713-4, 715-4, 740-4, 743-4, 746-4, 773-4, & 774-4

Freewheeling Trim

The lever rotates when the door is locked preventing excessive force from being applied to the horizontal lever

Electrified ET Trim

Voltage must be specified for the following functions: 73 and 74. Specify: 12VDC or 24VDC

SARGENT Function Numbers	ANSI Function Numbers	Description & Cylinder Info (1-3/4" Door)	ANSI Type 8 MD8600 Panic & Fire
06	09	Key unlocks Trim, Trim retracts latch/ Trim relocks when key is removed #41 Cylinder Supplied	MD8606 x ET_
10	01	No outside operation (No Cylinder)*	MD8610
10	02	No outside operation (No Cylinder)* ET Control is used as Pull Only	MD8610 x ET_
13	08	Key Outside Unlocks/locks Trim #41 Cylinder Supplied	MD8613 x ET_
15	14	Passage Only (No cylinder)	MD8615 x ET_
40	02	Freewheeling Trim - No outside Operation (No Cylinder)* Dummy Trim	MD8640 x ET_
43	08	Freewheeling Trim - Key Outside Unlocks/locks Trim #41 Cylinder Supplied	MD8643 x ET_
46	09	Freewheeling Trim - Key unlocks Trim, Trim retracts latch/ Trim relocks when key is removed #41 Cylinder Supplied	MD8646 x ET_
73		Electrified ET Trim - Fail Safe Power Off, Unlocks Lever (No Cylinder)*	MD8673 x ET_
74		Electrified ET Trim - Fail Secure Power Off, Locks Lever (No Cylinder)*	MD8674 x ET_

Note: Exit devices are available in all standard finishes, except 14, 15, 26 & 26D. With these finishes, exit devices are supplied in 32 or 32D to match accordingly. 32 or 32D is automatically supplied when 26 or 26D is specified. For nickel finishes, specify 14/32 or 15/32D to receive nickel finished trims and stainless exit devices
Note: AFF means Above Finished Floor, center line of rail Above Finished Floor
* Cylinder Override is available with a 106 Aux Control
Example Order: MD8673F 12V x ETMG x 106 x RHR x 32D x 36"w x 84"h

100 Series Auxiliary Control* & 862 Pull

100 Series Aux. Control

862 Pull

SARGENT Function Numbers	ANSI Function Numbers	Description & Cylinder Info (1-3/4" Door)	MD8600 Panic & Fire
06	12	Key unlocks Turn, Turn retracts latch/ Turn relocks when key is removed #41 Cylinder Supplied	MD8610 x 106
10	02	862 Pull Only (Optional Pulls: 863 & 864)	MD8610 x 862 Pull
13	11	Key Outside Unlocks/locks Turn #41 Cylinder Supplied	MD8610 x 113

Note: When ordering MD8600/NB-MD8600 Series Exit Device x 100 Series Aux. Control, specify 10 Function for the exit.
Example: MD8610F x 106 x RHR x 32D x 42" x 90"

Options

MD8600

Mechanical Options:
12-
16-
19-
31-
36-
37-
43-
53-
54-
55-
56-
56-HK-
57-
58-
59-
5CH-
BC-59-
76-
85-
86-
87-
AL-
BT-
CPC-
HC-
LD-
NB-
PL-
* SG-
TL-
WS-

Cylinder Options:
10-
10-21-
10-63-
11-
11-21-
11-60-
11-63-
11-64-
11-70-7P-
11-72-7P-
11-73-7P-
11-65-73-7P-
21-
22-
51-
52-
60-
63-
64-
70-
72-
73-
65-73-
65-73-7P-
73-7P-
81-
82-
F1-82-
83-
F1-83-
84-
BR-
LC-
SC-
SE-

* Only available with 15, 26D and 32D finishes

Available Finishes

SARGENT Finishes	BHMA Finishes
03	605
04	606
09	611
10	612
10B	613
10BE	613E
10BL	614
14	618
15	619
20D	624
26	625
26D	626
32	629
32D	630
BSP	—
WSP	

8800 Rim Exit Device

80 Series

SARGENT®

ASSA ABLOY

8800 Series
Rim Exit Device

8800 Features

- Designed for standard width stile applications on wood and metal doors
- Also available as an HC8800 or WS8800 for hurricane-resistant applications, see Hurricane-Resistant section of this catalog
- Single point rim latching device
- Single door & double door applications with mullions
- Quiet operation and solid security
- ANSI/BHMA A156.3 - Grade 1
- UL10C (Fire) and UL305 (Panic) Listed

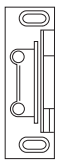
Specifications — 8800 Series Rim Exit Device

Door Type	Metal Doors
Door Thickness	1-3/4" (44mm) minimum thickness. For doors over 1-3/4" to 2 1/4" thick, specify thickness and order as 31-
Rail sizes as determined by door width	Rails are available in 4 sizes, use door width to determine size needed. Rails will be factory cut to size, if door width is supplied • E Rail for 24" to 32" door widths, No cutting required for 32" door • F Rail for 33" to 36" door widths, No cutting required for 36" door • J Rail for 37" to 42" door widths, No cutting required for 42" door • G Rail for 43" to 48" door widths, No cutting required for 48" door
Strike	649 Standard Black Nylon Coated
Optional Strikes	642, 644 and 613
Dogging Feature	Hex key dogging standard on non fired rated devices; specify 16- for cylinder dogging (#41 cylinder supplied)
Electric Options	AL- Alarm PL- SARGuide Photoluminescent Coated TL- SARGuide Illuminated Touchpad
	49- Indicator 53- LX Latchbolt Monitor 54- Outside Lever Monitoring 55- Request-to-Exit Signal - Rail Monitoring 56- Remote Latch Retraction 57- Delay Egress & Electromagnets 58- Electric Dogging 59- Electroguard – Self Contained Delayed Egress
Mounting Fasteners	Supplied standard with wood and machine screws Available with through-bolts and mortise (sex) nuts
Latch Bolt	Stainless steel, 3/4" (19mm) throw
Device Centerline from Finished Floor	41" (1041 mm) for Standard Applications
Center Case Dimensions	8-3/8" (213mm) x 2-5/8" (67mm)
Projection	Pushbar Neutral – 3" (76 mm) Pushbar Depressed – 2-1/8" (54 mm)
Fire Exit Hardware	See Chart – Page 6

49- Lock/Unlock Indicator Option

- Displays whether the door has been secured by the inside cylinder.
- Red icon indicates locked
- White icon indicates unlocked
- Dogging overrides 49- functionality (must order less dogging)
- Available on 8816 and 8866 functions only

649 Strike



- Supplied standard for panic & fire rated openings
- Surface applied
- Black nylon coated

688 Trim Retrofit Kit

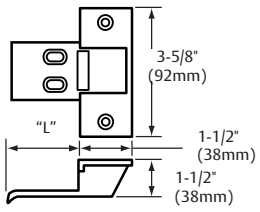
- 688 Trim Retrofit kit allows an 8800* Series rim exit with an ET to replace Von Duprin's 98/99 Series exit with trim with minimal door prep.

* Except for 16 function

- Order as: 688 Kit

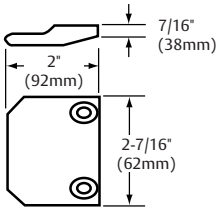
Alternate Strikes For 8800 Rim Devices

642 Strike



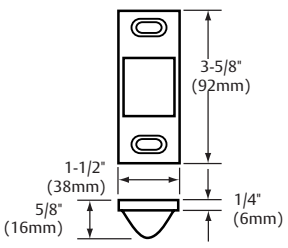
- Mortised. Dimension "L" equals door thickness plus 1/2" (13mm). Black nylon coated on lip only

644 Strike



- Surface applied. For use on pairs of doors without mullion. Ductile Iron. Black nylon coated

613 Strike



- Half mortised. Black nylon coated

8800 Functions and Trims

80 Series

SARGENT®
ASSA ABLOY

Options	Series	Function	Rail Lgth	Trim	Hand	Outside Finish	Inside Finish	Door Width
F1-83-56	88	13	F	ETL	RHR	26D	32D	36"

700 Series ET Trim

Exits with ET Trim, specify lever design after the ET designation (e.g., ETL)

Lever Designs for ET Controls

A, B, E, F, J, L, P, W

Also available with Coastal Series & Studio Collection Levers

ET Designation with Suffix (Used to order ET without device)

8800 Series: 704, 706-8, 710, 713-8, 715-8, 716, 740, 743-8, 744, 746-8, 773-8, 774-8, 775-8 & 776-8

Freewheeling Trim

The lever rotates when the door is locked preventing excessive force from being applied to the horizontal lever

Electrified ET Trim

Voltage must be specified for the following functions: 73, 74, 75 and 76. Specify: 12VDC or 24VDC

SARGENT Function Numbers	ANSI Function Numbers	Description & Cylinder Info (1-3/4" Door)	ANSI Type 1 8800 Panic & Fire
04	03	Night Latch Key Retracts Latch #34 Cylinder Supplied	8804 x ET_
06	09	Key unlocks Trim, Trim retracts latch/ Trim relocks when key is removed #41 Cylinder Supplied	8806 x ET_
10	01	No outside operation (No Cylinder)	8810
10	02	No outside operation (No Cylinder) ET Control is used as Pull Only	8810 x ET_
13	08	Key Outside Unlocks/locks Trim #41 Cylinder Supplied	8813 x ET_
15	14	Passage Only (No cylinder)	8815 x ET_
16	10	Key Outside Retracts Latch; Key Inside Unlocks/Locks O/S Trim O/S #34 Cylinder & I/S #44 Cylinder Supplied	8816 x ET_
40	02	Freewheeling Trim - No outside operation (No Cylinder) Dummy Trim	8840 x ET_
43	08	Freewheeling Trim - Key Outside Unlocks/locks Trim #41 Cylinder Supplied	8843 x ET_
44	03	Freewheeling Trim - Key Retracts Latch #34 Cylinder Supplied	8844 x ET_
46	09	Freewheeling Trim - Key unlocks Trim, Trim retracts latch/ Trim relocks when key is removed #41 Cylinder Supplied	8846 x ET_
73		Electrified ET Trim - Fail Safe Power Off, Unlocks Lever (No Cylinder)	8873 x ET_
74		Electrified ET Trim - Fail Secure Power Off, Locks Lever (No Cylinder)	8874 x ET_
75		Electrified ET Trim - Fail Safe Power Off, Unlocks Lever, Key Retracts Latch #34 Cylinder Supplied	8875 x ET_
76		Electrified ET Trim - Fail Secure Power Off, Locks Lever, Key Retracts Latch #34 Cylinder Supplied	8876 x ET_

Note: Exit devices are available in all standard finishes, except 14, 15, 26 & 26D. With these finishes, exit devices are supplied in 32 or 32D to match accordingly. 32 or 32D is automatically supplied when 26 or 26D is specified. For nickel finishes, specify 14/32 or 15/32D to receive nickel finished trims and stainless exit devices

Options

8800

Mechanical Options:
12-
16-
19-
31-
36-
37-
43-
53-
54-
55-
56-
56-HK-
57-
58-
59-
5CH-
BC-59-
76-
85-
86-
87-
AL-
BT-
CPC-
GL-
LD-
PL-
** SG-
TB-
TL-

Cylinder Options:
10-
10-21-
10-63-
11-
11-21-
11-60-
11-63-
11-64-
11-70-7P-
11-72-7P-
11-73-7P-
11-65-73-7P-
21-
22-
51-
52-
60-
63-
64-
70-
72-
73-
65-73-
65-73-7P-
73-7P-
81-
82-
F1-82-
83-
F1-83-
84-
BR-
LC-
*SC-
*SE-

* Options are not available with 8816
** Only available with 15, 26D and 32D finishes

Pull & Thumbpiece Trim Section

Trim Designations

- Use three letter designations (Ex "PTB") when ordering the Exit Device with trim
- Use the six digit designation (Ex "866-MAL") when ordering trim without an Exit Device, always specify finish

Series

8800
Panic & Fire

SARGENT Function Numbers	ANSI Function Numbers	Description & Cylinder Info. (1-3/4" Door)	814-FSL*	814-FSW*	814-MSL*	814-PSB*	814-STS	862 Pull	8804 x Trim Designation
04	03	Night Latch Key Retracts Latch #34 Cylinder Supplied							
10	02	No O/S Operation or Cylinder (Pull Only)	810-FLL	810-FLW	810-MAL	810-PTB	810-STS	862 Pull	8810 x Trim Designation
28	15	Passage Only (No cylinder)	828-FLL	828-FLW	828-MAL	828-PTB	828-STS	N/A	8828 x Trim Designation
63	05	Key Outside Unlocks/ Locks Thumbpiece #34 Cylinder Supplied	866-FLL	866-FLW	866-MAL	866-PTB	866-STS	N/A	8863 x Trim Designation
66	07	Key Outside Retracts Latch; Key Inside Unlocks/Locks O/S Trim O/S #34 & I/S #44	866-FLL	866-FLW	866-MAL	866-PTB	866-STS	N/A	8866 x Trim Designation

* FSL, FSW, MSL and PSB trims are used with (HC-& 12-) 8888 and 8804 only and are the same as FLL, FLW, MAL and PTB pulls except for cylinder hole located 3/8" (9mm) lower.
Note: Thumbpiece trims for 63 and 66 function devices are identical and are identified as 66 function when trim is ordered separately.
Note: FLW & FSW trims are not available in 32(629) or 32D(630).
Note: Pulls and thumb piece trims are not available in 14, 15, 26 or 26D.

Available Finishes

SARGENT Finishes	BHMA Finishes
03	605
04	606
09	611
10	612
10B	613
10BE	613E
10BL	614
14	618
15	619
20D	624
26	625
26D	626
32	629
32D	630
BSP	—
WSP	

Product Catalog

SARGENT
ASSA ABLOY

80 Series
Exit Device

ASSA ABLOY, the global leader
in door opening solutions

Windstorm Certifications

80 Series

SARGENT
ASSA ABLOY

Windstorm Certifications: Florida Building Codes & UL Listings

SARGENT Manufacturing's products meet building codes that require hurricane, windstorm and FEMA certifications, including some of the most stringent building codes as specified in the Florida Building Code, Miami Dade Code and the International Building Code. Listed below are certifications and standards met by the 80 Series lock.

Florida Building Code: FL2998
UL Certification Directory: ZHEM.R21744 – Latching Hardware

ANSI/SDI-BHMA A250.13	"Testing and Rating of Severe Windstorm Resistant Components for Swinging Door Assemblies"
ANSI/ASTM E330	"Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference"
ANSI/ASTM E1886	"Standard Test Method for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials"
ASTM E1996	"Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors and Impact Protective Systems Impacted by Windborne Debris in Hurricanes"
(TAS) 201	"Impact Test Procedures"*
(TAS) 202	"Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference"
(TAS) 203	"Criteria for Testing Products Subject to Cyclic Wind Pressure Loading"*

* Published in the "Florida Building Code"

Any retrofit or other field modification to a fire rated opening can potentially impact the fire rating of the opening, and Sargent Manufacturing Company makes no representations or warranties concerning what such impact may be in any specific situation. When retrofitting any portion of an existing fire rated opening, or specifying and installing a new fire-rated opening, please consult with a code specialist or local code official (Authority Having Jurisdiction) to ensure compliance with all applicable codes and ratings.

UL Certification Directory: ZHLL.R21744 – Products for Use in Windstorm-rated Assemblies

Certifications to meet assembly requirements are done in conjunction with doors from ASSA ABLOY Group companies CECO DOOR and CURRIES.

ASTM E330	"Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference"
ANSI/ASTM E1886	"Standard Test Method for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials"
ASTM E1996	"Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors and Impact Protective Systems Impacted by Windborne Debris in Hurricanes"
AAMA/WDMA/CSA 101/I.S.2/A440	"Standard/Specification for Windows, Doors, and Unit Skylights"
FEMA Publication 320 (2014)	"Taking Shelter From the Storm: Building a Safe Room for Your Home or Small Business", investigated with respect to impact and pressure requirements only.
FEMA Publication 361 (2015)	"Design and Construction Guidance for Community Safe Rooms", investigated with respect to impact and pressure requirements only.
ICC 500 (2014)	"ICC/NSSA Standard for the Design and Construction of Storm Shelters", investigated with respect to impact and pressure testing. Minimum missile impact speeds vary with the design wind speed desired for a particular product. The information below correlates design wind speed to the minimum missile speeds as discussed in Table 305.1.1 of ICC 500

Any retrofit or other field modification to a fire rated opening can potentially impact the fire rating of the opening, and Sargent Manufacturing Company makes no representations or warranties concerning what such impact may be in any specific situation. When retrofitting any portion of an existing fire rated opening, or specifying and installing a new fire-rated opening, please consult with a code specialist or local code official (Authority Having Jurisdiction) to ensure compliance with all applicable codes and ratings.

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Cylinder Information for Exit Devices

Cylinder Chart: Exit Device Series x Function	Door Thickness	ET Trim (700 Series Auxiliary Control) 1-3/4" (44mm)	ET Trim (700 Series Auxiliary Control) 2-1/4" (57mm)	PTB, PSB, STS, MAL, MSL, FLL, FSL, FLW, FSW 1-3/4" (44mm)	PTB, PSB, STS, MAL, MSL, FLL, FSL, FLW, FSW 2-1/4" (57mm)
Narrow Stile Mortise Exit Device	8304	46	48	41	43
	8313/8343	41	41	Not Available	
	8344	46	48	Not Available	
	8363	Not Available		41	43
	8375/8376	46	48	Not Available	
Narrow Stile CVR Exit Device	All 8400	41	41	Not Available	
Narrow Stile Rim Exit	8504	34	34	Not Available	
	8513/8543	41	41	Not Available	
Concealed Vertical Rod Exit Devices	All LP/LR/LS8600	41	Not Available		
	All SP/PP/PR8600	41	Not Available		
	All AD, MD & WD8600	41	41	Not Available	
Surface Vertical Rod Exit Devices	8706/8713/8743/8746	41	41	Not Available	
	8762/8763	Not Available		34	34
	All SP/PP/PR8700	41	N/A	Not Available	
Rim Exit Devices	8804	34	34	34	34
	8806/8813/8843/8846	41	41	Not Available	
	8816	34/*44	34/*44	Not Available	
	8844	34	34	Not Available	
	8863	Not Available		34	34
	8866	Not Available		34/*44	34/*44
	8875/8876/8877	34	34	Not Available	
Mortise Lock Exit Devices	8904	46	48	41	43
	8913/8943	41	41	Not Available	
	8916	*34/46	*34/48	Not Available	
	8944	46	48	Not Available	
	8963	Not Available		41	43
	8966	Not Available		*41/34	*43/34
	8975/8976	46	48	Not Available	

* Inside Cylinders
Chart shows cylinder type and size for conventional SARGENT cylinders.
Note: Cylinder sizes & types are limited, as noted: SC- & SE- cylinders are available in size 41
60-, 63- & 64- cylinders are available in sizes 42, 43, 44 & 46
70-, 11-70-, 72-, 11-72-, 73- & 11-73 cylinders are available in sizes 43 & 46
Note: The 8888's Lever & Rose Trim cylinder standard is the standard SARGENT 10 Line cylinder (13-3266)
Note: 41 Cylinder is 1-1/8" in length; For each additional digit, the cylinder is a 1/8" longer. Example: 42 is 1-1/4"; 43 is 1-3/8" and 46 is 1-3/4"
Note: SARGENT supplies standard blocking rings. Specify if using competitor cylinders

Mullions: Aluminum, Steel and Electrified

80 Series

SARGENT®
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Aluminum Mullions

Product Designation	650A	980	L980
Description	Removable	Removable	Lockable
Material	Aluminum	Aluminum	Aluminum
Standard Finish	US28/Satin Anodized Aluminum	Prime Coat	Aluminum Prime Coat
Options	Specify "650A x 10B" for 313AN to match 10B	Specify "980A" for Anodized US28/ Satin Aluminum	Specify: "L980A" Anodized Aluminum Specify: "L980A x10B" for 313AN to match 10B
Stk Size	96"	96"	96"
Max Stk Height	120"	120"	120"
Pre-prepped	658 Strikes Included	No	No
Cylinder Size	Not Required	Not Required	#41
Shape	1-1/2" x 2-1/2"	T Shaped 2-1/2" x 3"	T Shaped 2-1/2" x 3"
Misc. Information and Accessories	Includes 651 Stabilizers and imbedded Weather Stripping Top Retainer 94-2050 Bottom Retainer 94-2051	Top Retainer - 511 Bottom Retainer - 502 Adapter for narrow transom: 507 - Aluminum Prime Coated 507A - Anodized Aluminum	All Cylinder Options Available Wall Mount Kit 98-2578 Top Ret Pack 98-2526 Bottom Ret Pack 98-2525 Cylinder Kit 980C1*

Electrified

EL980
Electrical Lockable
Steel
Gray Paint
Wall Mounting Kit: 98-2580 Top Ret Pack :98-2559
96"
120"
No
#46 Only
Rectangular 2" x 3"
For use with Electric Strikes and Monitoring, Quick Connect Wiring Supplied Cylinder Kit 980C2*

***Note:** Cylinder Kits must be ordered separately

Steel Mullions

Product Designations	HC980	980S	L980S	HCL980	12-HD980
Description	Hurricane Code	Standard Mullion	Lockable	Lockable Hurricane Code	Heavy Duty
Material	Steel	Steel	Steel	Steel	Steel
Fire Rated	Specify 12-HC980	Specify 12-980	Specify 12-L980	Specify 12-HCL980	Specify 12-HD980
Fire Rated Max Height	96"	96"	96"	96"	120"
Finish	Gray Paint	Gray Paint	Gray Paint	Gray Paint	Gray Paint
Stk Size	96"	96"	96"	96"	120"
Max Stk Height	96"	120"	120"	96"	120"
Pre-prepped	No	No	No	No	No
Cylinder Size	Not Required	Not Required	#41 Std (#42 & #43 available)	#41 Std (#42 & #43 available)	Not Required
Shape	Rectangular 2' x 3"	Rectangular 2" x 3"	Rectangular 2" x 3"	Rectangular 2" x 3"	Rectangular 2" x 3"
Misc. Information	Designed for severe wind load conditions due to hurricanes or windstorms. Tested to Dade County Protocols & ASTM Standards	For 12-8800 - Channel Iron & Malleable iron top & bottom retainers.	Fire rated for 8'0" x 8'0" paired openings	See Notes Below	12-HD980 is for pair of doors over 8'0" to 10'0" for use with 2-8800 Rim Exits includes two piece strikes
Accessories	Top Ret Pack - 98-2599 Bottom Ret Pack - 98-2600 Top Retainer Shim Kit - 601	Top Ret Pack - 98-2190 Bottom Ret Pack - 98-2191 Top Retainer Shim Kit - 601	Wall Mounting Kit - 98-2579 Top Ret Pack - 98-2559 Bottom Ret Pack - 98-2556 Top Retainer Shim Kit - 601 Cylinder Kit - 980C1*	- Top Retainer Pack: 98-2593 - Bottom Retainer Pack: 98-2594 - Top Retainer Shim Kit - 601 Cylinder Kit - 980C1*	Top Ret Pack - 98-2599 ottom Ret Pack - 98-2600 op Retainer Shim Kit - 601

***Note:** Cylinder Kits must be ordered separately

Note for HC980/12-HC980 Mullions:

- Designed for severe wind load conditions due to hurricanes or tornadoes
- Tested to Dade County protocols and ANSI 250.13 ASTM Standards and FEMA 361
- 12- Fire labeled version
- Replacement lock kits are available for lockable mullions Part numbers for each model are listed in the price book

HCL980 Mullion Information

- Model 12-HC-L980 may be supplied for doors UL fire rated up to and including 3 hrs not exceeding 8 ft in width and height
- Meets the following standards: ANSI 250.13, ASTM E330, ASTM 1886, ASTM 1996, TAS 201, TAS 202 & TAS 203
- Designed for use with UL Classified HC8810, HC8800 and 12-HC8800 rim exit devices

Mullion Accessories and Stabilizers

80 Series

SARGENT
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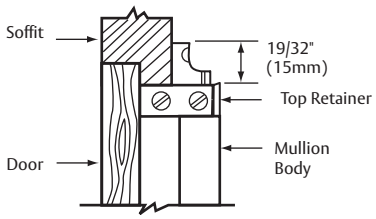
Mullion Accessories

RK980
Latchbolt assembly retrofit kit with top and bottom retainers for 980 aluminum mullion

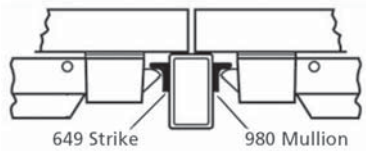
507 Narrow Transom Bars Adapter

- Available with 980 and 980A
- Required when soffit is 1-1/4" (32mm) to 2" (51mm) wide
- Order as a: 507 for 980 mullion or 507A for 980A mullion



980S Mullion Application

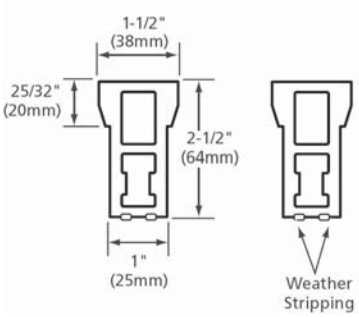
- All steel mullions are 2" x 3"



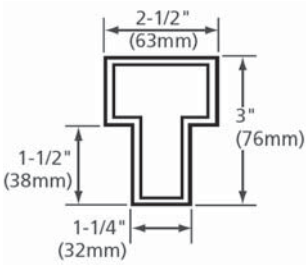
651 Mullion Stabilizer Kit

- Stabilizer block
- Furnished standard w/650A Mullion
- Order as a 651 Kit

650A Mullion



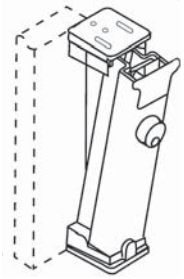
980 Mullion & L980 Lockable Mullion



980C1 Cylinder Mullion Kit

- Lockable mullions only
- Aluminum and steel
- Includes cylinder and collar
- Available in 26D & 10B finish

Lockable Mullion



Lockable Mullion Cylinder Kit Options*

L980, L980A, L980S & HC-L980 mullions are available with these options: 10, 10-21-, 10-63-, 11-, 11-21-, 11-60, 11-63-, 11-64-, 11-72-7P-, 11-65-73-7P-, 11-73-7P-, 21-, 22-, 60-, 63-, 64-, 70, 72-, 73-, 65-73-, 65-73-7P-, 73-7P-, 81-, 82-, F1-82-, 83-, F1-83-, 84-, SC- & SE-.

EL980 mullion is available with these options: 10, 10-21-, 10-63-, 11-, 11-21-, 11-60, 11-63-, 11-64-, 11-72-7P-, 11-65-73-7P-, 11-73-7P-, 21-, 22-, 60-, 63-, 64-, 70, 72-, 73-, 65-73-, 65-73-7P-, 73-7P-, 81-, 82- & F1-82-.

*Lockable mullions are shipped without cylinders. Order Cylinder Mullion Kit separately.

980C2 Cylinder Mullion Kit

- Lockable mullions
- Electrified only
- Includes cylinder and collar
- Available in 26D finish only

Mullion Weights & Packaging

Product	Avg Wt	Case
Exit Device with Trim	15 lbs	1 ea
980 Mullion	18 lbs	1 ea
12-980 Mullion	40 lbs	1 ea
650A Mullion	18 lbs	1 ea

Mechanical Options and Descriptions

80 Series

SARGENT®
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Mechanical Options:

Categories	How to Specify	Detailed Description
Fire Rated	**12-**	UL Fire Label Exit hardware (not available with 16- & HK-)
SVR Bolt	**14-**	Sliding bolt bottom case for 8700
Cylinder Dogging	**16-**	Cylinder lockdown with # 41 Cylinder & # 97 Ring (not available with 12-, 57, 59-, AL- or BT- Option)
	LD-	Less dogging for non fire rated devices
Less Touch Pad	**19-**	Pushbar without Lexan touchpad (not available TL-)
8900/8300 Strike	**23-**	4-7/8" (124mm) ANSI flat lip strike (for 8900 & 8300 Series Mortise Lock Exit Devices)
Thick Doors	**31-**	Doors over 1-3/4" and/or Panels (Specify door thickness, panel thickness & location as required) Not available for HC8700, FM8700, PP, PR & SP8700, PP, PR & SP8600, LP, LR & LP8700 Extended lip strike supplied for 8300 & 8900 Series
Security Fasteners	**36-**	Six lobe security head screws
	37-	Spanner head screws
Flush End cap	**43-**	Flush End Cap (Not available with LP, LR & LS Devices)
Indicator	**49-**	Indicator (Available on 8816 and 8866 functions only)
Electrical Options	**53-**	Latchbolt monitoring switch (not available with 59-, GL-, HC-, WS- or on FM8700, PP/PR/SP8600 & LP/LR/LS8600 Exit Devices)
	54-	Monitors ET Lever movement with Internal micro switch in ET Control
	55-	Request to Exit - Signal Switch in Rail (not available with 59- & FM8700)
	56-	Remote Latch Retraction (not available 57-, 58-, 59-, AL- or BT- Option)
	56-HK-	Remote Latch Retraction with manual Hex Key dogging (not available 12-, 57-, 58-, 59-, AL- or BT- Option)
	57-	Delayed Egress (Electromagnetic Lock required & purchased separately) (not available 16-, 53-, 56-, 56-HK, 58-, 59-, AL, Bc-59 - or BT, GL, TL Prefixes) (NB, 54- are available on request)
	58-	Electric Rail Dogging (Not available 56- & 59-)
	59-	Electroguard® Self Contained Delayed Egress Device (not available with 16-, 53-, 55-, 56-, 57-, 58-, AL-, BT-, GL-, HC- & WS Option Prefixes, PP/PR/SP8600, LP/LR/LS8600 Exit Devices) (NB, 54- are available upon request)
	AL-	Alarmed Exit (Not available 16-, 56-, 57-, 59-, BT-, GL-, HC- & WS-)
	BC-59-	Electroguard® Boca Code (Door Status Switch required) (not available with 16-, 55-, 56-, 57-, 58-, AL-, BT-, GL-, HC- & WS-Options and on NB8700, PP/PR/SP8600 & LP/LR/LS8600 Exit Devices)
	TL-	SARGuide Electro-Luminescent Touchpad (not available 19-, 85-, 87- & PL-)
Tactile Warning Options	**76-**	Tactile Warning - Milled Outside Lever (not available with Studio & Coastal Levers and the A Lever)
	85-	Tactile Warning - Abrasive strip on Push Rail (Not available with PL- & TL-)
	86-	Tactile Warning - Abrasive coating on Outside Lever
	87-	Tactile Warning - Abrasive strip on Push Rail & Abrasive coating on Outside Lever (not available with PL- & TL-)
Finish Protection	**CPC-**	Clear Powder Coat (Available for 32 & 32D Finishes)
	SG-	MicroShield® antimicrobial clear powder coat (only available with 15, 26D and 32D finishes)
Top Rod Only	**NB-**	Less Bottom Rod & Bolt (for SVR & CVR Devices)
Guarded Latch	**GL-**	Guarded Latch for Rim Exit Devices (not available 53-, 56-, 59-, AL-, HC- & WS-)
SARGuide	**PL-**	SARGuide™ PL – Photoluminescent Coated Push Rail – (Touchpad eliminated) (not available 85, 87 & TL-)
Through Bolts	**TB-**	Through Bolts for 8300, 8500, 8600, 8700, 8800 & 8900 Devices
Rail Force	**5CH-**	5lb. Pressure Release (8800 only)

Cylinder Options and Descriptions

80 Series

SARGENT®
ASSA ABLOY

Cylinder Options:

Conventional Cylinder	-	SARGENT Conventional Cylinders Supplied Standard (Unless Otherwise Specified)
Degree Key System	**DG1-**	SARGENT Degree Key System Level 1 (bump resistant with patented keys)
	DG1-21-	Degree Level 1 Construction Master Keying
	DG1-60-	Degree Level 1 Removable Disposable Construction Core
	DG1-63-	Degree Level 1 Removable Core
	DG1-64-	Degree Level 1 Removable Construction Keyed LFIC
	DG1-65-	Degree Level 1 Unassembled/Uncombined Core
	DG2-	SARGENT Degree Key System Level 2 (geographically exclusive; bump and pick resistant)
	DG2-21-	Degree Level 2 Construction Master Keying
	DG2-60-	Degree Level 2 Removable Disposable Construction Core
	DG2-63-	Degree Level 2 Removable Core
	DG2-64-	Degree Level 2 Removable Construction Keyed LFIC
	DG2-65-	Degree Level 2 Unassembled/Uncombined Core
	DG3-	SARGENT Degree Key System Level 3 (geographically exclusive; UL437 certified; bump and pick resistant)
	DG3-21-	Degree Level 3 Construction Master Keying
	DG3-60-	Degree Level 3 Removable Disposable Construction Core
	DG3-63-	Degree Level 3 Removable Core
	DG3-64-	Degree Level 3 Removable Construction Keyed LFIC
	DG3-65	Degree Level 3 Unassembled/Uncombined Core
Signature Key System	**10-**	SARGENT Signature Key System (Not Available with other Key Systems)
	10-21-	SARGENT Signature Construction Key System (Lost Ball)
Signature- LFIC	**10-63-**	SARGENT Signature Large Format Interchangeable Core Cylinder (Removable)
XC- Key System	**11-**	XC Key System (Not available with other Key systems unless specified)
	11-21-	XC- Construction Key System (Lost Ball)
XC- Large Format Interchangeable Core (Removable Core)	**11-60-**	Device to accept XC- Permanent Large Format Interchangeable Core, Disposable plastic Core- provided
	11-63-	Device provided with XC- Large Format Interchangeable Core Cylinder - (Includes masterkeying, grand masterkeying)
	11-64-	Device provided with Keyed construction core to accept XC- Permanent Large Format Interchangeable Core (ordered separately)
XC- Small Format Interchangeable Core	**11-70-7P-**	Device to accept XC- SFIC (7-Pin) XC- Permanent Cores, plastic disposable core provided
	11-72-7P-	Device to accept XC- SFIC (7-Pin Keyed Construction Core provided) cylinder Permanent core ordered separately
	11-73-7P-	Device provided with XC- Small Format 7-Pin interchangeable core (Includes masterkeying, grand masterkeying)
	11-65-73-7P-	Device provided to accept XC- Uncombinated 7-Pin SFIC (Permanent) Core - (Packed Loose)
Construction Key Systems	**21-**	SARGENT Lost Ball Construction Keying for Conventional, XC and Signature Series (N/A with 63- or 73-)
	22-	SARGENT Construction Split Key System for Conventional Cylinders (Existing Systems Only) (N/A with 10-, 11-, 63- or 73-)
Old Style Removable Core	**51-**	Removable Core Cylinder (Old Style) provided (existing systems only)
	52-	Removable Construction Core (Old Style) Permanent core ordered separately (existing systems only)
Large Format Interchangeable Core (Removable Core)	**60-**	Device to accept SARGENT Permanent Large Format Interchangeable Core, Disposable plastic Core provided (Permanent Cores ordered separately)
	63-	Device provided with Large Format Interchangeable Core Cylinder - (Includes masterkeying, grand masterkeying)
	64-	Device provided with Keyed construction core to accept Permanent Large Format Interchangeable Core (ordered separately)
Small Format Interchangeable Core	**70-**	Device to accept 6- or 7-Pin SFIC Permanent Cores, plastic disposable core provided
	72-	Device to accept 6- or 7-Pin SFIC (6-Pin Keyed Construction Core provided) Cylinder (Permanent Core ordered separately)
	73-	Device provided with 6-Pin SFIC (Includes masterkeying, grand masterkeying)
	65-73-	Device provided to accept Uncombinated 6-Pin SFIC (Permanent) Core - (Packed Loose for field keying)
	65-73-7P-	Device provided to accept Uncombinated 7-Pin SFIC (Permanent) Core - (Packed Loose for field keying)
	73-7P-	Device provided with Small Format 7-Pin Interchangeable Core (Includes masterkeying, grand masterkeying)
Keso & Keso F1	**81-**	Device provided with housings to accept Keso (83) & Keso F1 (F1-83-) removable cores. (Permanent Cores ordered separately)
	82-	Device provided with SARGENT Keso Security Cylinder
	F1-82-	Device provided with SARGENT Keso F1 Security Cylinder (Patented)
	83-	Device provided with SARGENT Keso Security Removable Core cylinder
	F1-83-	Device provided with SARGENT Keso F1 Security Removable Core cylinder (Patented)
	84-	Device provided with SARGENT Keso Construction Cores (Permanent Cores ordered separately)
Added Security	**BR-**	Bump Resistant Cylinder (Available with Conventional & Conventional XC Cylinders Only)
Less Cylinder	**LC-**	Less Cylinder - SARGENT supplies standard blocking rings for 1-1/8" Cylinders (For longer cylinders order collars/rings separately)
Schlage Keyways	**SC-**	Schlage C keyway cylinder, 0 bitted (not available with: 8904, 8916, 8944, 8975, 8976, 8866, 8304, 8344, 8375 & 8376)
	SE-	Schlage E keyway cylinder, 0 bitted (not available with: 8904, 8916, 8944, 8975, 8976, 8866, 8304, 8344, 8375 & 8376)
Lever to Accept Schlage	**SF-**	L Lever to accept MEDECO KeyMark Large Format Interchangeable and Schlage Full Size Interchangeable Core (Supplied Less Cylinder, but with tailpiece needed) (Available for 88-KLL & 88-CLL)

Note: For V-10 Cylinders and information, contact ASSA

WD8600 and NB-WD8600 Concealed Vertical Rod Exit Device for Wood Doors

80 Series

SARGENT®
ASSA ABLOY

WD8600 Series

Concealed Vertical Rod Exit Device for Wood Doors

Features

- Designed for standard width stile applications on wood doors
- Concealed rods offer security
- Single and double door applications
- Specify NB- for less bottom rod
- Devices are ANSI/BHMA A156.3 - Grade 1
- UL10C (Fire) and UL305 (Panic) listed

Specifications for WD8600 & NB-WD8600 Series Exit

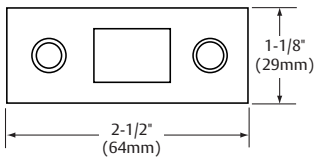
Door Type	Wood Doors
Door Thickness	1-3/4" (44mm) minimum thickness. For doors over 1-3/4" to 2-1/4" thick, specify thickness and order as 31-
Stile	4-1/2" (114mm) minimum stile width
Rail sizes as determined by door width	Rails are available in 4 sizes, use door width to determine size needed. Rails will be factory cut to size, if door width is supplied • E Rail for 24" to 32" door widths, No cutting required for 32" door • F Rail for 33" to 36" door widths, No cutting required for 36" door • J Rail for 37" to 42" door widths, No cutting required for 42" door • G Rail for 43" to 48" door widths, No cutting required for 48" door
Strike	650 Top Strike & 606 Bottom Strike (Panic and Fire Rated)
Dogging Feature	Hex key dogging standard on non fired rated devices; specify 16- for cylinder dogging (#41 cylinder supplied)
Electric Options	AL- Alarm PL- SARGuide™ Photoluminescent Coated TL- SARGuide™ Illuminated Touchpad 53- LX Latchbolt Monitor 54- Outside Lever Monitoring 55- Request-to-Exit Signal - Rail Monitoring 56- Remote Latch Retraction 57- Delay Egress & Electromagnets 58- Electric Dogging 59- Electroguard – Self Contained Delayed Egress
Mounting Fasteners	Supplied standard with wood screws
Top Bolt	Stainless steel
Device Centerline from Finished Floor	41" (1041mm) for Standard Applications 38" (965mm) for elementary schools
Door/Opening Height	**Must be specified** - 108" (2743mm) Max Door Opening - Fire rated doors 120" (3048mm) Max Door Opening - Non-fire rated doors
Center Case Dimensions	8-3/8" (213mm) x 2-5/8" (67mm)
Projection	Pushbar Neutral – 3" (76mm) Pushbar Depressed – 2-1/8" (54mm)
Fire Exit Hardware	See Chart – Page 6

Note: WD8600 & 12-WD8600 can be used as NB- Device by simply not installing the bottom rod/bolt
Note: 12-NB applications require thermal pin. Thermal pin supplied when ordered as a 12-NB device

100 Series Aux Control

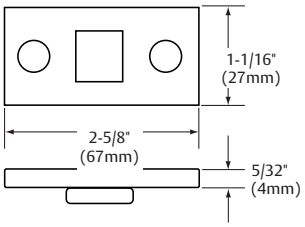
- Available as an 06 or 13 function
- Supplied with a SARGENT #41 Mortise Cylinder
- Can be used with any SARGENT Mortise Key System

650 Top Strike



- For application in hollow metal frames
- Stainless steel

606 Bottom Strike



- Furnished with expansion shields
- Mortised into floor
- Stainless steel

WD8600 and NB-WD8600 Functions and Trims for Wood Doors

80 Series

SARGENT®
ASSA ABLOY

How to order:	Options	Series	Function	Rail Lgth	Trim	Hand	Outside Finish	Inside Finish	Door Width	Door Height	AFF
	58-NB-	WD86	13	F	ETL	RHR	26D	32D	36"	84"	41"

700 Series ET Trim

Exits with ET Trim, specify lever design after the ET designation (e.g., ETL)

Lever Designs for ET Controls

A, B, E, F, J, L, P, W
Also available with Coastal Series & Studio Collection Levers

ET Designation with Suffix (Used to order ET without device)

MD8600 & NB-MD8600 Series:
706-4, 710-4, 713-4, 715-4, 740-4, 743-4, 746-4, 773-4, & 774-4

Freewheeling Trim

The lever rotates when the door is locked preventing excessive force from being applied to the horizontal lever

Electrified ET Trim

Voltage must be specified for the following functions: 73 and 74.
Specify: 12VDC or 24VDC

SARGENT Function Numbers	ANSI Function Numbers	Description & Cylinder Info (1-3/4" Door)	ANSI Type 7 WD8600 Panic & Fire
06	09	Key unlocks Trim, Trim retracts latch/ Trim relocks when key is removed #41 Cylinder Supplied	WD8606 x ET_
10	01	No outside operation (No Cylinder)*	WD8610
10	02	No outside operation (No Cylinder)* ET Control is used as Pull Only	WD8610 x ET_
13	08	Key Outside Unlocks/locks Trim #41 Cylinder Supplied	WD8613 x ET_
15	14	Passage Only (No cylinder)	WD8615 x ET_
40	02	Freewheeling Trim - No outside operation (No Cylinder)* Dummy Trim	WD8640 x ET_
43	08	Freewheeling Trim - Key Outside Unlocks/locks Trim #41 Cylinder Supplied	WD8643 x ET_
46	09	Freewheeling Trim - Key unlocks Trim, Trim retracts latch/ Trim relocks when key is removed #41 Cylinder Supplied	WD8646 x ET_
73		Electrified ET Trim - Fail Safe Power Off, Unlocks Lever (No Cylinder)*	WD8673 x ET_
74		Electrified ET Trim - Fail Secure Power Off, Locks Lever (No Cylinder)*	WD8674 x ET_

Note: Exit devices are available in all standard finishes, except 14, 15, 26 & 26D. With these finishes, exit devices are supplied in 32 or 32D to match accordingly. 32 or 32D is automatically supplied when 26 or 26D is specified. For nickel finishes, specify 14/32 or 15/32D to receive nickel finished trims and stainless exit devices.
Note: AFF means Above Finished Floor, center line of rail Above Finished Floor
* Cylinder Override is available with a 106 Aux Control
Example Order: WD8673F 12V x ETMG x 106 x RHR x 32D x 36"w x 84"h

100 Series Auxiliary Control* & 862 Pull

100 Series Aux. Control

862 Pull

SARGENT Function Numbers	ANSI Function Numbers	Description & Cylinder Info (1-3/4" Door)	WD8600 Panic & Fire
06	12	Key unlocks Turn, Turn retracts latch/ Turn relocks when key is removed #41 Cylinder Supplied	WD8610 x 106
10	02	862 Pull Only (Optional Pulls: 863 & 864)	WD8610 x 862 Pull
13	11	Key Outside Unlocks/locks Turn #41 Cylinder Supplied	WD8610 x 113

Note: When ordering WD8600/NB-WD8600 Series Exit Device x 100 Series Aux. Control, specify 10 Function for the exit.
Example: WD8610F x 106 x RHR x 32D x 42" x 90"

Options

WD8600

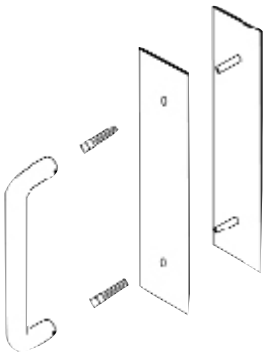
Mechanical Options:
12-
16-
19-
31-
36-
37-
43-
53-
54-
55-
56-
56-HK-
57-
58-
59-
5CH-
BC-59-
76-
85-
86-
87-
AL-
BT-
CPC-
LD-
NB-
PL-
* SG-
TL-

Cylinder Options:
10-
10-21-
10-63-
11-
11-21-
11-60-
11-63-
11-64-
11-70-7P-
11-72-7P-
11-73-7P-
11-65-73-7P-
21-
22-
51-
52-
60-
63-
64-
70-
72-
73-
65-73-
65-73-7P-
73-7P-
81-
82-
F1-82-
83-
F1-83-
84-
BR-
LC-
SC-
SE-

* Only available with 15, 26D and 32D finishes

Available Finishes

SARGENT Finishes	BHMA Finishes
03	605
04	606
09	611
10	612
10B	613
10BE	613E
10BL	614
14	618
15	619
20D	624
26	625
26D	626
32	629
32D	630
BSP	—
WSP	



Concealed Mount Pull Plate Sets
No. 107 x 73B/73BL, 110 x 73C/73CL, 111 x 73C/73CL

Material: Stainless steel

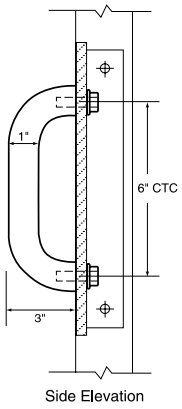
Finishes: US32D

Fastener: Type 9. Stud welded lugs on the back of the push plate are permanently attached to the 1/8" thick push plate. Cone head MS attached to selected door pull

Features:
- This set has no perimeter screw holes in either plate
- Concealed mounting system. Any of the rod type door pulls from No. 105 to No. 118 are appropriate for this application

Options:
- Engraving on plates 4" wide or wider. Specify copy. See page B1 for standard engraving locations
- Cylinder cutouts (CFC) and turn knob cutouts (CFTT). See page B1 for standard locations and sizes
- *Other overall sizes available upon request

No.	Pull	Pull Size	Pull CTC	Pull Plate	Push Plate	Overall*	Weight	ANSI A156.6
107 x 73B/73BL	107	3/4" dia.	8"	73B	73BL	3 1/2" x 15"	5.8 lbs.	J406
110 x 73C/73CL	110	1" dia.	8"	73C	73CL	4" x 16"	8.0 lbs.	J406
111 x 73C/73CL	111	1" dia.	10"	73C	73CL	4" x 16"	8.5 lbs.	J406



Side Elevation

Security Door Pull No. 110-6SP

Material: Stainless steel

Finishes: US32D

Fastener: 3/8 - 16 hex head MS with nylon patch

Features: For use on security hollow metal doors with reinforcing plate and access hole cover plate with TORX - security Torx screws — all to be supplied by door manufacturer

No.	Material Size	CTC	Overall	Base	Projection	Clearance	Weight	ANSI A156.6
110 - 6SP	1" dia.	6"	7"	1"	3"	2"	2.4 lbs.	J401

Door Coordinators No. 2600 Series

Material: Steel

Finishes: Black prime coat, silver powder coat

Fastener: 7 ea. #12 - 24 x 1 1/4 TH type C tapping screws

Size: Standard device size 5/8" x 1 5/8" x 52"

Features: Non-handed. Override protection to prevent damage in case of abnormal force on door Mechanism and filler bar completely fill width of opening and when painted to match frame it becomes virtually invisible

Options: Specify make and model of exit device for vertical rod preparation

Ordering: Stock Sizes

No.	Opening	Weight	ANSI A156.3
2660	60"	7.0 lbs.	Type 21A
2672	72"	8.0 lbs.	Type 21A
2696	96"	9.75 lbs.	Type 21A

Custom Sizes — The 2600 Series coordinators are manufactured in different housing lengths to coordinate the full range of door sizes:

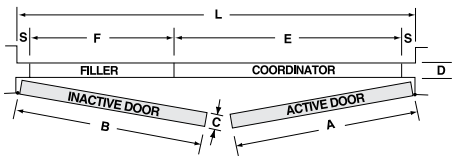
- NX2600 Series: For jamb opening widths (A + B dimension) from 48" - 54". E dimension, 42"
- 2600 Series: For jamb opening widths (A + B dimension) from 54" - 96". E dimension, 52"

Determining Coordinator Item Number

- Active door widths A plus inactive door width B equals the last two or three digits of all 2600 Series coordinator item numbers (2680 is for 80" door opening)
- Less than 48" jamb widths = N2600 Series (N2644 = 44" opening).
- Larger sizes are available (XL, XXL). Contact the factory

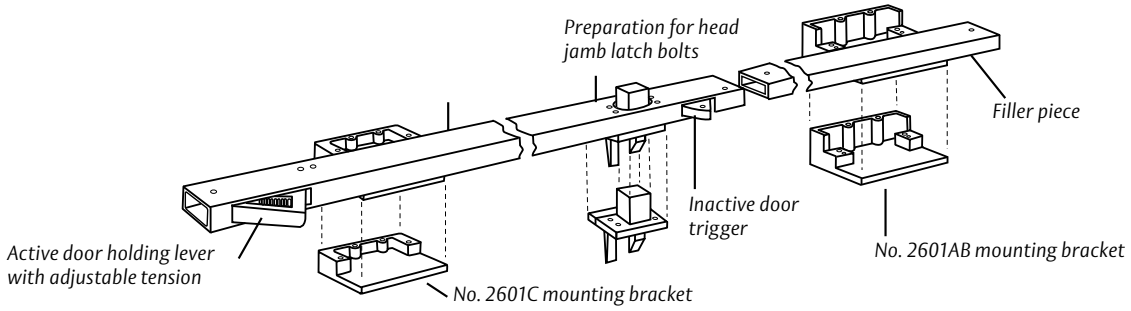
NOTE: Some panic hardware requires the coordinator to be factory prepped. Contact factory.

No.	Jamb Widths	Coordinator Length	ANSI A156.3
NX2648- NX2654	48"-54"	42"	Type 21A
2655 - 2660	55" - 60"	52"	Type 21A
2661 - 2672	61" - 72"	52"	Type 21A
2673 - 2696	73" - 96"	52"	Type 21A



Fillers are usually supplied precut from the factory (filler bars shown on page E14).

NOTE: If "S" dimension is other than 5/8" advise the factory.



ASSA ABLOY

The global leader in door opening solutions

Architectural Door Accessories

ASSA ABLOY
Opening Solutions

Experience a safer
and more open world

Rockwood RM2110 - MezzoTek - Straight Pull without GripZone

Available Finishes:

- US3/605
- US4/606
- US10/612
- US10B/613
- US10BE/613E
- US32/629
- US32316
- US32D/630
- US32D316

DIAMETER:
1 1/4"

Overall:
Up to 96"

PROJECTION:
3"

Specifications:

MATERIAL:
Brass, Bronze, Stainless Steel

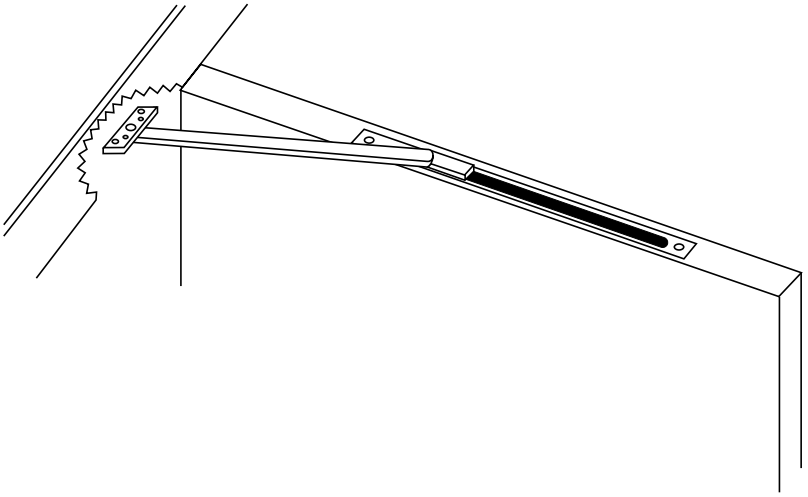
OPTIONS:
- For optional mid-post, suffix the product number with a "MP" (example: RM2110MP)
- Over 96" available on select finishes

ASSA ABLOY Opening Solutions
Architectural Accessories Group
Rockwood, PA
Phone: (800) 458-2424 • Fax: (800) 922-9212
www.assaabloydooraccessories.us

Concealed Mount – Interior or Exterior – High Traffic Doors

Product Description & Features

- Doors may be single or double acting
- Non-handed
- Slide track design
- Recommended for high traffic, heavy abuse installations
- Heavy shock absorber spring provides 5 -7° compression before dead stop
- LS option omits spring for special applications
- Surface on/off knob on hold open models
- Stop, friction stay or hold open functions
- Complete screw packet for installation in wood and machine screws for door and frame.
- For security areas, Torx® screws available for exposed fasteners
- Standard architectural finishes
- Durable slider cam and shock block
- 110° maximum opening
- 1-3/4" minimum door thickness, for thicker doors, note thickness when ordering
- 1-3/16" square channel
- Stop function UL listed for fire door assemblies
- Hanging means other than standard butts or offset pivots require special templating and pricing. Consult factory



Door Opening Chart (*in inches*)

Butts Offset Pivots	Center Hung Pivots	Model Number		
		Friction	H.O.	Stop
*24 - 28	—	1-116	1-126	1-136
28-1/16 - 33	30 - 36	1-216	1-226	1-236
33-1/16 - 38	36-1/16 - 41	1-316	1-326	1-336
38-1/16 - 43	41-1/16 - 46	1-416	1-426	1-436
43-1/16 - 48	46-1/16 - 50	1-516	1-526	1-536

**Butt hung only on this size door. No swing clear hinges.*

	ANSI No.		
Shipping Weight 4.5 lbs.	Friction	H.O.	Stop
	C01531	C01511	C01541

Checkmate® Stops and Holders Options, Certifications, Limited Warranty, Specifications

Options

Less Spring – Suffix LS

Heavy duty slide track type stops have a spring in the end of the channel that keeps the slider from deadstopping. If these units are being used with electromechanical closer, where the door must deadstop, the LS option is needed. For non-adjustable models 1 and 9 only.

Angle Jamb Bracket Adapter –
Standard-duty models suffix 5258 (non-handed)
Heavy-duty models suffix 5458 (LH) or 5459 (RH)

When surface mounted units are mounted on a rabbeted door on the push side, flush door and transom on the push side, or in a reverse installation on the pull side of the door a special bracket is needed. Note that not all models can be mounted on the pull side of the door (*See specific model numbers in catalog.*)

5258

5458

Security Screws – Suffix Torx

Security screws can be supplied for exposed fasteners.

Certifications

All Rixson Checkmate® overhead stops and holders are in compliance with ANSI/BHMA 156.8, Grade 1 and 2 Standards. See individual products for sub sections. See individual models for UL Listing.

Limited Warranty

Rixson Checkmate® stops and holders are warranted for 2 years for defect. See *Rixson* price book for specific details of the limited warranty

Specifications

All overhead stops and holders shall be from a single manufacturer.

Standard-duty models used for interior or low to medium traffic doors.

Heavy-duty models used for exterior or high traffic doors or doors subject to abuse.

For extremely abusive areas or high winds use double lever arm type.

Coordinate deadstop and/or hold open location with concealed floor closers.

Checkmate products provide hold open and/or deadstop.

Product Catalog

SARGENT
ASSA ABLOY

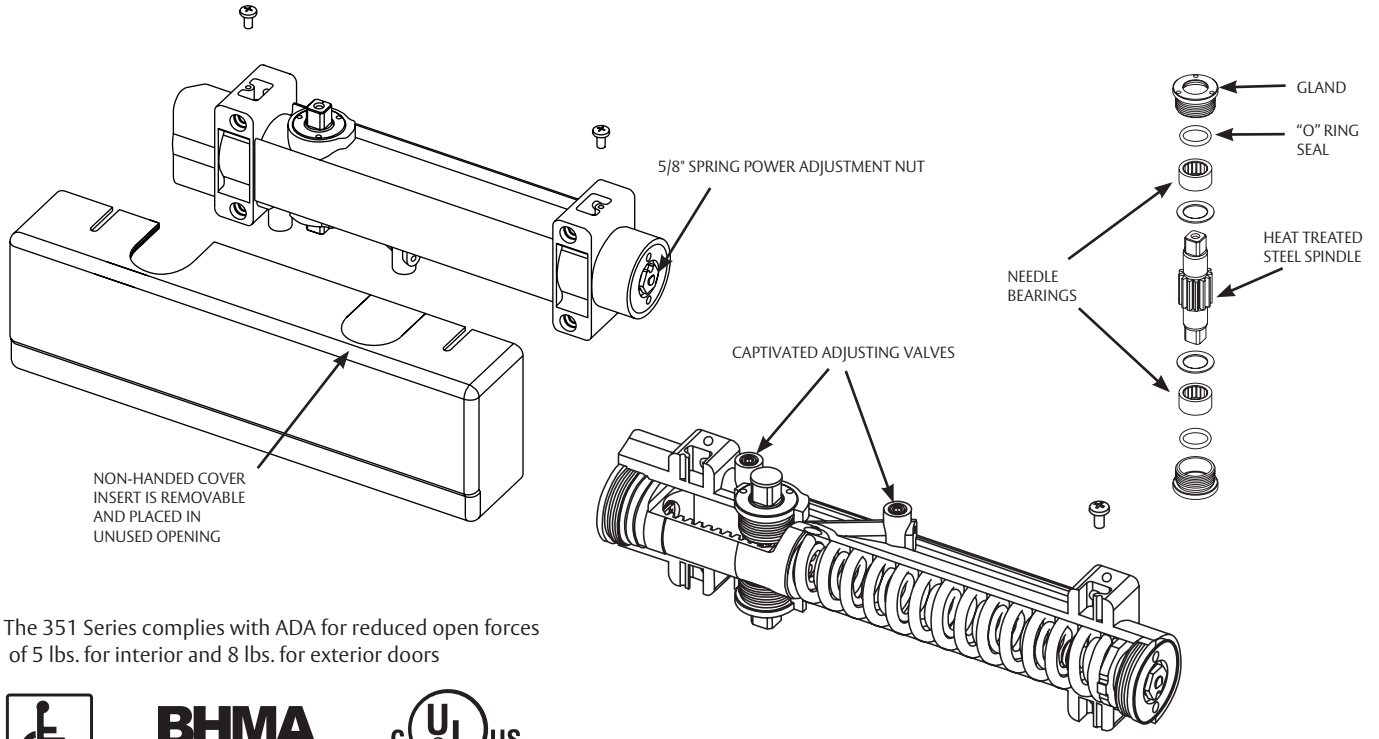
351 Series

Powerglide® Door Closer

Experience a safer
and more open world

Features and Benefits

351 Series Powerglide®



The 351 Series complies with ADA for reduced open forces of 5 lbs. for interior and 8 lbs. for exterior doors

BHMA CERTIFIED

c UL us LISTED

Features

- Certified ANSI/BHMA A156.4 Grade 1
- UL 10C listed for positive pressure fire test
- UL /cUL listed for use on fire rated doors
- 25 year limited warranty
- User friendly versatile mounting applications permit standard, top jamb, parallel and track installations
- Self sticking templates supplied for most applications
- Adjustable spring power allows 351 closers a size range of 1 through 6. They are adjusted to size 3 before leaving the factory
- One door closer body for all applications. All 351 are non-handed
- Meets ADA requirements in all applications, except Push Side Track application (except track)
- High impact non-corrosive plastic covers with two machine screws standard, metal covers and lead lined are optional
- All weather fluid allows closer to operate effectively in extreme temperatures without readjustment
- 1-1/2" diameter piston for superior door control
- Standard pressure relief valves for both opening and closing cycles protect the door & frame from damage caused by abuse

Heavy Duty Construction

- Heat treated full closed rack and pinion provide control from the full open position
- Heavy duty one piece die cast aluminum silicon alloy body with 14% silicon provides superior strength and wear resistance
- 1/2" arm engagement over a 7/16 square spindle ensures a wear-resistant tight joint

Fasteners

- Machine Screws and self tapping screws provided for closer and arm

Valves

- Brass body low sensitivity control valves offer separate regulating for door speed, latching, backcheck and optional delayed action
- All valves are controlled by an 1/8" allen wrench to discourage tampering and are captivated to prevent removing valves from the body and damaging door closer
- Adjustable backcheck (standard) protects the door and hardware from damage during the opening cycle
- Adjustable delayed action (optional) permits easy access for physically impaired individuals
- Valves are captivated to prevent accidental removal

Full Complement of Arm Types

- Interchangeable forged steel arms
- Standard and parallel arms
- Push and pull track arms (including double egress)
- Heavy duty forged steel arms are finely finished and interchangeable between SARGENT 351, 1431 and 281 Series

Standard Applications

351 Series Powerglide®

SARGENT
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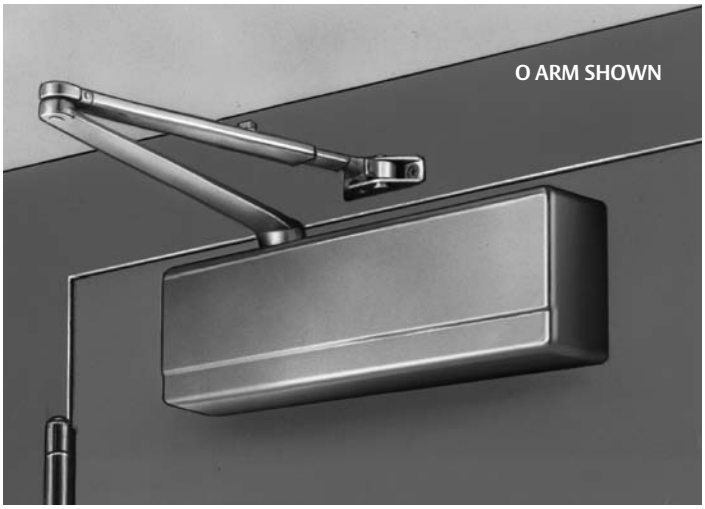
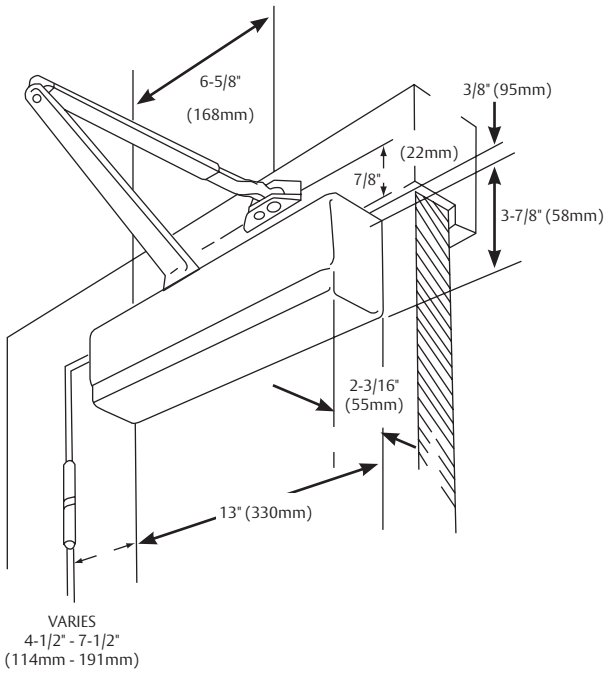


The standard application of the 351 door closer is the most common and the most desirable. The closer mounts on the hinge (pull) side of door (except when the W Corner Bracket is used). **Note:** This application is not recommended on exterior doors (the closer is not protected from weather). The cover projection normally limits the door opening to a maximum of 160°.

351-0 Standard Application



351 Standard Application for:

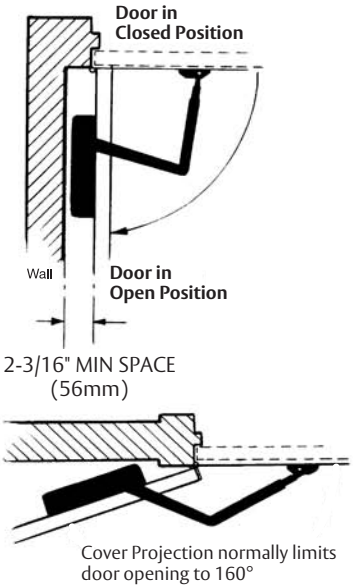
- Interior Doors Opening In or Out
- Exterior Doors Opening In
- Maximum Reveal 7/16"
- Non-hand universal body

351 Standard Application Door Opening Range

(Range based on Mounting Position)

- O- Standard Arm: 120° – 180°
- H- Hold Open Arm: 90° – 160°

Wall Clearance Requirement

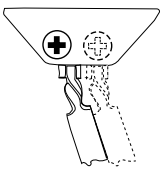


Adjustable Closing Force

- Interior doors to 5'0" wide
- Exterior doors to 4'0" wide
- Shipped factory preset for 3'0" door
- Factory pre-sized upon request

Arm Leverage Adjustment

Closers using "O" arms have the provision to increase closing power by 15% by adjusting foot pivot



Arms and Accessories for Standard Applications

351 Series Powerglide®

SARGENT
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O - Standard Arm

- Forged Steel Main Arm
- Non-handed
- Permits 120° door opening with standard mounting
- Permits 180° door opening with alternate mounting or corner bracket
- Can be used with the 351L retrofit plate when replacing a LCN 4040 closer

Order as 25-O x finish for arm only
Includes: 63-2607 - Main arm
63-2216 - Foot assembly
63-3684 - Screw pack

H - Hold Open Arm

- Forged Steel Main Arm
- Non-handed
- Hand is changed by inverting the foot assembly
- Friction type holder easily adjusted by a wrench
- Permits 180° door opening
- Holds open from 80° – 180°

Order as 25-H x finish for arm only
Includes: 63-2229 - Main arm
61-2303 - Foot assembly
63-3684 - Screw pack

O8 - Mortise Foot Arm

- Forged Steel Main Arm
- Non-handed
- Permits 120° door opening
- Commonly used with bull nose frames

Order as 25-O8 x finish for arm only
Includes: 63-2607 - Main arm and link assembly
63-2273 - Foot assembly
63-2391 & 63-3684 - Screw packs

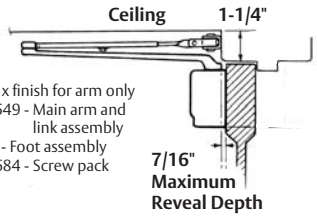
H8 - Mortise Foot Hold Open Arm

- Forged Steel Main Arm
- Handed same as door
- Friction type holder easily adjusted by a wrench
- Holds open from 80° – 180°

Order 25 R-H8 for right hand and 25 L-H8 for left hand x finish for arm only
Includes: 63-2289 - Left hand foot assembly
63-2290 - Right hand foot assembly
63-2229 - Main Arm and Link Assembly
63-2391 & 63-3684 - Screw packs

OLC - Standard Arm for Low Ceiling

- Forged Steel Main Arm
- Non-handed
- 1-1/4" between the top of door to ceiling is required for OLC Arm
- Permits 120° door opening with standard mounting



Order as 25-OLC x finish for arm only
Includes: 63-2549 - Main arm and link assembly
2216 - Foot assembly
63-3684 - Screw pack

UH Package

- Universal hold open arm package provides brackets and arms to install closer in top jamb, standard or parallel applications
- Order closer as 351-UH x finish
- 351-UH not available with (MC) metal cover or plated finishes

Screw packs
63-3684

125-PH9

UO Package

- Universal arm package provides brackets and arms to install closer in standard top jamb or parallel applications
- Order closer as 351-UO x finish
- 351-UO not available with (MC) metal cover or plated finishes

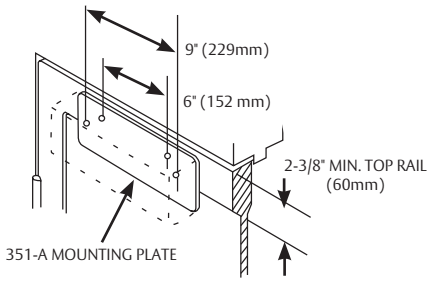
Screw packs
63-3684 &
63-2391

125-P9

351-A Mounting Plate

Allows the mounting of a 351 Closer onto a door with a minimum top rail of 2-3/8"

Order as: 351-A x finish



351- LCN Retrofit Plate

Allows an LCN 4040 closer body to be replaced with a SARGENT 351 with an O Arm without drilling new holes in door (NOTE: New holes required for arm bracket only)

Order as: 351L x finish

Top Jamb Applications

351 Series Powerglide®

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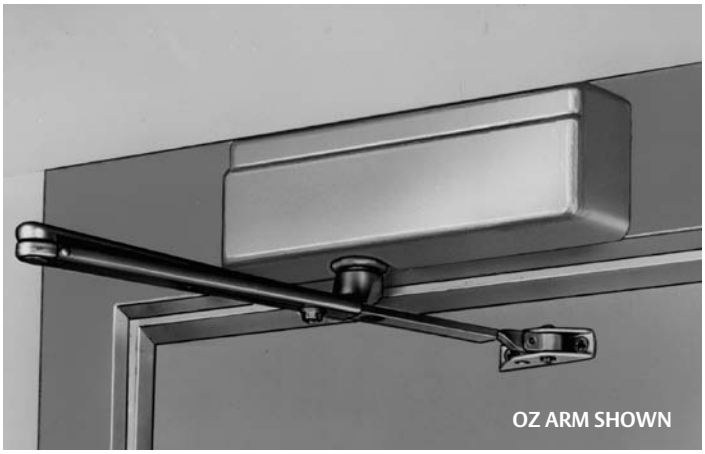
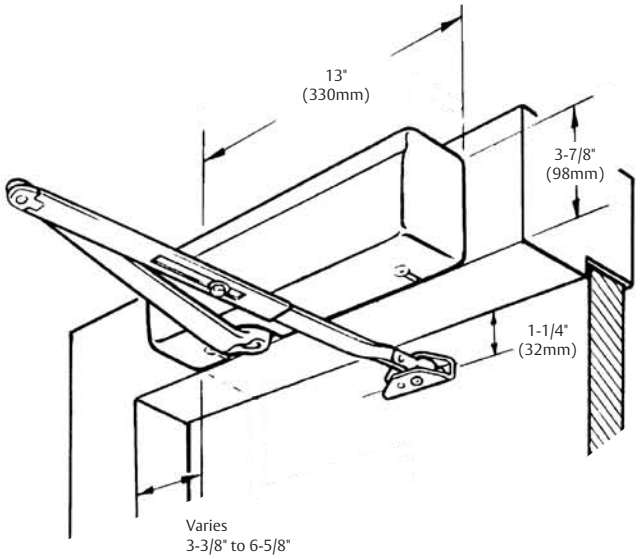


351-0 Top Jamb Mounting Position



Top Jamb applications - The 351 closer is mounted on the frame face above the door. The foot is mounted on the push side of door. This application is for use on exterior doors opening out to protect the closer from the weather.

Minimum Frame Face Required

- 3-7/8" minimum required for 351 Top Jamb applications for both single and double rabbeted frames

Minimum Door Top Rail Required to Mount Closer Foot

- 2" (51mm) minimum
- Rail height used will vary depending on type and make of auxiliary holder

Adjustable Closing Force

- Interior doors to 5'0" wide
- Exterior doors to 4'0" wide
- Shipped factory preset for 3'0" door
- Factory pre-sized upon request

351 Typical Reveal Top Jamb Applications

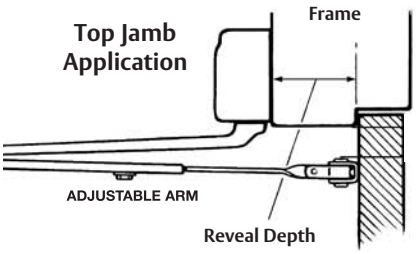
For reveals up to 2" (51mm) maximum

- O Arm - Max. Door Opening: 180°
- H Arm - Hold Open Range: 80° – 180°

351 Extra Deep Reveal Top Jamb Applications

For reveals from 5-1/8" (130mm) to 8" (230mm)

- OZA Arm - Max. Door Opening: 140°
- HZA Arm - Hold Open Range: 80° – 130°



351 Deep Reveal Top Jamb Applications

For reveals from 2-1/8" (54mm) to 5" (127mm)

- OZ Arm - Max. Door Opening: 140°
- HZ Arm - Hold Open Range: 80° – 140°

351-A & 351-B Mounting Plates

These Mounting Plates permits closers to be mounted for special applications when overhead auxiliary door holders are used or in low ceiling applications for both single and double rabbeted frames.

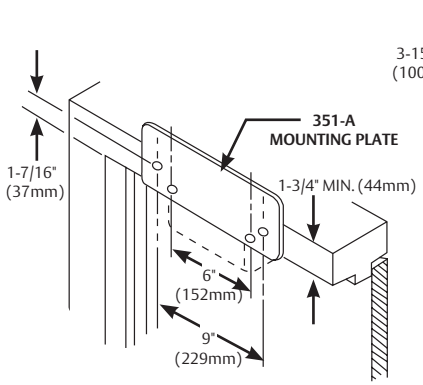
351-A Mounting Plate

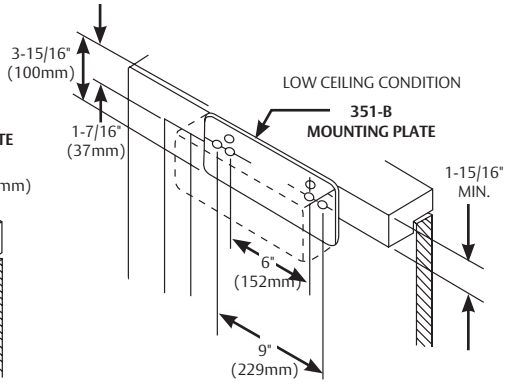
The 351-A allows top jamb mounting of a 351 with a 1-3/4" minimum frame clearance.

351-B Mounting Plate

The 351-B for low ceiling applications allows top jamb mounting of a 351 with a minimum 1-15/16" frame.

- Plates are painted or plated steel to match closer
- Plates are non-handed
- Order as 351-A x finish or 351-B x finish





Arms for Top Jamb Applications

351 Series Powerglide®

SARGENT
ASSA ABLOY

Narrow Reveal

O - Standard Arm

- Forged Steel Main Arm
- For reveals up to 2" (51mm)
- Non-handed
- Permits 180° door opening

Order as 25-O x finish for arm only
Includes: 63-2607 - Main arm assembly
63-2216 - Foot assembly
63-3684 - Screw pack

H - Hold Open Arm

- Forged Steel Main Arm
- For reveals up to 2" (51mm)
- Adjustable friction holder
- Non-handed
- Permits 180° door opening

Order as 25-H x finish for arm only
Includes: 63-2229 - Main arm assembly
61-2303 - Foot assembly
63-3684 - Screw pack

Deep Reveal Arms

OZ - Standard Arm for Deep Reveals

- Forged Steel Main Arm
- For reveals from 2-1/8" (54mm) to 5" (127mm)
- Non-handed
- Permits 140° door opening

Order as 25-OZ x finish for arm only
Includes: 63-2607 - Main arm assembly
63-2217 - Foot assembly
63-3684 - Screw pack

HZ - Hold Open Arm for Deep Reveals

- Forged Steel Main Arm
- For reveals from 2-1/8" (54mm) to 5" (127mm)
- Adjustable friction holder
- Non-handed
- Permits 140° door opening

Order as 25-HZ x finish for arm only
Includes: 63-2230 - Main arm assembly
61-2303 - Foot assembly
63-3684 - Screw pack

Extra Deep Reveal Arms

OZA - Standard Arm for Extra Deep Reveal

- Forged Steel Main Arm
- For reveals 5-1/8" (130mm) to 8" (203mm)
- Non-handed
- Permits 140° door opening

Order as 25-OZA x finish for arm only
Includes: 63-2607 - Main arm assembly
63-2218 - Foot assembly
63-3684 - Screw pack

HZA - Hold Open Arm for Extra Deep Reveal

- Forged Steel Main Arm
- For reveals 5-1/8" (130mm) to 8" (203mm)
- Adjustable friction holder
- Non-handed
- Permits 140° door opening

Order as 25-HZA x finish for arm only
Includes: 63-2231 - Main arm assembly
61-2303 - Foot assembly
63-3684 - Screw pack

Parallel Arm Applications

351 Series Powerglide®

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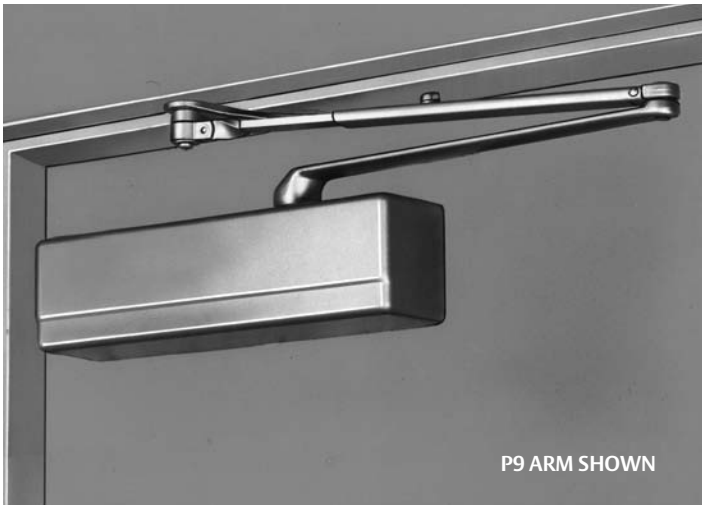
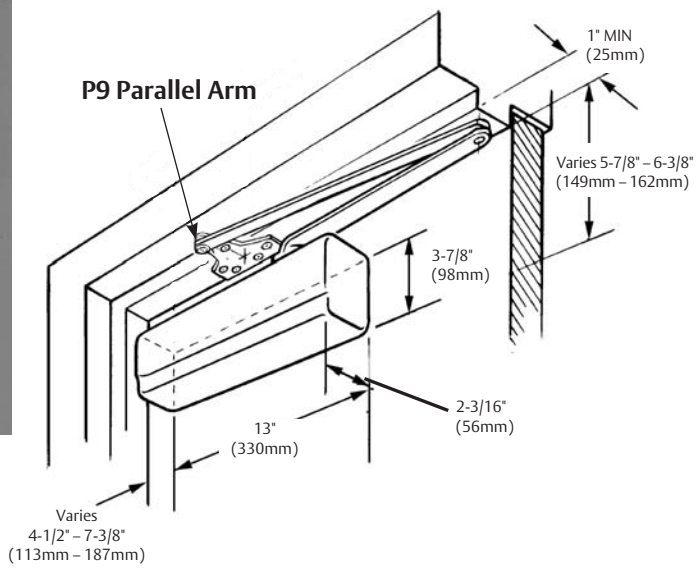


Parallel Arm Applications - The 351 closer is mounted on the push side of the door. As the door opens, the closer swings with the door and gives full headroom in the door opening. Other advantages: the closer arm does not project into the room; the frame can be quite narrow and the door can be swung open much farther than in Top Jamb Applications.

351-P9 Regular Duty Parallel Arm



Heavy Duty Parallel Arms

For use in high traffic and abusive environments

- Forged steel arm and cast iron foot bracket for strength and durability
- Oiled bronze bearings for superior wear resistance
- 2 piece rigid arms for ease of installation
- Friction and positive hold open arms available
- Use friction hold open arms for doors subject to moderate hold open use
- Dead stop and compression stop arms available
- Security non-hold open arms available

Non hold-open arms

- Two mounting positions for 120° and 180° maximum door openings

Stop arms

- 6 mounting positions with PS or CPS arms to allow stop from 85°–110°

Regular Duty Parallel Arms

Available Arms for institutional installations:

- Regular duty parallel arms
- Offset bracket arms for use with Auxiliary Holders & Stops
- Parallel flush frame arms
- Flush frame arms for use with Auxiliary Holders & Stops
- Flush frame, friction Hold Open Arms

NON HOLD OPEN ARMS

- Two mounting positions for 120° and 180° maximum door opening

HOLD OPEN ARMS

- Friction hold open arms available for doors subject to moderate hold open use
- 6 mounting positions to hold open from 85° – 110° with PSH or CPSH arms

Heavy Duty Parallel Arms

351 Series Powerglide®

SARGENT
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P10 - Heavy Duty Parallel Arm

- Forged Steel Constructions
- Non-Handed
- Easily installed
- Permits 120° opening at standard mounting
- Permits 180° opening at alternate mounting
- Can be used with the 351L retrofit plate when replacing a LCN 4040 closer

Order as 25-P10 x finish for arm only
25-P10 Includes: 63-0641 - Main arm
63-3727 - P10 foot assembly
63-3684 & 63-2392 - Screw packs

PS - Heavy Duty Parallel Arm with Positive Stop

- Forged Steel Constructions
- Handed arm is field-reversible
- Provides built in stop from 85° – 110°
- Permits 110° opening maximum
- Easily installed
- Permits 85° – 110° door opening

Order as 25-PS x finish for arm only
Includes: 63-0641 - Main arm
63-3837 - PS foot assembly
63-3684 & 63-2398 - Screw packs

CPS - Heavy Duty Parallel Arm with Compression Stop

- Forged Steel Constructions
- Provides built in compression stop from 85° – 105°
- Permits 105° opening maximum
- Easily installed
- Handed arm is field-reversible
- Dead stop within 3°

Order as 25-CPS x finish for arm only
Includes: 63-0641 - Main arm
63-3830 - CPS foot assembly
63-0516 - Bumper holder
63-3493 - Bumper
63-3684 & 63-2398 - Screw packs

SP10 Heavy Duty Security Arm

- Same as P10, except factory assembled at arm joint (elbow) to prevent disassembly in SSP package along with metal cover

PH10 - Heavy Duty Friction Hold Open Parallel Arm

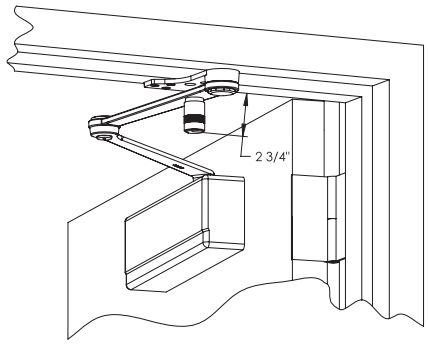
- Forged Steel Constructions
- Adjustable hold open from 75° – 180°
- Forged steel arm 11-1/4" (286mm) long
- Handed same as door
- Use friction hold open arms for doors subject to moderate hold open use

Order as 25-PH10 x finish for arm only
25-PH10 Includes: 63-0641 - Main arm
63-3839 - Left hand PH10 foot assembly
63-3840 - Right hand PH10 foot assembly
63-3684 & 63-2392 - Screw packs

PSH - Heavy Duty Parallel Hold Open Arm with Positive Stop

- Forged Steel Constructions
- Provides holder and stop features
- Handed arm is field-reversible
- Easily installed/adjusted
- Permits 85° – 110° door opening

Order as 25-PSH x finish for arm only
Includes: 63-0641 - Main arm
63-3833 - PSH foot assembly
63-3684, 63-2392 & 63-2398 - Screw packs



The PSH and CPSH arms project 2-3/4" below the head stop

CPSH - Heavy Duty Hold Open Parallel Arm with Compression Stop

- Forged Steel Constructions
- Handed arm is field-reversible
- Provides built in compression stop and holder mechanism from 85° – 105°
- Easily installed/adjusted
- Permits 105° opening maximum
- Dead stop within 3°

Order as 25-CPSH x finish for arm only
Includes: 63-0641 - Main arm
63-3836 - CPSH foot assembly
63-0516 - Bumper holder
63-3493 - Bumper
63-3684, 63-2392 & 63-3487 - Screw packs

Positive Stop Hold Open Arms (PSH & CPSH ARMS)

- Use on doors subject to repetitive hold open use
- 6 hold open positions from 85° – 110° determined by mounting position
- Hold open function may be disengaged
- Hold open tension is easily adjustable

Regular Duty Parallel Arms

351 Series Powerglide®

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ASSA ABLOY

Standard Arms

P9 - Standard Parallel Arm

- Forged Steel Main Arm
- Non-handed
- Can be used with the 351L retrofit plate when replacing a LCN 4040 closer

Order as 25-P9 x finish for arm only
Includes: 63-2607 - Main arm
63-3405 -Foot assembly
63-3684 & 63-2391 - Screw packs

Regular Duty Hold Open Arms

PH9 - Friction Hold Open Arm

- Forged Steel Main Arm
- Holds open from 75° – 180°
- Easily adjusted by wrench
- Non-handed

Order as 25-PH9 x finish for arm only
Includes: 63-2229 - Main arm
61-2303 - Foot assembly
64-0039 - Foot bracket (125 PH9)
63-3684 & 63-2391 - Screw packs

PH4 - Flush Frame, Friction Hold Open Arm

- Forged Steel Main Arm
- Holds open from 75° – 180°
- Easily adjusted by wrench
- Non-handed
- Use on frames where stop or soffit is too narrow to mount the standard hold open foot bracket

Order as 25-PH4 x finish for arm only
Includes: 63-2229 - Main arm
61-2303 - Foot assembly
64-0050 - Foot bracket
63-3684 & 63-2391 - Screw packs

Offset Brackets for use with overhead stops, holders and door coordinators

P3 - 1" Offset Bracket for use with Auxiliary Holder/Stop

- Forged Steel Main Arm
- For use with auxiliary surface overhead stops and holders
- Foot bracket is offset 1" more than P-9, allowing door closer to be lowered on door face
- Non-handed

Order as 25-P3 x finish for arm only
Includes: 63-2607 - Main arm
63-2270 - Foot assembly
63-3684 & 63-2391 - Screw packs

P3A - 1-3/4" Offset Bracket for use with Auxiliary Holder/Stop

- Forged Steel Main Arm
- For use with auxiliary surface overhead stops and holders and door coordinators
- Foot bracket lowers door closer an additional 3/4" below P3 bracket
- Non-handed

Order as 25-P3A x finish for arm only
Includes: 63-2607 -Main arm
63-2274 - Foot assembly
63-3684 & 63-2391 - Screw packs

P4 - Parallel Flush Frame Arm

- Forged Steel Main Arm
- Foot bracket is attached to frame or transom face
- For use where stop or soffit is too narrow for the standard P9
- Permits 120° opening with standard mounting
- Permits 180° opening with alternate mounting
- Non-handed

Order as 25-P4 x finish for arm only
Includes: 63-2607 - Main arm
63-2295 - Foot assembly
63-3684 & 63-2391 - Screw pack

P4A - Flush Frame Arm for use with Auxiliary Holder/Stop

- Forged Steel Main Arm
- For use with auxiliary surface overhead stops and holders
- Foot bracket is attached to frame or transom face
- Foot bracket lowers door closer an additional 3/4" below P4 bracket
- Non-handed

Order as 25-P4A x finish for arm only
Includes: 63-2607 - Main arm
63-2272 - Foot assembly
63-3684 & 63-2391 - Screw packs

Tri-Packs

UO Package

- Universal arm package provides arms and brackets to install closer in standard top jamb or parallel application

351-UO not available with (MC) metal cover or plated finishes

Screw pack 63-3684

125-P9

UH Package

- Universal hold open arm package provides brackets and arms to install closer in top jamb, standard or parallel applications

351-UH not available with (MC) metal cover or plated finishes

Screw pack 63-3684

125-PH9

Heavy Duty Parallel Arm Accessories

581-2 Blade Stop Spacer Kit

- For frames with 1/2" blade stops
- For use with P10, PH10, PS, PSH, CPS and CPSH arms
- 125-V bracket included
- Packed with 1-1/4" long screws

Use P/N 63-0756 to order blade stop only

125-V/125-VF Brackets

125-V

125-VF

- For use with all heavy duty parallel arms
- Use 125-V for narrow stop and frame conditions
- Use 125-VF for flush door and frame conditions

Spacer 63-0191

- 1/2" x 5/8"
- Included standard with PS, PSH, PH10, P-10 CPS and CPSH arm for use with rabbited frames

Regular Duty Parallel Arm Accessories

125-P3 Arm Conversion Unit

- Converts O or P9 arm to P3 Parallel Arm

125-P3A Arm Conversion Unit

- Converts O or P9 Arm to P3A Parallel Arm

125-PH9 Parallel Arm Foot

- Converts standard hold open (H) arm to PH9 Parallel Hold Open Arm

125-P4 Conversion Unit

- Converts O or P9 Arm to P4A Arm

125-P4A Arm Conversion Unit

- Converts O or P9 arm to P4A Arm

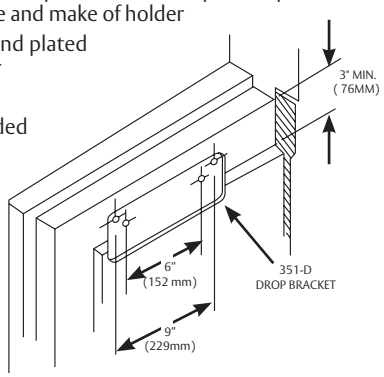
581-1 Blade Stop Spacer Kit

- For frames with 1/2" blade stops
- For use with P9, PH9 and PF9 arms only
- Packed with 1-1/4" long screws

Regular Duty Parallel Arm Accessories

351-D Drop Plate

- Permits mounting parallel arm 351 Series Closer applications on doors with narrow top rails
- Requires 3" (76mm) minimum top rail
- For closers used with overhead stops and holders, top rail requirements will vary depending upon type and make of holder
- Available with powder coat and plated finishes to match door closer
- Plates are not handed
- Plate mounting screws included
- Order as 351-D x finish



351L - LCN RETROFIT Plate

The 351L allows replacement of LCN 4040 closer body with a SARGENT 351 without drilling new holes in door (**Note:** New mounting holes required for arm bracket only)

- 351L Retrofit Plate:
  Can be used with these parallel arms
  - P9 – Regular Duty Parallel Arm
  - P10 – Heavy Duty Parallel Arm
- Plates are non-handed
- Available in powder coat and plated finishes
- Order as: 351L x finish

Track Type Applications

351 Series Powerglide®

SARGENT
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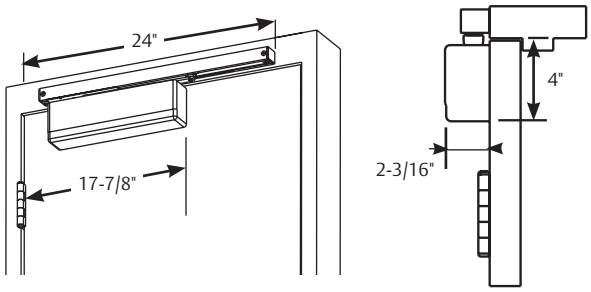
Pull Side Mounting (Hinge Side)

The closer is for use on interior doors opening in or out. As the door opens, the closer swings with the door. This affords a variable hold-open feature option.

Pull Side Track Application

Arm & Track	Description
OT	Pull Standard pull side
OTB	Pull Track with bumper
HT	Pull Holder
HTB	Pull Holder with bumper

Track Arm Applications



Pull Hinge Side Mounting (Track mounts on frame face)

- Minimum top rail required with a 351-A plate = 2-1/4" (57mm)
- Minimum top rail required without mounting plate = 4" (102mm)

Maximum Door Opening

- 160° with standard track
- 120° with optional bumper track
- 180° with standard track if frame conditions permit

Hold Open Range

- 85° – 120°

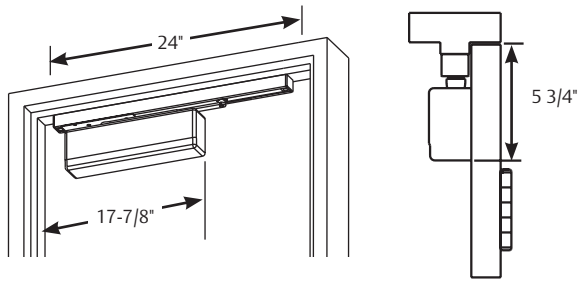
Push Side Mounting (Stop Side)

The closer is for use on interior doors opening in or out. As the door opens, the closer swings with the door. This affords a variable hold-open feature option.

Push Side Track Application

Arm & Track	Description
POT	Push Standard
POTB	Push Bumper
PHT	Push Holder
PHTB	Push Holder and bumper

Track Arm Applications



Push Stop Side Mounting (Track mounts on frame stop)

- Minimum top rail required without drop plate = 5-3/4" (146mm)
- 3" (76mm) minimum top rail required with 351-D Drop Plate

Minimum Stop Required

- 1-9/16" (40mm) wide

Maximum Door Opening

- 100° with standard track
- 95° with optional bumper track

Hold Open Range

- 85° – 95°

Common Features

Standard Finishes

- EAB, EB, ED, EN, EP, powder coated on all exposed surfaces
- Architectural plated arms and covers optional

Track

- Extruded aluminum track

Arm

- Forged steel

Bumper (optional)

- Mounts in track to assist backcheck
- Not designed to be used as a stop
- Auxiliary stop is required
- Available for both regular or hold open tracks

Holder (optional)

- Mounts within the track (adjustable)

Non Sized-Adjustable

- Interior doors to 5'0" wide
- Shipped factory preset for 3'0" door
- Factory pre-sized upon request

Double Egress Applications

351 Series Powerglide®

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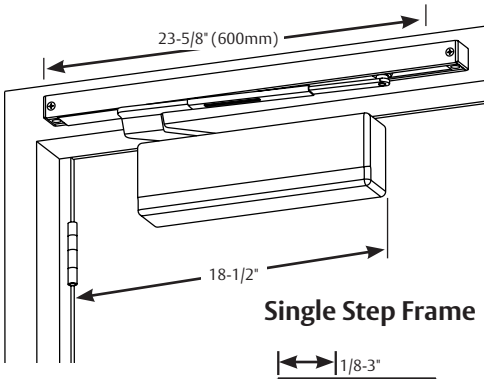
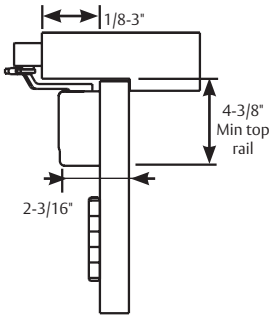
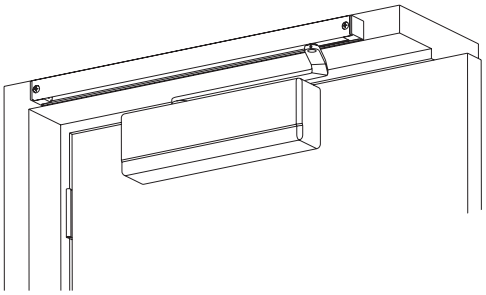
ODS - Single Step Double Egress Arm



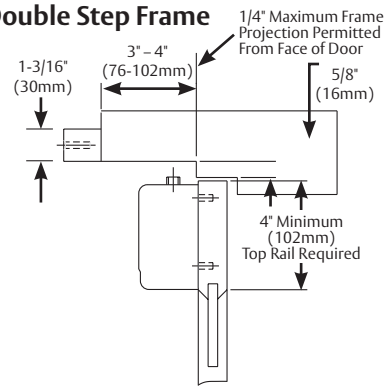
Single Step Frame



OD - Double Step Double Egress Arm



Double Step Frame



ODS Applications

- 160° maximum door opening
- 120° opening with bumper option
- Range of hold open 85°–120°
- Used with reveals 1/8" – 3" (3mm-76mm)

Track

- Extruded aluminum track
- End caps finished to match track

Arm

- Forged steel
- Bearing roller
- Arm handed same as door

Non Handed

- Universal body

Finishes (Powder Coat)

- EAB, EB, ED, EN, EP (standard for all exposed surfaces)

Bumper (optional)

- Mounts in track to assist backcheck
- Not designed to be used as a stop
- Auxiliary stop is required
- Available for both regular or hold open tracks

Holder (optional)

- Mounts within the track (adjustable)

Non Sized-Adjustable

- Interior doors to 5'0" wide
- Shipped factory preset for 3'0" door
- Factory pre-sized upon request

Double egress track arms are used when the aesthetics of a track application is required on the pull side of a deep reveal frame.

This application is commonly used on cross corridor openings.

Double Egress Track Applications

OD	Double step double egress
ODB	Double step double egress with bumper
HD	Double step double egress with holder
HDB	Double step double egress with bumper and holder
ODS	Single step double egress
ODSB	Single step double egress with bumper
HDS	Single step double egress with holder
HDSB	Single step double egress with bumper and holder

OD Applications

- 160° maximum door opening
- 120° opening with bumper option
- Range of hold open: 85° – 120°
- Used with reveals 3" – 4" (76mm-101mm)

Track

- Extruded aluminum track
- End caps finished to match track

Arm

- Forged steel
- Bearing roller
- Arm is handed same as door

Non Handed

- Universal Body

Finishes (Powder Coat)

- EAB, EB, ED, EN, EP (standard for all exposed surfaces)

Bumper (optional)

- Mounts in track to assist backcheck
- Not designed to be used as a stop
- Auxiliary stop is required
- Available for both regular or hold open tracks

Holder (optional)

- Mounts within the track (adjustable)

Non Sized-Adjustable

- Interior doors to 5'0" wide
- Shipped factory preset for 3'0" door
- Factory pre-sized upon request

Pocket Door Applications

351 Series Powerglide®

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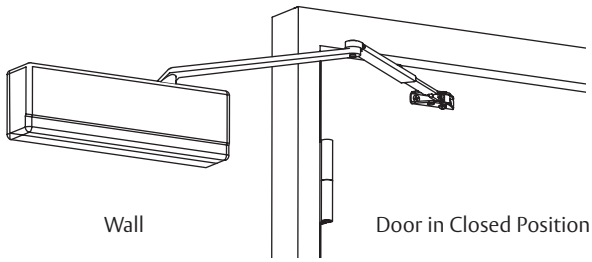
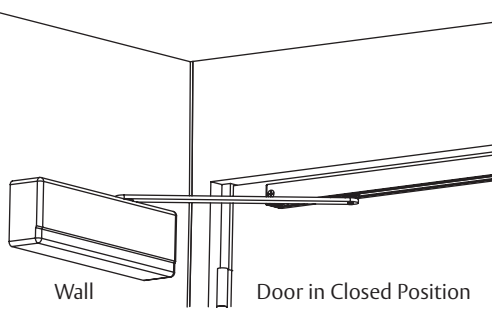
OP - Double Lever Arm Application



OTP - Track Type Application



Pocket Door Applications

The 351 Series Powerglide Door Closer body is mounted on the wall and installed so that it pushes the door closed. This application is typically used with fire doors that are held open. In this application when the door is open, the closer and arms are completely hidden from view.

OP - Pocket Arm Application

- 180° Maximum Opening
- Non handed

Note: 90° Maximum Opening, use OTP Track Type

Arm

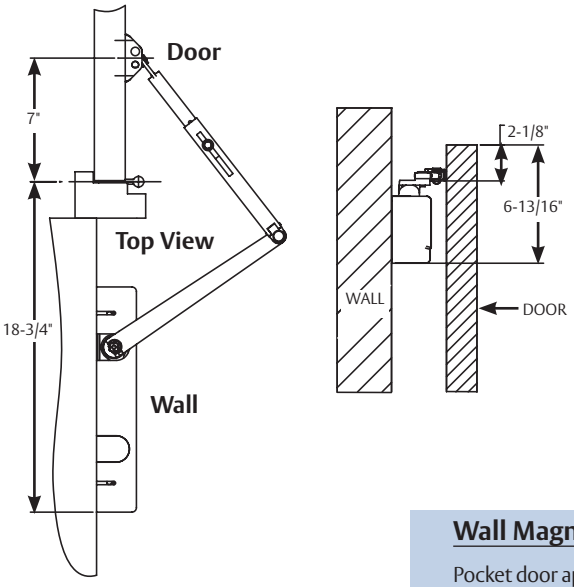
- Forged steel

Non Handed

- Universal Body

Finishes (Powder Coat)

- EAB, EB, ED, EN, EP (standard for all exposed surfaces)
- Plated Covers and arms available



OTP - Track Type Application

- 90° Maximum Opening
- Extruded Aluminum Track
- Non handed

Arm

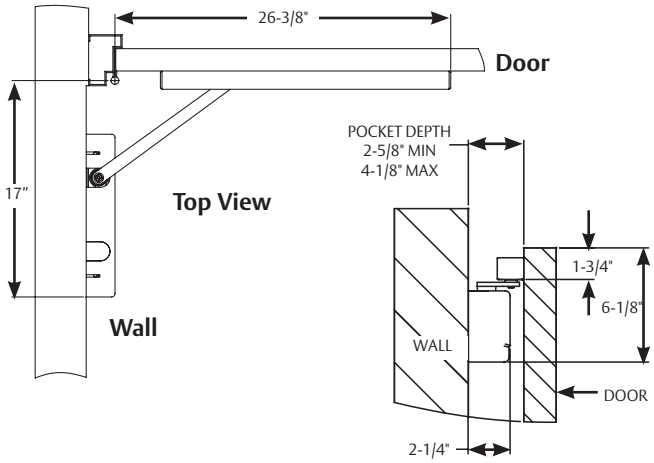
- Forged steel
- Bearing roller

Non Handed

- Universal Body

Finishes (Powder Coat)

- EAB, EB, ED, EN, EP (standard for all exposed surfaces)
- Plated Covers and arms available



Wall Magnets - see SARGENT holders and stops catalog

Pocket door applications commonly use wall mounts (wall magnets).

1560 Surface Mount

1561 Flush Mount

How to Order, Options and Finishes

351 Series Powerglide®

SARGENT
ASSA ABLOY

Packing

All closer assemblies are packaged 4 per carton. On request, door closers will be packed 2 per carton.

Series	Number per Carton	Approx. wt per Carton
351	4-Standard (2 upon request)	19 lbs. per 4

How To Order

CPC-DA	351	P4H	26	LH
Options	**Series**	**Closer Arm**	**Finish**	**Hand**
31- 36- 74- CPC- DA- MC- SG- SRI- TB-	351	Standard Page 7 Top Jamb Page 9 Parallel Pages 11 & 12 Track Type Page 14 & 15	EB ED EN EP EAB 03* 04* 09* 10* 10B* 10BE 10BL* 14* 15* 20D* 26* 26D* BSP	LH RH

* These finishes are automatically provided with a metal cover

Options Available

Specify	Detailed Description
31-	For doors 1-7/8" – 2-1/4" thick, specify door thickness, doors over 2-1/4" thick contact factory
36-	Security Torx Screws
74-	Lead lined cover
CPC-	Clear Powder Coat (available on 26 & 26D)
DA-	Delayed Action
MC-	Handed Metal Cover
SRI-	Special Rust Inhibitor finish for powder coated finishes only (arm)
TB-	Through Bolt (1-3/4" Std) For others, specify 31-TB- & door thickness

Note:

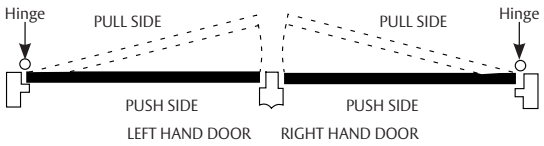
- The MC- option is used when a metal cover is desired on a powder coated finish
- When MC- is added to a plated finish, the MC- option indicates that only the cover is to be plated, the arms will be powder coated to match
- Do not specify the MC suffix if both the cover and arms are to be plated

How To Order Accessories

Accessories	Example	
Arm Only	Specify arm required and finish	25-PSH EN
Closer Body Only	Specify: CB-351*	CB-351
Arm conversion Units	Specify unit and finish	125-P4 EB
Cover Only (Standard)	351-C x finish	351-C EN
Cover Only (Metal)	351-CMC x finish and hand & arm type	351-CMC + 26D + LH + P10

Note: When complete closer assembly is ordered with an accessory, order accessory as a separate item

*DA (Delay Action) option is available with closer body

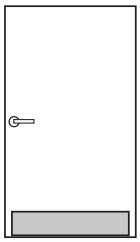


Finishes

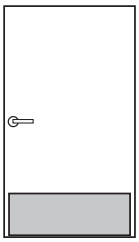
Finishes	ANSI/BHMA	Description
EB	695	Bronze powder coated to match finish 10B
EN	689	Aluminum powder coated
ED	693	Black powder coated to match finish 20D
EAB	696	Brass powder coated
EP	691	Bronze powder coated to match finish 10
03	605	Bright brass, clear coated
04	606	Satin brass, clear coated
09	611	Bright bronze, clear coated
10	612	Satin bronze, clear coated
10B	613	Dark oxidized satin bronze, oil rubbed
10BE	613E	Dark oxidized satin bronze - equivalent
10BL	614	Oxidized satin, bronze, clear coated
14	618	Bright nickel plated, clear coated
15	619	Satin nickel, clear coated
20D	624	Statuary dark bronze, clear coated
26	625	Bright chromium plated
26D	626	Satin chromium plated
BSP	—	Black Suede Powder Coat

Special Rust Inhibitor Process (SRI)

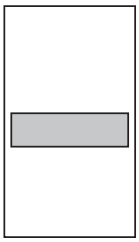
Additional process available for bracket and arms provides an extra layer of protection for extreme corrosive environments. Available with powder coated finishes only, specify SRI- as an option when ordering.



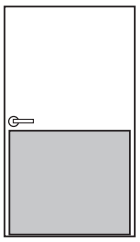
Mop Plate
Up to 6" h x 48" w



Kick Plate
6" to 12" h x 48" w



Stretcher Plate
6" to 12" h and up to 48" w



Armor Plate
Up to 48" h x 48" w and available in most finishes

OPTIONAL Self-Drilling TEK Screws: Cuts door plate installation time in half.

Width of Plates:
Push Side: 2" less than door width.
Pull Side: 1 1/2" less than door width.

NFPA 80 STANDARDS — 2-4.5 Protection Plates: Factory-installed protection plates shall be installed in accordance with the listing of the door. Field-installed protection plates shall be labeled and installed in accordance with their listing.

Exception: Labeling is not required where the top of the protection plate is not more than 16" (406 mm) above the bottom of the door.

Metal Door Plate – Economy Duty No. K1038

Material: .038" aluminum, stainless steel
Finishes: US32D
Fastener: #6 x 5/8" OH SMS
Ordering: Specify height x width x finish code. Add any options
Weight: 8" x 34" = 3.2 lbs
Options:
- SA – self-adhesive mounting
- TORX – security Torx screws
- TEK – self-drilling screws
- Cutouts for locks, louvers, or windows (see worksheets on pages C14-C15 for details on how to order)

Metal Door Plate - Standard Duty No. K1050

Material: .050" Stainless Steel
Finishes: US32D
Fastener: #6 x 5/8" OH SMS
Ordering:

Size	High	Width
8x34BEV.32D	8"	34"
10x34BEV.32D	10"	34"
34x34BEV.32D	34"	34"

Options:
- Beveled Edge and Counter Sink included
- One day shipping available
- Door markings are not available on quick ship

Metal Door Plate – Standard Duty No. K1050, K1050F

Material: .050" aluminum, brass, bronze, stainless steel
Finishes: US10BE, US32D, US32DMS
Fastener: #6 x 5/8" OH SMS
Ordering: Specify height x width x finish code. Add any options
Weight: 8" x 34" = 4.0 lbs
ANSI: J101 - metal armor plate, J102 - metal kick plate, J103 - metal stretcher & mop plate

Options:
- SA – self-adhesive mounting
- TEK – self-drilling screws
- Beveled 3 or 4 edges, specify B3E or B4E
- Cutouts for locks, louvers, or windows (see worksheets on pages C14-C15 for details on how to order)
- Heavy bevel available, specify HVBEV
- Screw mounting (K1050F) and UL listed for use on 90-minute label wood doors and 3-hour label metal doors
- CSK – countersunk holes
- TORX – security Torx screws

Windstorm Plate – K1050WS

Material: 050" Aluminium, Brass, Bronze, Stainless Steel
Finishes: Standard Architectural Finishes
Fastener: #10x5/8" Pan Head Tek Screws
Ordering: Part # when ordering is K1050WS
All plates are UL and Windstorm rated

Options:
- Cutouts for locks, louvers or windows
- Rounded Corners
- Heavy Bevel
- Screw Mount only

Certified to the below standards:
- ICC-500 (2014)
- FEMA Guideline 320 (2014)
- FEMA Guideline 361 (2015)

Part of windstorm assembly cards: ZHLA.45, ZHLA.46, ZHLA.47, ZHLA.51, ZHLA.53, ZHLA.54

Solid Cast Wall Stops No. 400, 401, 402

Material: Cast brass with DuraFlex bumper

Finishes: Available in standard architectural finishes (see page 9)

Features: Concealed mounting, convex bumper. Back plate prevents damage to wall

No.	Bumper	Fastener	Size	Projection	Weight	ANSI A156.16
400	Convex	#6 x 1 1/2" FH SMS, plastic toggle	2 7/16" dia.	1"	3.3 lbs./10	L02101
401	Convex	#8 x 1" RH WS, plastic anchor	2 7/16" dia.	1"	3.3 lbs./10	L02101
402	Convex	#8 - 32 x 1" TH MS, lead anchor	2 7/16" dia.	1"	3.3 lbs./10	L02101

Solid Cast Wall Stops No. 403, 404, 405

Material: Cast brass with DuraFlex bumper

Finishes: Available in standard architectural finishes (see page 9)

Features: Concealed mounting, concave bumper. Back plate prevents damage to wall

No.	Bumper	Fastener	Size	Projection	Weight	ANSI A156.16
403	Concave	#6 - 1 1/2" FH SMS, plastic toggle	2 7/16" dia.	1"	3.3 lbs./10	L02251
404	Concave	#8 x 1" RH WS, plastic anchor	2 7/16" dia.	1"	3.3 lbs./10	L02251
405	Concave	#8 - 32 x 1" TH MS, lead anchor	2 7/16" dia.	1"	3.3 lbs./10	L02251

Wrought Wall Stops No. 406

Material: Wrought brass, bronze, and stainless steel with DuraFlex bumper

Finishes: Available in standard architectural finishes (see page 9)

Features:
- Concealed mounting, convex bumper. Back plate prevents damage to wall
- Accepted by the New York State Office of Mental Health (OMH) for use in high risk areas

No.	Bumper	Fastener	Size	Projection	Weight	ANSI A156.16
406	Convex	#8 x 1 1/4" TH SMS, plastic toggle	2 1/2" dia.	3/4"	1.8 lbs./10	L02101

Wrought Wall Stops No. 409

Material: Wrought brass, bronze, and stainless steel with DuraFlex bumper

Finishes: Available in standard architectural finishes (see page 9)

Features:
- Concealed mounting, concave bumper. Back plate prevents damage to wall
- Accepted by the New York State Office of Mental Health (OMH) for use in high risk area

Options: DuraFlex bumper available in standard gray or optional black

No.	Bumper	Fastener	Size	Projection	Weight	ANSI A156.16
409	Concave	#8 x 1 1/4" TH SMS, plastic toggle	2 1/2" dia.	3/4"	1.8 lbs./10	L02251

Heavy Duty Door Stop No. 466

Material: Flame resistant molded rubber bumper

Finishes: Black

Mounting: Drill 1" dia. x 2 1/2" deep hole, fill with anchoring grout

Features:
- Ideal for use in high vandalism or security areas
- No exposed fasteners

No.	Diameter	Height	Mounting Bolt	Weight
466	2" dia.	x 1 1/2" h	5/8" x 2 1/2"	0.6 lbs.

Heavy Duty Door Stop No. 467

Material: Flame resistant molded rubber bumper

Finishes: Black

Mounting: Drill 1" dia. x 2 1/2" deep hole, fill with anchoring grout

Features:
- Suitable for concrete floor or wall mounting
- Ideal for use in high vandalism or security areas
- No exposed fasteners
- Accepted by the New York State Office of Mental Health (OMH) for use in high risk areas

No.	Diameter	Height	Mounting Bolt	Weight
467	2" dia.	x 3 1/2" h	5/8" x 2 1/2"	0.9 lbs.

Heavy Duty Door Stop No. 468

Material: Wrought stainless steel and black rubber bumper

Finishes: US32D

Mounting: Drill 1 1/2" dia. x 7" deep hole, fill with anchoring grout

Features:
- Ideal for use in high vandalism or security area
- No exposed fasteners
- Accepted by the New York State Office of Mental Health (OMH) for use in high risk areas

No.	Diameter	Height	Mounting Bolt	Weight
468	2" dia.	x 3" h	1" x 7"	2.6 lbs.

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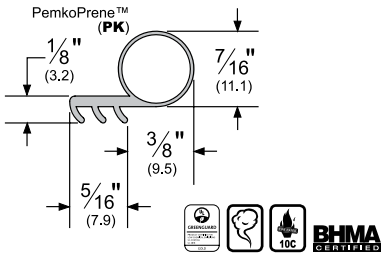
Kerf-In Weatherstrip (Cont.)

PK52_

AVAILABLE FINISHES: **BL, W**
ANSI: **R0G154**
AVAILABLE LENGTHS: **18', 20', 300'**

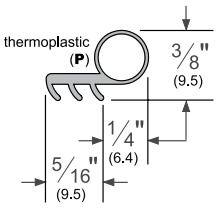
- Minimum space between the door face and the stop is 1/16"; maximum space is 3/8"



P50_

AVAILABLE FINISHES: **BL, W**
AVAILABLE LENGTHS: **17', 25', 250'**

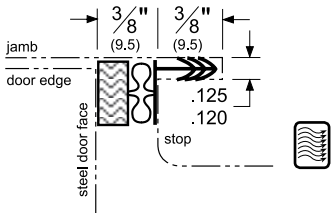
- Minimum space between the door face and the stop is 1/16"; maximum space is 5/16".
- Thermoplastic elastomer formulation will not transmigrate; remains flexible to -60° F



MAG349_

AVAILABLE FINISHES: **D, W**
AVAILABLE LENGTHS: **37", 85", 96", 121"**

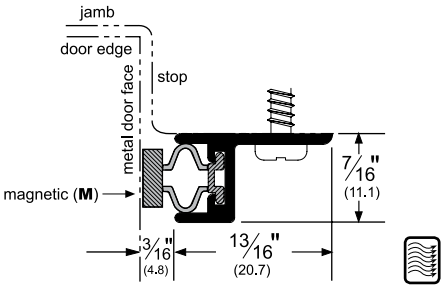
- Minimum space between the door face and the stop is 3/8"; maximum space is 7/16"
- Magnetic kerf-in weatherstrip features a magnetic strip encased by a UV-stable TPE cover
- Use for steel-faced door and wood frame applications
- Can be trimmed in the field and corner-mitered



Magnetic Kerf-In Weatherstrip

2815_M

AVAILABLE FINISHES: **C, D, G**
REPLACEMENT INSERT: **2815MAG**



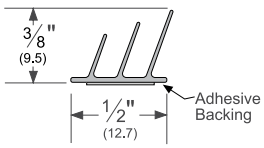
Adhesive Perimeter Gasketing

For more information on these perimeter gasketing products, please see the Adhesive Gasketing section.

S773_

AVAILABLE FINISHES: **BL, D, GR, W**
AVAILABLE LENGTHS: **17', 18', 20', 21', 25', 30', 250', 500'**
ANSI: **R0E154, R0E155**

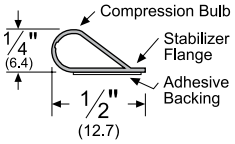
- Triple-fin design blocks light and sound from infiltrating a room
- Product designed as hospitality gasketing (see more hospitality products in the Hospitality Products section)
- Seal begins compressing at 3/8"; compresses to seal up to a 1/16" gap



S88_

AVAILABLE FINISHES: **BL, C, D, GR, TAN, W**
AVAILABLE LENGTHS: **17', 18', 20', 21', 25', 30', 204', 510'**
ANSI: **R0E154, R0E155**

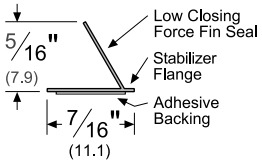
- Seal begins compressing at 1/4"; compresses to seal up to a 1/16" gap
- Available with perforations for Behavioral Health applications. Substitute "P" in place of "S" to order this option.



S44_

AVAILABLE FINISHES: **BL, C, D, GR, W**
AVAILABLE LENGTHS: **17', 18', 20', 21', 25', 30', 204', 510'**
ANSI: **R0E154, R0E155**

- Designed for tighter frames.
- Demonstrates extremely low closing force.
- Seal begins compressing at 5/16"; compresses to seal up to a 1/16" gap
- Available with perforations for Behavioral Health applications. Substitute "P" in place of "S" to order this option.



NOTE: Products shown in this section may not be drawn to scale.
AVAILABLE FINISHES FOR PRODUCTS SHOWN ON THIS PAGE (see General Information section for finish chart)
Adhesive Gasketing Colors: **BL** (Black) **C** (Clear) **D** (Dark Brown) **GR** (Light Gray) **TAN** (Tan) **W** (White)

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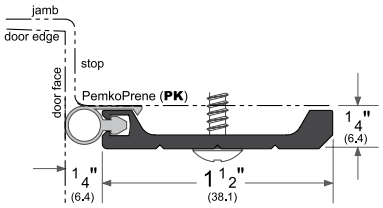
Heavy Duty Perimeter Gasketing - Standard Jamb

- For the head section of the frame where a parallel arm closer bracket or other hardware is required. Supplied undrilled (36") or drilled (80" and above) and supplied with sheet metal screws for mounting
- If used as a stop, flat head machine screws can be provided upon request and take a countersunk #10 hole. PEMKO will drill the head member only if drilling instructions for countersink holes are provided
- All gasketing shown below is sold individually

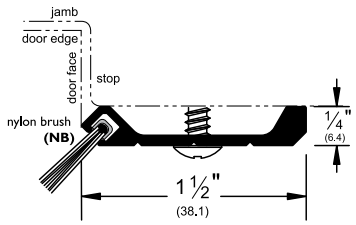
290_PK

AVAILABLE FINISHES: **A, D, G**
REPLACEMENT INSERT: **PK47 (BL, GR)**
ANSI: **R3G164, R3G165**



29045_NB

AVAILABLE FINISHES: **A, D, G**
REPLACEMENT INSERT: **P14050 (BL, GR)**
ANSI: **R3A164, R3A165**



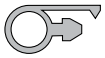
Alternate Inserts For 290

290_S

AVAILABLE FINISHES: **A, D, G**
REPLACEMENT INSERT: **S3 (BL, GR, W)**
ANSI: **R3E164, R3E165**

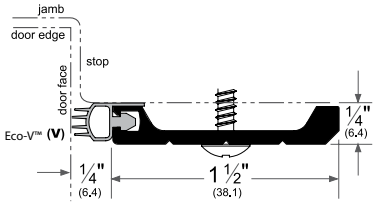
290_V

AVAILABLE FINISHES: **A, D, G**
REPLACEMENT INSERT: **EV47 (BL, GR, W)**



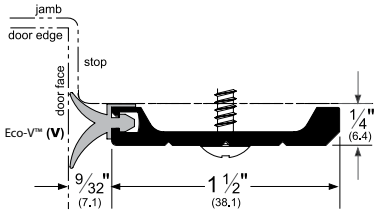
2902_V

AVAILABLE FINISHES: **A, D, G**
REPLACEMENT INSERT: **EV59 (BL, GR, W)**



2903_V

AVAILABLE FINISHES: **A, D, G**
REPLACEMENT INSERT: **EV60 (GR)**

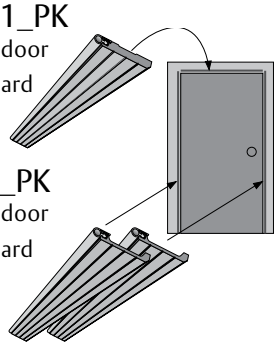


2891_PK

1 per door standard

290_PK

2 per door standard



When ordering a head section such as 2891_PK, two corresponding side sections (i.e. 290_PK) should also be ordered for the latch and hinge sides of the frame.

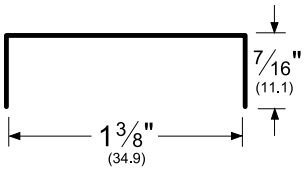
NOTE: Products shown in this section may not be drawn to scale.
AVAILABLE FINISHES FOR PRODUCTS SHOWN ON THIS PAGE (see General Information section for finish chart)
A (Mill Finish Aluminum) **D** (Dark Bronze Anodized) **G** (Gold Anodized)

Door Top Weatherstrip

_343

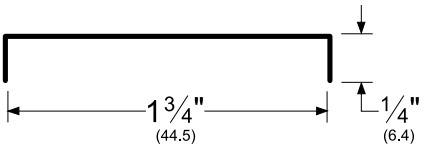
AVAILABLE FINISHES: **PA**
AVAILABLE LENGTHS: **36", 48"**

- For top of 1 3/8" wood doors



_344

AVAILABLE FINISHES: **PA**
AVAILABLE LENGTHS: **36", 48"**



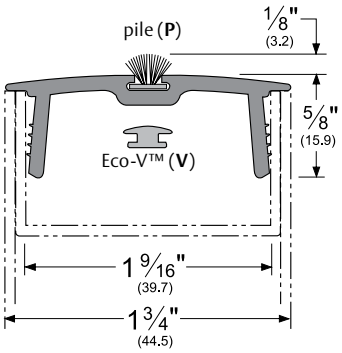
377VP_

REPLACEMENT INSERT: **P2 (BL, GR)**

377V_

REPLACEMENT INSERT: **EV38 (Tan)**

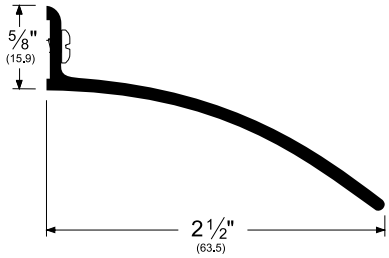
Rigid tan colored Eco-V™ with Eco-V™ (V) insert or pile (P) insert used as a door top (or bottom) filler strip for hollow metal doors



346_

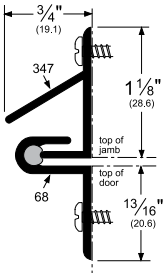
AVAILABLE FINISHES: **C, D, G, PW**

- Overhead rain drip with slotted holes
- Should be ordered a minimum of 4" longer than the door width



347_
68_R

AVAILABLE FINISHES: **A, D, G**



Heavy Duty Door Bumper

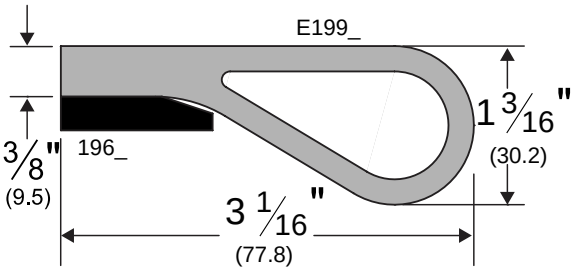
- Heavy duty door bumper extruded from black EPDM (E)
- Order 196_ separately; furnished undrilled unless requested otherwise

E199_

AVAILABLE COLOR: **BL**

196_

AVAILABLE COLOR: **A**



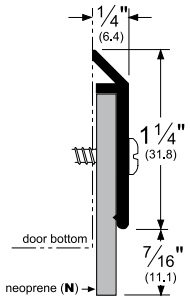
NOTE: Products shown in this section may not be drawn to scale.

AVAILABLE FINISHES FOR PRODUCTS SHOWN ON THIS PAGE (see General Information section for finish chart)
A (Mill Finish Aluminum) **C** (Clear Anodized) **D** (Dark Bronze Anodized) **G** (Gold Anodized) **PA** (Painted Aluminum) **PW** (Painted White)
Non-Metal Finish: **BL** (Black)

Door Bottom Sweeps

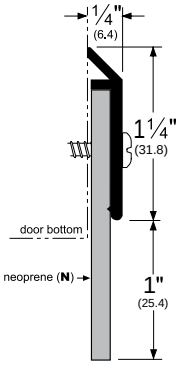
315_N

AVAILABLE FINISHES: **B, C, D, G, PW, SN**
REPLACEMENT INSERT: **N8 (BL, GR)**
ANSI: **R3B434, R3B435**



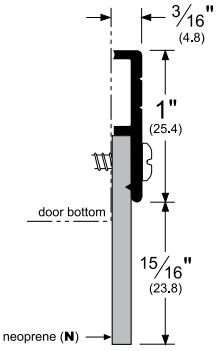
3151_N

AVAILABLE FINISHES: **C, D, G**
REPLACEMENT INSERT: **N9 (BL)**
ANSI: **R3B434**



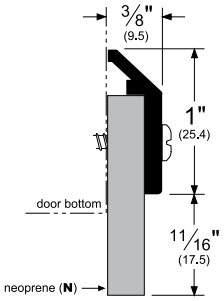
321_N

AVAILABLE FINISHES: **C, D, G**
REPLACEMENT INSERT: **N8 (BL)**
ANSI: **R3B434, R3B435**



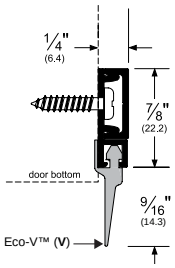
368_N

AVAILABLE FINISHES: **C, D, G**
REPLACEMENT INSERT: **N10 (BL)**
ANSI: **R3B434, R3B435**



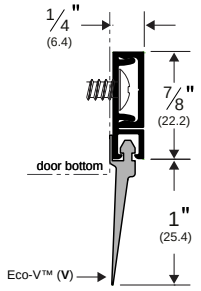
29326_V

AVAILABLE FINISHES: **C, D, G**
REPLACEMENT INSERT: **EV65 (BL, GR, W)**
ANSI: **R3D434**



293100_V

AVAILABLE FINISHES: **C, D, G**
REPLACEMENT INSERT: **EV54 (BL, GR, W)**
ANSI: **R3D434**



NOTE: Products shown in this section may not be drawn to scale.

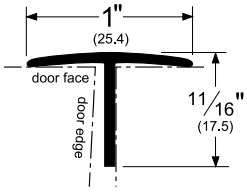
AVAILABLE FINISHES FOR PRODUCTS SHOWN ON THIS PAGE (see General Information section for finish chart)
B (Mill Finish Extruded Bronze [Brass]) **BDG** (Bright Dip Gold Anodized) **C** (Clear Anodized)
D (Dark Bronze Anodized) **G** (Gold Anodized) **PW** (Painted White) **SN** (Satin Nickel Anodized)

"T" and Overlapping Astragals

359_

AVAILABLE FINISHES:
A, BDG, D

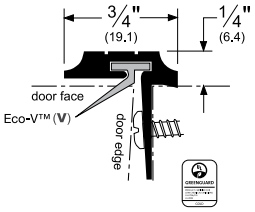
- Supplied with weatherstrip nails for installation



356_V

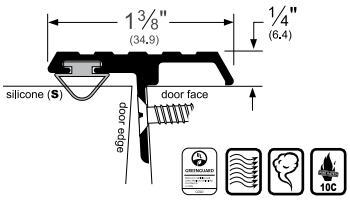
AVAILABLE FINISHES:
A, BDG, D, PW, SN
REPLACEMENT INSERT:
EV17 (BL, GR, W)

- Countersink drilling with countersunk flathead screws also available upon request at no extra charge



355_S

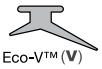
AVAILABLE FINISHES:
B, BDG, C, D, G, PW, SN
REPLACEMENT INSERT:
S4 (BL, GR)



Alternate Inserts For 355

355_V

AVAILABLE FINISHES:
B, BDG, C, D, G, PW, SN
REPLACEMENT INSERT:
EV7 (BL, GR, W)



355_P

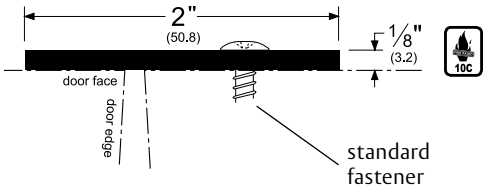
AVAILABLE FINISHES:
B, BDG, C, D, G, PW, SN
REPLACEMENT INSERT:
P2 (BL, GR)

357_
357_ND

AVAILABLE FINISHES:
C, D, G, SP, SS (#4 Finish & #4 Edge)

11 GAUGE

- "ND" denotes "no drill" (unless specified "ND", astragals are drilled)
- Standard fastener is #10 x 1" Truss Head SMS
- Lead-line option available

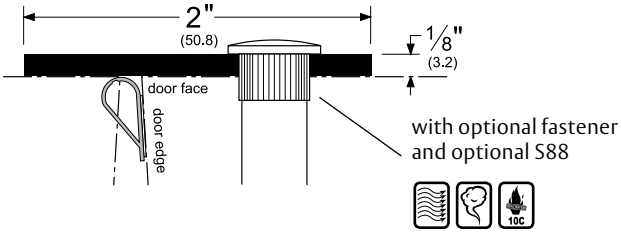


357_ with S88

AVAILABLE FINISHES:
SP, SS (#4 Finish & #4 Edge)

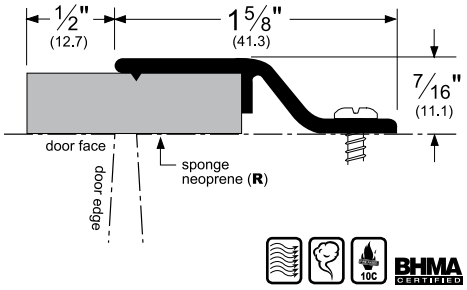
11 GAUGE

- Standard fastener is #10 x 1" Truss Head SMS
- 1/4" - 20 machine screws and thru-bolts must be ordered separately at additional cost
- S88 seal must be ordered separately at an additional cost, if required
- If specifications state that an astragal is required to satisfy a fire and / or smoke opening, then a thru-bolted 357SP or SS in conjunction with S88 seal is the only configuration that can be used.



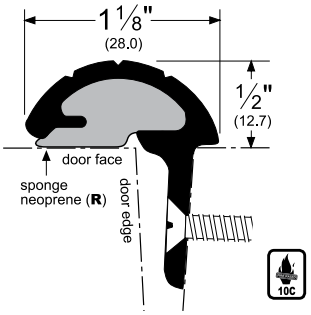
375_R

AVAILABLE FINISHES: **B, C, D, G**
REPLACEMENT INSERT: **R4 (BL)**
ANSI: **R3C634, R3C635**

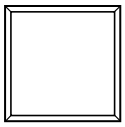


352_R

AVAILABLE FINISHES: **C, D, G**
REPLACEMENT INSERT: **R8 (BL)**
For reverse bevel doors



AVAILABLE FINISHES FOR PRODUCTS SHOWN ON THIS PAGE (see General Information section for finish chart)
A (Mill Finish Aluminum) **B** (Mill Finish Extruded Bronze [Brass]) **BDG** (Bright Dip Gold Anodized) **C** (Clear Anodized) **D** (Dark Bronze Anodized) **G** (Gold Anodized) **PW** (Painted White) **SN** (Satin Nickel Anodized) **SP** (Galvannealed Steel) **SS** (See Individual Part) Special finishes available upon request



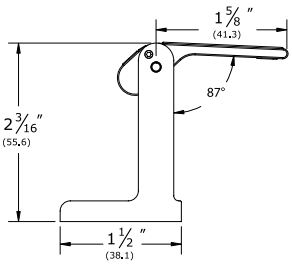
Wall Guard No. 606

Material: Clear rubber

Other: Sold in sheets of 55

Features: Self-adhesive mounting

No.	Fastener	Size	Weight
606	Self-adhesive back	1" x 1"	0.4 lbs./55



Privacy Door Latch No. PDL (formerly 607)

Material: Zinc die cast

Finishes: BRS, DBRS, STNN, CRM, DCRM, ORB

Features:
- ADA compliant
- Enhanced in room privacy
- Easy to install
- For use with UL Classified fire doors for use with hollow metal steel composite type fire doors rated up to and including 3 hrs Wood composite type fire doors rated up to and including 1 1/2 hrs and 20 minutes without hose stream

No.	Fastener	Size	Weight
PDL	#12 x 1 1/4" FH SMS	1 1/2 " x 2 13/16"	0.75 lbs.

Door Silencer No. 608CA

Material: Clear rubber

Other: Sold in packages of 300

Features: Self-adhesive mounting

No.	Fastener	Size	Weight
608CA	3/8" dia. x 1/8"	Metal or wood	0.2 lbs./300

608

609

Door Silencers No. 608, 609

Material: DuraFlex gray rubber

Other: Sold in packages of 100

No.	Size	Frame Type	Weight	ANSI A156.16
608	1/2" dia. x 5/8"	Metal	1.3 lbs./500	L03011
609	3/8" x 3/4"	Wood	1.3 lbs./500	L03021

ASSA ABLOY

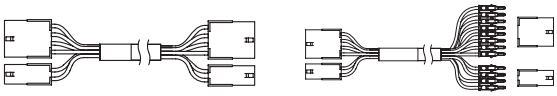
The global leader in door opening solutions

ElectroLynx® Retrofit Cables

If you are not ordering ASSA ABLOY Door Group doors with the ElectroLynx® cable pre-installed in the door, you must order an ElectroLynx® retrofit cable to go between ANY hardware and the hinge. This includes 3" cables to go from the hinge to an exit device and up to a 15' cable to go up and around a full lite metal door.

QC-C1500P Shown

Standard ElectroLynx® Retrofit Cable Sizes



Actual Cable Length	12 Conductor and Molex both ends	12 Conductor and Molex one end, pinned one end	Typical Application
3"	QC-C003	QC-C003P	Between hinge and the end of an exit device.
6"	QC-C006	QC-C006P	
12"	QC-C012	QC-C012P	
26"	QC-C200	QC-C200P	Between hinge and through the door to the lockset or exit device trim.
32"	QC-C206	QC-C206P	
38"	QC-C300	QC-C300P	
44"	QC-C306	QC-C306P	
50"	QC-C400	QC-C400P	
15' 2"	QC-C1500	QC-C1500P	From the hinge location, up the jamb to above the ceiling, or up and around full lite or half lite metal door.
25'	-	QC-C2500P	
30'	-	QC-C3000P	

Custom lengths available.

800-346-7707 | www.assaabloydooraccessories.us
Check the web site for the up-to-date catalog

ACCESS CONTROL »PRODUCTS

SECURITRON®

ASSA ABLOY

ASSA ABLOY, the global leader in door opening solutions

DPS
Door Position Switches

DPS-W and DPS-M door position switches enable access control systems to monitor the open or closed state of a door. These switches can transmit an initiate signal to Securitron's XDT delayed exit logic timers and DPA door prop logic timers.

DPS-W

Concealed Door Position Switch for Wood Doors:

- Mated magnetic switch and cylindrical magnetic contact
- Recesses into door and frame
- 3/4" [19mm] round installation, 15/16" deep
- Provides Normally Closed SPST switch
- Works with door gap up to 3/4" [18mm]
- MagnaCare® lifetime replacement, no fault warranty

PRODUCT OPTIONS

- Available in white, gray or black

DPS-M

Concealed Door Position Switch for Metal Doors:

- Mated magnetic switch and magnetic contact
- Recessed into door and frame
- 3/4" [19mm] round installation, 1/2" deep
- Larger cylindrical magnet counters shielding effect of steel
- Provides Normally Closed SPST switch
- Works with door gap up to 3/4" [18mm]
- MagnaCare® lifetime replacement, no fault warranty

SPECIFICATIONS

Electrical:
Switching Current AC/DC (max): 0.4A

Operating Temperature:
-40 to +150F [-40 to +65C]

MODELS

PART #	Description
DPS-M-BK	DPS for Metal Doors - Black
DPS-M-GY	DPS for Metal Doors - Grey
DPS-M-WH	DPS for Metal Doors - White
DPS-W-BK	DPS for Wood Doors - Black
DPS-W-GY	DPS for Wood Doors - Grey
DPS-W-WH	DPS for Wood Doors - White

MAGNACARE WARRANTY

DPA
Door Prop Alarm

The DPA complements door position/door state detection with timed logic and relays that provide escalating alerts when a door is held, propped or unsecure after a defined time period. This unit promotes safety and loss prevention at ancillary exits for healthcare, commercial and retail facilities, and dorms.

PRODUCT FEATURES

- Multi-functional control timer provides relay action for alarms and alerts
- Monitors whether a door remains open after a defined time frame
- Includes three 5A SPDT outputs providing local and remote signaling
- Digital time settings from 30 to 240 seconds
- Detects attempts to tamper with lock or door status
- Multiple time ranges for escalating alerts
- Bypass mode for valid access/ egress needs
- Comes with Piezo sounder and LED
- MagnaCare® lifetime replacement, no fault warranty

SPECIFICATIONS

Electrical:
Max draw 100 mA at 12 VDC
Max draw 50 mA at 24 VDC

Operating Temperature:
+32 to +120F [0 to +49C]

Shipping Weight:
2.05 lbs [0.93kg]

MODELS

PART #	Description
BA-DPA-12	Door Prop Alarm Timer - 12 VDC w/ Boxed Alarm
BA-DPA-24	Door Prop Alarm Timer - 24 VDC w/ Boxed Alarm

MAGNACARE WARRANTY

SECURITRON
ASSA ABLOY

POWER
»PRODUCTS

SECURITRON®
ASSA ABLOY

ASSA ABLOY, the global leader in door opening solutions

Securitron® AQD Series

Dual-voltage switching power supplies

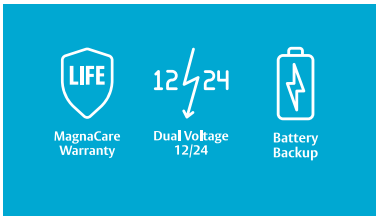
A full line of highly efficient power supplies that protect devices from over voltage.

The Securitron AQD Series of switching power supplies are dual voltage supervised units with a battery charger designed to power magnetic locks, electric strikes, card readers, sensors, access control boards and other devices in access control systems. The Securitron AQD Series can also be used to power DC cameras and other DC locking equipment. These units provide field selectable 12 or 24 VDC with up to 16 independently controlled power limited outputs.

Features

Standard Features

- Dual voltage 12 or 24 VDC field selectable continuous output
- Tolerates brownout or overvoltage input ± 15% of nominal voltage
- Thermal shutdown protection with auto restart
- Circuit breaker protects against overcurrent and reverse battery faults (batteries sold separately)
- Dedicated battery charging circuit prevents overvoltage on locking devices (except AQD1)
- Expandable up to 16 outputs in the standard enclosure
- Outputs are Class 2 limited when used with PTC Polyswitch output distribution boards
- Available with a single relay fire trigger or individually fire trigger relayed outputs
- MagnaCare® lifetime replacement, no-fault, no questions asked warranty
- Low noise design provides better than linear performance
- Mix and match configuration allows for UL compliance even when used in other UL Listed enclosures



Specifications

Certifications

- UL 294 Listed
- UL 603 Listed
- ULC-S318 Listed
- ULC-S533 Listed
- RoHS Compliant
- REACH Compliant

Dimensions

- Enclosure: 14" x 14" x 4-3/4" [356mm L x 356mm W x 121mm D]

Electrical

- 12 VDC or 24 VDC field selectable output
- 115 or 230 VAC input*
- Supports up to two (2) sealed gel, AGM or wet lead acid batteries
- Up to 90% efficiency
- Low voltage ripple design as low as 240mV p-p

Environmental

- Operating Temperature: -4˚ to 122˚F [-20˚ to 50˚C]

Shipping Weight

- 12.7 lbs [5.76kg]

**AQD1 115VDC only*

Models

Model	Amperage	Rated Voltage (12 or 24 VDC)	Input Voltage	Typical Voltage	Class 2 Outputs	Replaces
AQD1	1	12 or 24 VDC	115	13.7 / 27.4	Yes	AQD3
AQD2	2	12 or 24 VDC	115/230	12.5 / 25.0	Yes	AQD3
AQD4	4	12 or 24 VDC	115/230	12.5 / 25.0	Yes	AQD5
AQD6	6	12 or 24 VDC	115/230	12.5 / 25.0	Available*	AQD6

** Outputs are class 2 limited when used with 4 or 8 output PTC distribution boards*

Updated 1/23/19 Patent pending and/or patent www.assaabloydss.com/patents

SECTION 08 80 00 - GLAZING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Glazing for the Project except as noted below.
2. Glazing accessories.
3. Glazing sealants.

B. Related requirements:

1. Division 08 for framed mirrors.

1.2 SUBMITTALS

A. Data: Manufacturer Product Data for glass, sealants, gaskets and glazing accessories.
B. Samples:

1. Twelve-inch square labeled Samples of each type and color of glass, with taped or ground edges.
2. Coated glass Samples shall show extremes of color range.
3. Glass indicated or required to be “heat-treated” need not be when submitting Samples.

C. Certification: Glass manufacturer’s certification as specified.

1. Product certificates signed by glazing materials manufacturers certifying that their products comply with specified requirements. Include wind pressure analysis, thermal stress analysis, including shading effects, and review of Shop Drawings stating that details are suitable for proposed glass products.
2. Separate certifications are not required for glazing materials bearing the manufacturer's permanent label designating type and thickness of glass, provided labels represent a quality control program of a recognized certification agency or independent testing agency acceptable to authorities having jurisdiction.

D. Glazing schedule: Use same designations indicated on Drawings for glazed openings in preparing a schedule listing glass type and thickness for each size opening and location.
E. Preconstruction adhesion and compatibility test report: From glazing sealant manufacturer indicating glazing sealants were tested for adhesion to glass and glazing channel substrates and for compatibility with glass and other glazing materials.
F. Product test reports: From a qualified testing agency indicating the following products comply with requirements, based on comprehensive testing of current products:

1. Tinted float glass.
2. Coated float glass.
3. Insulating glass.
4. Monothetic glass
5. Glazing sealants.
6. Glazing gaskets.

G. Labels: Provide NFRC Rating Labels as required by the California Energy Code. Reference compliance guide for information required

1.3 QUALITY ASSURANCE

A. Glazier qualifications: Experienced installer who has completed glazing similar in material, design, and extent to that indicated for this Project; whose work has resulted in glass installations with a record of successful in-service performance; and who employs glass installers for this Project who are certified under the National Glass Association Glazier Certification Program as Level 2 (Senior Glaziers) or Level 3 (Master Glaziers).
B. Fabricator qualifications: When the glass manufacturer has a certification program, the fabricator shall have a current “Certified Fabricator” certificate form the glass manufacturer.
C. Source limitations for clear glass: Obtain clear float glass from one primary glass manufacturer.
D. Source limitations for tinted glass: Obtain tinted, heat absorbing, and light reducing float glass from one primary glass manufacturer for each tint color indicated.
E. Source limitations for coated glass: Obtain coated glass from one manufacturer for each type of coating and each type and class of float glass indicated.
F. Source limitations for insulating glass: Obtain insulating-glass units from one manufacturer using the same type of glass and other components for each type of unit indicated.
G. Source limitations for glazing accessories: Obtain glazing accessories from one source for each product and installation method indicated.
H. Tempered or Laminated safety glass, noted as SG on Door and Window Schedule on Drawings:

    1. Category II materials complying with testing requirements in 16 CFR 1201 or ANSI Z97.1.
    2. Subject to compliance with the above, provide a permanent mark on safety glass with certification label of Safety Glazing Certification Council or another certification agency acceptable to AHJ.

I. Insulating glass certification program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of the following inspecting and testing agency.

    1. Insulating Glass Certification Council.
    2. Associated Laboratories, Inc.
    3. National Accreditation and Management Institute.

J. Mockups: Before glazing, build mockups for each glass product indicated below in accordance with the following requirements, using materials indicated for the completed Work.

    1. Build mockups in the location and of the size indicated or, if not indicated, as directed by Architect.
    2. Build mockups with the following kinds of glass to match glazing systems required for Project, including typical lite size, framing systems, and glazing methods:

        a. Heat-strengthened coated glass.
        b. Tempered glass.
        c. Coated insulating glass.

    3. Obtain Architect's approval of mockups before starting fabrication.
    4. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
    5. Demolish and remove mockups when directed.
    6. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

K. Manufacturer certification: Submit manufacturer certification that.

1. All materials to be used in the glazing system such as sealants, setting blocks, spacers, backing rods, metal finishes, etc. have been reviewed by the glass manufacturer.
2. These materials are compatible with the glass supplied to the Project site.
3. These materials will not cause deterioration, premature aging, and staining of adjacent materials.

L. Labeling:

1. Submit a certificate stating that the glass furnished for the Project complies with the Specifications.
2. Label each piece of heat-treated glass with a permanent logo etched in one corner to identify the fabricator.

1.4 HANDLING

A. Storage: Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, run-off, and other causes.

1.5 PROJECT CONDITIONS

A. Do not proceed with installation of bulk sealants under adverse weather conditions, or when temperatures are below or above manufacturer's recommended limitations for installation.

1.6 SPECIAL WARRANTIES

A. Warrant insulating glass for 5 years after Substantial Completion against fogging and loss of transparency and frost build-up between the glass panes due to defective materials or sealant failure.
B. Replace defective materials and workmanship during the warranty period at no cost to the Owner.

PART 2 - PRODUCTS

2.1 PRIMARY GLASS MANUFACTURERS

A. Basis of Design: Vitro Architectural Glass (formerly PPG Glass.)
B. AGC Flat Glass North America Ltd.
C. Guardian Glass.
D. Pilkington Group.
E. Or equal.

2.2 CRITERIA AND PERFORMANCE REQUIREMENTS

A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

B. Confirm glass thicknesses by analyzing Project loads and in-service conditions. Provide glass lites for various size openings in nominal thicknesses indicated, but not less than thickness and in strengths (annealed or heat-treated) required to meet or exceed the criteria specified below and with the CBC and ASTM E 1300.

1. Design wind pressures:

   a. Positive: As indicated on structural Drawings. If not indicated, comply with ASCE/SEI “Minimum Design Loads for Buildings and Other Structures,” unless otherwise prescribed by Code.
   b. Negative: 20 psf, unless otherwise indicated.

2. Vertical glazing: For glass surfaces sloped 15 degrees or less from vertical, design glass to resist design wind pressure based on glass type factors for short-duration load.
3. Sloped glazing: For glass surfaces sloped more than 15 degrees from vertical, design glass to resist each of the following combinations of loads.

   a. Outward design wind pressure minus the weight of the glass. Base design on glass type factors for short-duration load.

4. Probability of breakage for glass surfaces sloped less than 15 degrees from vertical: Design glass for a probability of breakage not greater than 0.008.
5. Probability of breakage for glass surfaces sloped more than 15 degrees from vertical: Design glass for a probability of breakage not greater than 0.001.
6. Maximum lateral deflection: For glass supported on all 4 edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length or one-inch, whichever is less.
7. Differential shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.

C. Thermal movements: Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.

1. Temperature change: 120 deg F, ambient; 180 deg F, material surfaces.
2. Thermal and optical performance properties: Provide glass with performance properties specified based on manufacturer's published test data, as determined according to procedures indicated below:

   a. For monolithic glass lites, properties are based on units with lites 6 mm thick.]For insulating glass units, properties are based on units with lites 6 mm thick and a nominal 1/2-inch-wide interspace.
   c. Center of glass U values: NFRC 100 methodology using LBL-35298 WINDOW 4.1 computer program, expressed as Btu/ sq.-foot by hour by -degree F.
   d. Center of glass solar heat gain coefficient: NFRC 200 methodology using LBL-35298 WINDOW 4.1 computer program.
   e. Solar optical properties: NFRC 300.

2.3 GLASS MATERIALS-GENERAL

A. General:

1. Float glass: Shall comply with ASTM C 1036; heat-treated glass shall comply with ASTM A 1048.
2. ASTM E 1300 Standard Practice for Determining Load Resistance of Glass in Buildings
3. ASTM E 2190 Standard Specification for Insulating Glass Unit Performance and Evaluation.

4. Provide glass free from bubbles, smoke vanes, air holes, scratches and other defects.
5. Laminated glass shall comply with ASTM C 1172. Glass in the lamination shall be from the same manufacturer when heat strengthened.
6. The same manufacturer shall make all tinted and reflective glass.
7. Fabricate tempered glass by horizontal (roller hearth) process with roll wave distortion parallel to bottom edge of glass as installed, unless otherwise indicated.

    a. Comply with Category II of CPSC 16 CFR Part 1201 or Class A of ANSI Z97.1. (2408.3.).

8. Comply with Code and the Drawings for glass in hazardous locations. Laminated glass subject to human impact shall comply with Category II of CPSC 16 CFR Part 1201 or Class A of ANSI Z97.1. (2408.3.).

    a. Note that safety glass shall be installed where required by the CBC including 2406 and 2408.3 as well as other requirements in Chapter 24.

9. Unless otherwise indicated or specified, overall thickness of each glass type and composite thickness of multiple layer glass types shall be consistent throughout the Project.
10. Provide insulating glass assemblies CBA rated by IGCC when tested in compliance with ASTM E 774, and permanently labeled with the appropriate certification label of IGCC, ALI or NCTL.

2.4 EXTERIOR GLASS

A. Glass Types: See the architectural exterior elevation Drawings.
B. GL-1- IGU at main entrance to Gym: Solar Control Low-E Clear Insulating Glass “Solarban®” 70 (2) “Solarblue ®” + Clear by Vitro Architectural Glass.

    1. Outdoor Lite: Fully tempered “Solarblue®” Glass by Vitro Architectural Glass, Sputter Coated on second surface (2).
    2. Indoor Lite: Fully Tempered clear (transparent) Float Glass.
    3. Low-E Coating: “Solarban®” 70 Solar Control (Sputtered) by Vitro Architectural Glass. Location: Second Surface (2).
    4. Performance Values:

        a. Visible Light Transmittance: 42%.
        b. U-Value Winter: 0.28.
        c. U-Value Summer: 0.26.
        d. SHGC: 0.23.
        e. Shading Coefficient: 0.26.
        f. Outdoor Visible Light Reflectance: 8%.

C. GL-2 - Typical Insulated Glass Units (IGU); Solar Control Low-E Clear Insulating Glass “Solarban®” 70 (2) Clear + Clear by Vitro Architectural Glass.

    1. Outdoor Lite: Fully tempered float Glass by Vitro Architectural Glass, Sputter Coated on second surface (2).
    2. Indoor Lite: Clear (transparent) Fully tempered float glass.
    3. Low-E Coating: “Solarban®” 70 Solar Control (Sputtered) by Vitro Architectural Glass. Location on second surface (2).
    4. Performance Values

        a. Visible Light Transmittance: 64%
        b. U-Value Winter: 0.28

c. U-Value Summer: 0.26
d. SHGC: 0.27
e. Shading Coefficient: 0.32
f. Outdoor Visible Light Reflectance: 13%.

D. GL-3 – IGU at exterior entrance: Solar Control Low-E Insulating Glass “Solarban®” 70 (2) clear + translucent by Vitro Architectural Glass.

1. Outdoor Lite: Fully tempered float glass by Vitro Architectural Glass, Sputter Coated on second surface (2).
2. Indoor Lite: Equal to fully tempered Pavia Clear/Color acid etched float glass by Vitro.

2.5 INTERIOR GLASS

A. GL-4: Clear Glass: Fully tempered, float glass.

1. Thickness: 1/4-inch minimum.

B. GL-5: Clear Glass: Fully tempered, float glass.

1. Thickness: 1/2-inch minimum.

C. GL-6: Laminated Glass: Two plies of fully tempered, float glass.

1. Basis of Design: Pulp Studio Laminated Glass ref # 5099.
2. Thickness 5/16” minimum.
3. Or equal.

D. GL-7: Interior Mirror - See Section 08 86 00.
E. GL-8: Fire Rated glass - See Section 08 41 23.

2.6 GLAZING MATERIALS

A. Setting block: Neoprene or, in the case of structural silicone glazing, dense extruded silicone; both with a hardness of 80 to 90 durometer Shore A with a minimum length of 4-inch or as required by GANA guidelines. For flush glazed skylights, provide L shaped setting blocks.
B. Side blocks: Neoprene or dense silicone with a hardness of 65 ±5 durometer Shore A.
C. Spacer: Neoprene, silicone, or EPDM, 50 to 60 durometer hardness, compatible with sealants used.
D. Sealants:

1. For primary seal of insulating units: Manufacturer standard sealant.
2. For all other conditions: Medium and low modulus (weatherseal) silicone sealant, one-part, non-acidic, neutral curing, Type S, Grade NS, Class 25, Use NT, capable of withstanding movements from plus 50 to minus 50 for medium modulus and plus 100 to minus 50 percent for low modulus based on original joint design.

a. Color: Match Architect’s paint color for sealant.
b. Acceptable products:

1) Dowsil “795” and “790.”
2) General Electric “Silpruf,” “Silpruf LM.”

c. Only low modulus sealant, such as Dowsil “790” or GE “Silpruf LM,” shall be used when sealing to cementitious substrate.

E. Glazing gasket: Resilient, continuous neoprene, (except as specified below) extrusions, 40 to 60 Shore A durometer hardness, meeting the requirements of ASTM C 509 for cellular (closed-cell) material, and AAMA SG-1 for non-cellular (dense) material, with molded corners.

1. Gaskets shall have a continuous mechanical engagement to framing members and factory molded corners.
2. Gasket corners, whether molded or not, shall be bedded in elastomeric sealant compatible with glazing gaskets.
3. When in direct contact with silicone sealants, gaskets, spacers and setting blocks shall be heat cured silicone rubber-based material chemically compatible with the silicone sealant and with sufficient hardness for the specific purpose intended. Compatibility testing by the silicone sealant supplier/manufacturer shall be required.
4. Design interior and exterior gasket profiles to produce a glass edge pressure of 12 psf unless otherwise recommended by the glass manufacturer.

F. Compressible filler rod:

1. Closed cell or waterproof jacketed rod stock of synthetic rubber or plastic foam compatible with sealants used, flexible and resilient, with 5 to 10 psi compressive strength at 25 percent deflection.
2. Do not use vinyl foam stock.

G. Cleaner, primer and sealer: Type recommended by sealant or gasket manufacturer.

H. Partition closure: Michael Rizza Co., LLC “Partition Closures” consisting of an extruded aluminum retainer channel and a compressible solid silicone closure.

I. Sealer for acid-etched and sandblasted glass: Etch Sealer by Skyline (773.278.4660), or equal wax-free, specially formulated sealer to resist fingerprints and stains.

2.7 FABRICATION

A. Cutting:

1. Obtain sizes from Shop Drawings or by field measurement. Cut glass to fit each opening with at least the minimum edge clearance and bite on glass recommended by glass manufacturer.
2. When glass will be precut to sizes obtained from Shop Drawings, take field measurements of each opening before glazing to verify adequate bite on glass and minimum edge clearance.
3. Glaze openings, which do not fall within tolerances for which precut glass has been sized only with glass specially cut to fit such openings.
4. Do not nip glass edges. Edges may be wheel cut or sawed and seamed at manufacturer's option.

B. Edge quality of annealed and heat-strengthened glass:

1. Shark teeth shall not penetrate more than half of glass thickness.
2. Serration hackle shall not penetrate more than 10 percent of glass thickness.
3. Flare shall not exceed 0.062-inch as measured perpendicular to glass surface edge.
4. Bevel shall not exceed 0.062-inch.
5. Flake chip depth shall not exceed 0.031-inch and length, or diameter shall not exceed 0.25-inch.
6. Rough chips are not permitted. Rough chips are those that exceed dimensional limits for flake chips.
7. For glass to be cut at site, provide glass 2-inch larger than required, in both dimensions, to facilitate cutting of clean-cut edges without seeming or nipping.

8. Do not cut, seam, nip, or abrade tempered and heat strengthened glass after tempering.
9. Provide flat ground edges with arised corners where glass edge is not covered by a metal stop.

C. When full height vision glass is shown (without intermediate horizontals or rails), safety glazing is only required on the inboard lite for Code compliance except on the ground floor or other areas where there is a walking surface on both sides. Alternately, if an aluminum rail is used on the interior of the framing, neither lite need not be safety glazing.
D. Glass in sloped glazing conditions (15 degrees or more from vertical) shall be laminated with both lites heat-strengthened. Fully tempered glass is not allowed, whether monolithic, laminated, or as the inboard lite of an insulated glass unit.
E. Insulating glass:

1. Provide black aluminum spacers with bent (not mitered or spliced) corners; only one seam is allowed in each spacer of each unit.
2. The date of the manufacture of the unit shall be discretely identified on the spacer (top of unit, left or right corner).

F. Identification: Identify tempered glass with a manufacturer-installed, removable paper designation as required by CBC section 2406.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions and measurements affecting the work of this Section at site.
B. Verify that openings and frames to be glazed are within allowable tolerances, plumb, level and square.
C. Inspect framing joint intersections to ensure that the offset in the joinery will not impose undue edge pressure on the glass in compliance with GANA, Glazing Manual, and Sealant Manual, guidelines.
D. Correct other detrimental conditions before proceeding with glazing.

3.2 STANDARDS AND PERFORMANCE

A. Watertight and airtight installation is required for each piece of glass installed in an exterior wall and skylight.
B. Each installation must withstand normal temperature changes, wind loading, and impact from normal operation for doors and windows, without failure of any kind including loss or breakage of glass, failure of sealants or gaskets to remain watertight and airtight, deterioration of glazing materials and other defects in the Work.
C. Installed glass shall be free from rattle.
D. Protect glass from damage at all times during handling, installation and operation of the building until Substantial Completion.
E. Comply with combined recommendations of glass manufacturer and manufacturer of sealants and other materials used in glazing, except where more stringent requirements are specified.
F. Except as recommended otherwise by the manufacturers of the glass and glazing materials, comply with GANA Glazing Manual and the following:

1. Provide minimum nominal glass bite of 0.375-inch on monolithic lites; 1/2-inch on insulated glass units.
2. Where joint movement will result in variable glass bite, increase nominal bit to provide 0.375-inch minimum bite and 0.25-inch minimum edge clearance.

G. Inspect each piece of glass immediately before installation and eliminate those with edge damage or face imperfections.
H. Unify appearance of each series of lights by setting each piece to match others as nearly as possible. Inspect each piece and set with pattern, draw and bow oriented in the same direction as other pieces.

3.3 PREPARATION FOR GLAZING

A. Immediately before glazing, clean the glazing channel and other framing members to receive glass.

1. Remove coatings not firmly bonded to the substrate.
2. Verify that framing is satisfactory to receive the glass.

B. Apply primer or sealer to joint surfaces when recommended by sealant manufacturer.

3.4 GLASS INSTALLATION

A. Structural glazing: Comply with the sealant manufacturer's instructions and the following ASTM standards.

1. C 794: Sealant compatibility and adhesion to each substrate to be encountered on the Project.
2. C 1087: Sealant compatibility with backing.
3. C 1087: Sealant compatibility and lack of adhesion to bond breaker.
4. C 1184: Structural Glazing Specifications.
5. C 1401: Guide for Structural Glazing.

B. Erect each pane of glass square, plumb, and with uniform clearances between panel and rebates.
C. Follow glass manufacturer's instructions and GANA Standards. Maintain minimum bed clearance between glass and frame.
D. Do not nip glass. Do not install glass with edge damage.
E. Install glass with required glass markings right side up so they can be read from the exterior.
F. Setting blocks:

1. Minimum length of 4 inches or as required by GANA guidelines; minimum width shall correspond to the glass thickness and retaining member but, in no case less than the glass thickness at point of contact.
2. Locate at quarter points, or in accordance with GANA glazing guidelines.
3. Secure against migration.
4. Shims used in conjunction with setting blocks must be of the same material, hardness, length and width as the setting blocks.

G. Side blocks:

1. Locate side blocks where required within the upper half of each jamb for each light.
2. Install block with 1/8-inch clearance between block and glass bearing surface.
3. Block shall be sufficient length to prevent point loading on the glass.
4. Side blocks are not required where an individual glass light is continuously sealed with silicone at 2 or more edges, when the sealant is installed immediately following the setting of the glass.

H. Provide spacers inside and out unless continuous gaskets are used. Use glass manufacturer recommended size and spacing.

I. Prevent exudation of sealant or compound by forming voids or installing filler rods in the channel at the heel of jambs and head (do not leave voids in the sill channels, except as needed for drainage and weep holes) depending on light size, thickness, and type of glass, and complying with manufacturer's recommendations.
J. Sealant shall not be adhered to, or placed against, the edge of a laminated glass unit interlayer.
K. Force sealants into channel to eliminate voids and to assure complete "wetting" or bond of sealant to glass and channel surfaces.
L. Tool exposed surfaces of sealants to provide a substantial "wash away" from the glass.
M. Install pressurized gaskets to protrude slightly out of the channel, so as to eliminate dirt and moisture pockets.
N. Clean and trim excess glazing materials from the glass, stops and frames promptly after installation, and eliminate stains and discolorations.
O. Where wedge shaped gaskets are driven into one side of the channel to pressurize the sealant or gasket on the opposite side, provide adequate anchorage to ensure that gasket will not "walk" out when subjected to dynamic movement.

    1. Anchor gasket to stop with matching ribs, or with adhesive.

P. Clean, prime and mask structural silicone joints the same day when silicone is applied.

3.5 MIRROR INSTALLATION

A. Apply one additional coat of mirror backing to the back of the mirror, allow to dry, then apply mirror mastic in compliance with the mastic manufacturer's instructions.
B. Fasten supporting angles securely to the studs; do not attach to gypsum board with toggle or Molly bolts.
C. Set mirrors in supporting angles and press against substrate to ensure bond with mastic.]
D. Leave open space of 1/8-inch or more between mirror and substrate. Do not seal ventilation space at edges of mirror.

3.6 CURING/PROTECTING/CLEANING

A. Cure glazing sealants and compounds in compliance with their manufacturer's instructions and recommendations, to obtain high early bond strength, internal cohesive strength and surface durability.
B. Protect glass from breakage immediately upon installation. Do not apply markers of any type to glass.
C. Before Substantial Completion, remove and replace glass that is broken, chipped, cracked, abraded, stained or damaged in other way, including natural causes, accidents and vandalism.
D. Maintain glass in a clean condition during construction so that it will not be damaged by corrosive action and will not contribute (by wash-off) to the deterioration of glazing materials and other work.
E. Remove remaining labels and wash and polish glass on both faces not more than 4 days prior to Owner's acceptance of the work in each area. Comply with GANA 01-0300 and the glass manufacturer's recommendations.

END OF SECTION

SECTION 08 86 00 - MIRRORED GLASS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Unframed mirrors.
2. Adhesives, sealers and accessories.

B. Related requirements: Section 10 28 00 for framed mirrors.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Scheduling and sequencing:
B. Pre-installation meeting:

1.3 SUBMITTALS

A. Data: Manufacturer Product Data for mirrors, sealers, adhesive, and trim.
B. Samples: 6-inch square, with finished edges.

1.4 QUALITY ASSURANCE

A. Label back of each mirror as required by ASTM C 1503.

1.5 SPECIAL WARRANTY

A. Warrant mirrors against silver spoilage for 5 years after Substantial Completion.
B. Replace defective materials and workmanship during the warranty period at no cost to the Owner.

PART 2 - PRODUCTS

2.1 MIRRORS

A. General:

1. Glass shall comply with ASTM C 1036.
2. Mirrors shall comply with ASTM C 1503.

B. Mirrors:

1. Tempered clear glass mirrors: Comply with ASTM C 1503, Mirror Glazing Quality, for blemish requirements in annealed float glass before silver coating is applied, for coating requirements, and with other requirements not affected by tempering process; and complying with ASTM C 1048 for Kind FT, Condition A, tempered float glass before silver coating is applied. Nominal Thickness 6.0 mm.
2. Nominal thickness: 6.0 mm unless indicated otherwise.

2.2 MISCELLANEOUS GLAZING MATERIALS

A. Adhesive: Mirror Mastic by Palmer, Ultra/Bond by C. Gunther Co. or Titebond Fast Set Polyurethane Construction Adhesive.
B. Backing and cut edge sealer: Primary Mirror Backing by CR Lawrence, Mirro-Bac by Palmer, Seal-Kwik by C. Gunther Co., or equal by Lilly Industries or Peacock Laboratories.
C. J moldings: Polished chrome (US 26) finished "J" moldings model 541 by JW Goss Co. or equal by CR Lawrence Co., Trident Consolidated Industries or A. Geo Diack.
D. Edge sealer: Coating compatible with glass coating and approved by mirror manufacturer for use in protecting against silver deterioration at mirrored glass edges.

2.3 FABRICATION

A. Obtain sizes from Shop Drawings or by field measurement.
B. Precut mirrors to sizes obtained from Shop Drawings, take field measurements before cutting. Fabricate mirrors in one piece for each toilet room, except as otherwise authorized by the Architect due to mirror size.
C. Cutouts: Fabricate cutouts before tempering for notches and holes in mirrors without marring visible surfaces. Locate and size cutouts so they fit closely around penetrations in mirrors.
D. Edge treatment:

1. Do not nip edges. Edges may be wheel cut or sawed and seamed at manufacturer's option.
2. Grind and polish exposed edges.
3. Edges when concealed by a continuous channel may be clean cut.
4. Seal edges of mirrors after edge treatment or require mirror manufacturer to perform edge treatment and sealing in factory immediately after cutting to final sizes.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions and measurements affecting the work of this Section at site.
B. When laminating directly to gypsum board, verify that gypsum board is sealed with an acrylic sealer prior to installing mirrors.
C. Correct detrimental conditions before proceeding with installation.

3.2 INSTALLATION

A. Apply one additional coat of mirror backing to the back of the mirror, allow the backing to dry, and then apply mirror mastic in compliance with the mastic manufacturer's instructions.
B. Fasten the J-channels to the studs. Level and countersink the fastener heads so they do not contact the mirror backing. Shim the J-channels where depressions in the wall occur so the mirror will be centered in the channel without distortion.
C. Tape the screw heads and the wall edge of the J-channel if it protrudes from the wall.
D. Place setting blocks at 2 locations for each mirror in the lower J-channel, approximately 6 inches from edges.
E. Paint the seam line of the mirror butt joint black to prevent the white wall from showing through the seams if applicable.
F. Dry fit each mirror to assure a secure fit. Adjust the setting blocks if necessary. Verify that mirror edges are sealed before installing to avoid black edge problems.
G. Apply mastic to the mirror according to the mastic manufacturer’s instructions by pats, a minimum of one per square foot and a maximum of 4. Compensate at the depressions and bows in the wall to make the installation flat.

H. Install the mirror with vacuum cups. Set the top of the mirror inside the upper J-channel and drop in the lower J channels on the setting blocks.
I. Leave open space of 1/8-inch or more between mirror and substrate. Do not seal ventilation space at edges of mirror.

3.3 CURING/PROTECTING/CLEANING

A. Protect mirrors from breakage immediately upon installation.
B. Maintain mirrors in a clean condition during construction.
C. Do not permit edges of mirrors to be exposed to standing water.
D. Maintain environmental conditions that will prevent mirrors from being exposed to moisture from condensation or other sources for continuous periods of time.
E. Remove remaining labels and wash and polish mirrors not more than 4 days prior to Owner's acceptance of the work in each area. Comply with GANA MD 01-0105 and mirror manufacturer's recommendations.
F. Before Substantial Completion, remove and replace mirrors which are broken, chipped, cracked, abraded, stained or damaged in other way, including natural causes, accidents and vandalism.

END OF SECTION

SECTION 08 87 00 - GLASS FILM

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes decorative film applied to monolithic glass.
B. Related Requirements: Section 08 80 00 for glass.

1.2 DEFINITIONS

A. Visible Light Transmittance: The ratio of the amount of visible light (380-780 nm) that is allowed to pass through a glazing system to the amount of visible light falling on the glazing system. The value is expressed as a percentage.
B. Diffuse Visible Light Reflectance (exterior): The percentage of visible light falling on a flat, non-mirrored surface that is neither transmitted nor absorbed but scattered backwardly at random angles from that surface. This value is also known as “non-specular reflectance”.
C. Privacy Film Rating: This number, between 0 (clear) and 10 (opaque), represents the relative difficulty an observer has in identifying the nature and character of an object located on the opposite side of the window, with the observer and the object both located at least 2 feet from the pane upon which the product has been installed.
D. Specialty Series: These films mask light, add privacy, or give a pop of color to any space. Bold, graphic hues and distinctive designs enliven retail spaces and commercial properties. Unique combinations of specialty films allow for endless customizable possibilities.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation meeting:

1. Arrange for a Preinstallation meeting between the Contractor, TJPA Representative, and Installer, at least a week prior to the start of installation to review proposed methods and processes.
2. Review Project schedule, scope of work indicated to receive the film, coordination between glazier and film Installer, scheduled finish, acceptability of glass, submittals and approvals.
3. Review procedures to be followed for protection of film during and after installation.
4. Record minutes of the meeting, decisions made and corrective measures to be taken before application starts. Send copy of the minutes to those present and the TJPA Representative no later than 3 days following the meeting.

1.4 SUBMITTALS

A. Shop Drawings: Where joints will occur in the film due to the size of the glass, submit Shop Drawings showing joint locations which are subject to rejection by the Architect.
B. Samples:

1. Submit full range of colors available to match GL-6, see Section 08 80 00 for Architect’s selection.
2. Submit three 24-inch square Samples of clear glass with the film applied to one half of the glass on both glass surfaces.

C. Product Data: Manufacturer Product Data sheets on each product to be used, including.

1. Physical properties and independent testing agency reports showing compliance with specified tests.
2. Preparation instructions and recommendations.
3. Storage and handling requirements and recommendations.
4. Provide detailed description of the installation method.

D. Closeout Submittals:

1. Film manufacturer’s instructions for maintenance and precautions to be used to clean film without damaging it.
2. Minimum quantity of film properly packaged and labeled, equal to one percent of the quantity installed.
3. Name, address (physical and email), and telephone number of Installer.

1.5 QUALITY ASSURANCE

A. Fire Performance: Surface burning characteristics when tested in accordance ASTM E 84:

1. Flame Spread: 25, maximum.
2. Smoke Developed: 450, maximum.

B. Manufacturer Qualifications: All primary products specified in this section will be supplied by a single manufacturer with a minimum of 10 years’ experience.

C. Installer’s Qualifications: Firm and individuals with a minimum of 5 consecutive years experience in installation of window films for projects similar in material, design, complexity and extent to this Project, and whose work has resulted in applications with a record of successful in-service performance.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store products indoors, off the floor, in manufacturer's unopened packaging until ready for installation.

1.7 PROJECT CONDITIONS

A. Maintain environmental conditions {temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.8 WARRANTY

A. Film shall be warranted for 12 years when installed indoors.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Basis-of-Design Product: 3M – Window Films.
B. Or equal.

2.2 DECORATIVE SPECIALTY FILMS

A. Decorative Film: Color to match GL-6 in Section 08 80 00.

2.3 DECORATIVE FILM ACCESSORIES

A. General: Provide accessories either manufactured by or acceptable to Decorative film manufacturer for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
B. Pressure Sensitive Adhesive: This adhesive is activated by pressure and water. It is characterized by its permanently tacky nature and its installation ease.
C. Cleaners, Primers, and Sealers: Types recommended by film manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION`

A. Examination: Examine conditions affecting the work of this Section. Reject excessively pitted and rusted components.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.
B. Prepare surfaces using methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions,

3.3 INSTALLATION

A. Install film in accordance with its manufacturer's instructions by recognized professional installers of film. Completed work must meet IWFA and these Specifications visual acceptance standard; in case of conflicts, the most stringent requirement shall take precedence.
B. Install without bubbles, ripples, drips, dirt, cuts, tears or gaps between film and frame and between film panels when the length or width exceeds manufacturer’s standard size; in all cases obtain the Architect’s approval of joint locations.
C. Clean newly installed film and window frames immediately after installation, using caution, do not displace the film.
D. Clean up cleaning solutions, run-off cleaning water and adhesive mounting solution.

3.4 CLEANING AND PROTECTING

A. Protect installed products until completion of Project.
B. Where installed film could be damaged by subsequent construction provide tape warning strips or barricades to prevent contact. Do not apply tape directly to film.
C. Touch-up, repair or replace damaged products before Substantial Completion.
D. After application of film, wash film using common window cleaning solutions, including ammonia solutions. Do not use abrasive type cleaning agents and bristle brushes to avoid scratching films. Use synthetic sponges or soft cloths.

END OF SECTION

SECTION 08 91 19 - EXTERIOR ALUMINUM WALL LOUVERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes design/build prefinished exterior aluminum wall louvers.
B. Related requirements: Division 23 for interior louvers connected to ductwork.

1.2 SUBMITTALS

A. Data: Manufacturer Product Data and specifications, air performance and water penetration graphs (AMCA Certified Ratings), anchorage details and installation instructions, including specifications for finishing materials.
B. Shop Drawings:

1. Detail the fabrication and erection of louvers not shown in the manufacturer data.
2. Include details of sections and connections.
3. Show interface with adjacent materials, anchorage and accessories.

C. Samples: 6-inch-long finished Samples of each profile of aluminum extrusions with the specified finish.

1.3 QUALITY ASSURANCE

A. Welding:

1. Qualify procedures and personnel according to AWS D1.1, Structural Welding Code-Steel, and AWS D1.3, ”Structural Welding Code-Sheet Steel”.
2. Welders shall have satisfactorily passed AWS qualification tests.
3. If recertification of welders is required, retesting will be Contractor's responsibility.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Airolite Co., Inc., Construction Specialties, Inc., Industrial Louvers, Inc., Cesco Products, Greenheck, or equal.

2.2 PERFORMANCE REQUIREMENTS

A. Structural performance: Provide assemblies capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by louver blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act on vertical projection of louvers.

1. Wind loads: As indicated on the Structural Drawings.

B. Seismic performance: The building is in Seismic Design Category (SDC) indicated on the Structural Drawings as defined by the CBC. Engineer, fabricate and Install assemblies requiring special bracing or mounting to meet the Seismic Design Category without failure or damage.
C. Thermal movements:

1. Provide louvers that allow for thermal movements resulting from the following change (range) in ambient and surface temperatures without buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
2. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
3. Temperature change (range) of 120-degree F, ambiant, 180-degree F, material surfaces.

D. Air performance, water-penetration, air-leakage, and wind-driven rain ratings: Provide louvers complying with performance requirements indicated, as demonstrated by testing manufacturer's stock units identical to those provided, except for length and width according to AMCA 500-L.

1. Wind Driven Water Penetration Performance:

a. Based on testing 39 inches x 39 inches core area, 41 inches x 44 inches nominal size unit in accordance with AMCA 500-L.
b. Wind Velocity: 29 mph.

1) Rainfall Rate: 3 inches/hour.
2) Free Area Velocity: 1190 feet per minute.
3) Water Resistance Effectiveness: 99.% (AMCA Class A).

c. Wind Velocity: 50 mph.

1) Rainfall Rate: 8 inches/hour.
2) Free Area Velocity: 759 feet per minute.
3) Water Resistance Effectiveness: 99.3%.

E. Beginning point of water penetration above 1,250 fpm free area velocity.
F. Free Area: 60%.
G. Airborne sound transmission loss: Provide acoustical louvers complying with airborne sound transmission loss ratings indicated, as demonstrated by testing manufacturer's stock units identical to those specified, except for length and width according to ASTM E 90.

2.3 MATERIALS

A. Aluminum blades and frame: 6063-T52 alloy.
B. Blank-off panels: Sheet aluminum, ASTM B 209.
C. Steel reinforcement: ASTM A 36.
D. Fasteners: Stainless steel or aluminum for aluminum-to-aluminum, galvanized steel for anchorage to supporting structure. Use Phillips flat-head machine screws for exposed fasteners.
E. Welding electrodes: As recommended by the aluminum producer and AWS.
F. Anchors and inserts:

1. Non-ferrous metal or hot-dip galvanized anchors and inserts.
2. Use steel or lead expansion bolt devices for drilled-in-place anchors.
3. Furnish inserts, as required, to be set into concrete and masonry.

G. Birdscreen: 1/2-inch mesh, 0.063-inch diameter galvanized wire, crimped aluminum screen material.
H. Paint:

1. For aluminum finish on exposed locations, see Section 07 42 13.
2. For concealed ferrous metal surfaces: Tneme-Zinc 90-93 by Tnemec, Zinc-Lock 308 by Porter International, or MZ-4 Epoxy Zinc-Rich Primer by Valspar Corp.
3. Bituminous paint: Cold-applied asphalt mastic paint complying with SSPC-Paint 12, except containing no asbestos, and formulated for 30-mil thickness per coat.

I. Sealants: As specified in Section 07 92 00.

2.4 FABRICATION

A. Fabricate louvers with continuous horizontal, weather type blades; minimum blade thickness shall be 0.125-inch unless Contractor demonstrates that the following criteria can be met with a lesser thickness (but not less than 0.062-inch.

1. Mid span deflection of louver can be limited to L/175.
2. Aerodynamic shudder or displacement does not occur at design wind load plus design throughput of louver.

B. Form blades and frames to the profiles, sizes and spacing indicated from minimum 0.08-inch aluminum extrusions. Overlap blades and "hook" both edges to prevent blow-through of water.

1. Provide concealed vertical stiffener assemblies of plates, angles, tees or shapes as required for rigidity, welded or fastened to the inside face of each blade.
2. Form ends of blades flat against frame jamb for fastening.

C. Frame louvers with mitered or coped and continuously welded or riveted and soldered joints.

1. Weld or rivet and solder blades to frames at each end, so that all joints will be watertight.
2. Reinforce frames and blades as required for stiffness and to comply with the design criteria.

D. Blank-off panels:

1. Provide blank-off where indicated.
2. Fabricate from 0.064-inch aluminum sheet.
3. Locate on inside face of louver.
4. Install on continuous foam tape, specified in Section 07 92 00, to provide an airtight seal.
5. Attach to louver frames with machine screws at each corner and spaced at 12-inches o.c. maximum between.

E. Provide sill extensions and loose sills of same material as louvers, where indicated or required for drainage to exterior and to prevent water penetration to interior.
F. Form frame to provide tolerances for installation, with sealants in joints between louvers and adjoining work.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine adjacent construction and supports.
B. Verify that openings are within allowable tolerances, plumb, level, clean, will provide a solid anchoring surface.
C. When areas behind louvers will be difficult to access after installation, clean free of debris and dust.
D. Correct detrimental conditions before proceeding with installation.

3.2 INSTALLATION

A. Place louvers plumb, level and in proper alignment with adjacent work.
B. Anchor securely to adjacent construction as indicated on the approved Shop Drawings. Use concealed anchorages wherever possible.
C. Form tight, flush joints with exposed connections accurately fitted together.
D. Protect unpainted aluminum surfaces that will be in contact with cementitious and dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint or by separating surfaces with waterproof gaskets or nonmetallic flashing.
E. Install removable bird screens in louver frames.
F. Install blank-off panels on continuous ribbons of tape sealant to affect a weathertight seal.
G. Repair finish damaged by cutting, welding, soldering and grinding operations required for fitting and jointing. Restore finish so that there is no evidence of corrective work or return damaged parts to the shop for refinishing.
H. Seal joints between louvers and adjacent construction as specified in Section 07 92 00.

END OF SECTION

DIVISION 09
FINISHES

SECTION 09 05 16 - WATER VAPOR EMISSION CONTROL SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes system for the reduction of moisture vapor transmission and alkalinity control for Interior concrete slabs.

1.2 SUBMITTALS

A. Submit the following product data:

1. Manufacturer’s Specification.
2. Installation Instructions.
3. Independent Test Data.
4. Certification Requirements.
5. Warranty Information.

B. Test results: Submit anhydrous calcium chloride testing according to ASTM F 1869 and/or RH Probe Test according to ASTM F 2170 from independent testing agency.

1.3 QUALITY ASSURANCE

A. Manufacturer qualifications: Firm with not less than 10 years experience in manufacturing water vapor reduction systems.

1. The water vapor reduction system must be specifically formulated and marketed for water vapor reduction and alkalinity control without change of system design for a minimum period of five (5) years.
2. Submit list of product use and performance history, for the same formulation and system design, listing reference sources for at least 3 projects dating back for a minimum of 5 years.

B. Applicator qualifications: Entity currently approved by the manufacturer, experienced in surface preparation and application of the material and subject to inspection of the manufacturer.

C. Independent testing: Manufacturer must provide Independent lab test reports documenting performance per the following:

1. ASTM E 96, Water Vapor Transmission (wet method) Performance shall be documented by an independent testing laboratory at a minimum of 97% water vapor transmission reduction compared to untreated concrete.
2. ASTM E96- Perm Rating - Standard Test Method for Water Vapor Transmission of Materials – Perm Rate results must not exceed 0.1 Perms.
3. ASTM D 1308; Insensitivity to alkaline environment up to, and including, pH 14. A 14 day test is required with no degradation of sample reported.
4. Certify acceptance and exposure to continuous topical water exposure after final cure.

1.4 DELIVERY, STORAGE AND HANDLING

A. Deliver products to the job site in their original unopened containers, clearly labeled with the manufacturer's name and brand designation.
B. Store products in an approved ventilated dry area; protect from dampness, freezing, and direct sun light. Product should not be stored in areas with temperatures in excess of 90 degrees F or below 50 degrees F.
C. Handle product in a manner that will prevent breakage of containers and damage products.

1.5 PROJECT/SITE CONDITIONS

A. Environmental conditions

1. Do not apply moisture vapor reduction system to unprotected surfaces or when water is accumulated on the surface of the concrete.
2. Do not apply water vapor reduction system when temperature is lower than 50 degrees F or expected to fall below this temperature within 24 hours from time of application.

B. Protection: Protect water vapor reduction system to prevent damage from active rain or topical water for a minimum period of 24 hours from time of application.

1.6 SCHEDULING

A. Before installation of VCT, sheet vinyl, rubber flooring, wood, carpet and/or epoxy flooring systems over the interior concrete slabs, anhydrous calcium chloride testing ASTM F 1869 (latest revision) and/or RH Probe Tests ASTM F 2170 shall be performed by the Owner's Special Inspector as outlined In Article 3.1 below.
B. The Owner's Special Inspector will coordinate with the Owner scheduling water vapor reduction system testing and allowing enough time to test, submit and install the water vapor reduction system before installation of floor finish.
C. The Owner's Special Inspector will allow for as much time as is reasonable for the concrete slab to dry before installing anhydrous calcium chloride tests and/or RH Probe Tests. All mastics, glues, and/or contaminants shall be removed to provide a clean, sound, concrete substrate prior to installing anhydrous calcium chloride tests as per ASTM F 1869 (latest revision).
D. The water vapor reduction system must allow installation as early as 7 days after concrete placement.

1.7 WARRANTY

A. Provide manufacturer’s warranty against defects in materials and workmanship for 10 years from Substantial Completion.
B. Correct failures during the warranty period at no cost to Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Water vapor reduction system, which may be incorporated in the work, shall be the product of a single manufacturer.

1. VAP I® 2000 System by KOSTER American Corporation;

2.2 MATERIALS

A. General: Use materials of one manufacturer throughout the project.
B. Koster “VAP I 2000”, 100 percent solids epoxy coating, containing specifically formulated chemicals and resins to provide the following characteristics and properties in a one coat system, complying with the following:

1. Minimum 97 percent water vapor transmission reduction compared to untreated concrete, ASTM E 96, Water Vapor Transmission (wet methods).
2. Not exceeding one perm rating, ASTM E 96 Perm Rating.
3. Insensitivity to alkaline environment up to, and including, pH 14 in a 14-day bath test, ASTM D 1308.
4. Certified acceptance and exposure to continuous topical water exposure after final cure.
5. Water Vapor reduction system shall be a single coat, stand alone system with no requirements for additional components such as sand broadcast for adhesion of flooring systems.
6. Reduce Calcium Chloride readings of up to 25lbs/1000 ft2/24 hrs by 97 percent in one coat.
7. Perform as required with RH Probe readings of 100 percent.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Calcium Chloride and/or RH Probe test requirements:

1. Conduct anhydrous calcium chloride tests according ASTM F 1869 protocols.
2. Provide RH Probe Tests according to ASTM F 2170 protocols.
3. Only conduct calcium chloride tests at the same temperature and humidity expected during normal use. If this is not possible, then the test conditions should be 75 degrees F +/-10 degrees F and 50+/-10 percent relative humidity. Maintain these conditions 48 hours prior to and during testing. Water vapor transmission levels are directly affected by ambient room temperature and readings conducted without a sustained ambient temperature are not acceptable.
4. Submit test results with a marked up floor finish plan showing test results along with a written clarification on status of the ambient air temperature and humidity before start of testing.

B. Concrete Slab Inspection:

1. Test existing slabs (primarily), for concrete deficiencies and contaminates such as un-reacted water-soluble silicates, chlorides, A.S.R. (alkali-silica reaction), to avoid bonding issues. This testing shall be performed by Owner’s independent testing agency using standard coring methods and review of the history of the slab installation if available. Concrete shall conform to ACI Committee 201 Report “Guide to Durable Concrete.”

C. Floor treatment calcium chloride tests: After proper cure (>72 hrs min.) of the moisture vapor reduction system, conduct calcium chloride tests to determine if the level of water vapor transmission and alkalinity are reduced to the Owner's specified levels in conjunction with the flooring manufacturer’s installation requirements.
D. Adhesion tests: Verify proper adhesion of flooring adhesives, coatings, and leveling compounds to the final vapor reduction coating system for acceptability.

3.2 PREPARATION

A. Inspect all surfaces with regard to their suitability to receive moisture vapor reduction system with manufacturer's representative.
B. Clean all surfaces to receive moisture vapor reduction system. Shot blast all floors to a Concrete Surface Profile (CSP) #3 or #4 and clean surfaces with an industrial vacuum cleaner and remove all residues from the substrate. Grinding is allowed only in areas not accessible by shot blasting. Remove defective materials, and foreign matter such as dust, adhesives, leveling compounds, paint, dirt, floor hardeners, bond breakers, oil, grease, curing agents, form release agents, efflorescence, laitance, Shot blast bee bees. Repair cracks, expansion joints, control joints, and open surface honeycombs and fill in accordance with vapor reduction manufacturer's recommendations. If concrete additives such as chlorides or any other soluble compounds that may contaminate surfaces have been used in the concrete mix do not use this product on that floor without written approval from the vapor reduction system manufacturer. Reinforcing fibers that are visible after shot blasting must be removed and vacuumed leaving no fibers left on the concrete surfaces. Provide an uncontaminated, sound surface. Do not acid-etch.
C. Repair concrete prior to vapor reduction system installation by using system manufacturer-recommended bonding agent with approved concrete repair materials. Comply with all requirements as listed in vapor reduction manufacturer's technical data information.
D. Ensure surfaces to be treated with moisture vapor reduction system have not previously been treated with other materials such as underlayments, screeds, penetrating sealants, or silicates. If this is the case, consult with the manufacturer prior to any application of moisture vapor reduction system.
E. Testing for concrete deficiencies or contamination such as alkali silica reaction, untreated silicates, or organic residue is recommended.
F. Shot blast a small test area and inspect surface profile with the finished flooring applicator. As the specified vapor reduction system is not a leveling material, make sure the flooring installer is aware that a feather finish or leveling material may be required to "flatten" or level the vapor reduction-treated concrete prior to flooring installation.

3.3 APPLICATION

A. Coverage rates depend on the surface profile and porosity of the concrete substrate as well as the measured level of moisture. On average, a coverage rate of 75-150 ft2/gal.
B. Apply one coat, using a squeegee and or 3/8 inch nap roller leaving no areas untreated. Allow to cure a minimum of 12 hours before installing flooring system.

3.4 PROTECTION

A. Protect each coat during specified cure period from traffic, topical water and contaminants.

END OF SECTION

SECTION 09 22 16 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes non-structural metal framing (NSMF) as follows:

1. Interior steel studs and furring.
2. Shaftwall framing.
3. Pocket door framing.
4. Horizontal steel suspension systems for support of lath/plaster and gypsum board assemblies.
5. Resilient sound clips.
6. Resilient channels.
7. Backing plates not provided by other trades for support of items attached to metal framing system.

B. Work installed but furnished in other Sections:

1. Access panels furnished by electrical and mechanical trades for access to their work.
2. Backing plates furnished with fixtures and equipment attached to or supported by metal framing system.

C. Related requirements:

1. Division 05 for cold-formed steel framing (exterior walls).
2. Division 09 for gypsum board shaftwall systems.
3. Division 09 for ceiling and soffit suspension systems.

1.2 REFERENCES

A. Lath and plaster framing: Specifications for Metal Lathing and Furring, and Specification Guide For Cold-Formed Lightweight Steel Framing published by the Steel Studs Manufacturers Association.
B. Gypsum board framing: ASTM C 754, Installation of Steel Framing Members to Receive Screw Attached Gypsum Wallboard, Backing Board or Water-Resistant Backing Board.
C. Welding: AWS D1.1, Structural Welding Code, Steel, and D1.3, Structural Welding Code, Sheet Steel.
D. Studs and runners:

1. ASTM C 955, Specifications for Load Bearing (Transverse and Axial) Steel Studs, Runners (Tracks), and Bracing or Bridging, for Screw Application of Gypsum Board and Metal Plaster Bases.
2. ASTM C 645, Specifications for Non-Load (Axial) Steel Studs, Runners (Track), and Rigid Furring Channels for Screw Application of Gypsum Board.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Pre-construction meeting: Prior to starting erection of the NSMF, but not later than one week prior to commencing work, arrange a preliminary meeting with trades associated with the work of this Section.

1. Presided over by Contractor, include subcontractor performing work of this Section, testing company representative, as appropriate, and a representative of the Fire Marshall.
2. Review locations of access panels, fire hose cabinets and fire extinguisher cabinets; the latter with a representative of the Fire Marshall.
3. Identify those locations on the slab. Use a removable marker where the slab is scheduled to remain exposed in the Work.
4. Review installation methods, procedures, time schedule and conditions under which work will proceed, including stud manufacturer's instructions and coordination required with related work.
5. Review and verify availability of materials and installer’s experience.
6. Record meeting minutes and distribute PDF copy to all concerned, including the Architect, within 48 hours of the meeting.

B. Coordination:

1. Notify concerned trades of items required to be incorporated into work of other Sections. Certain components specified under this Section includes items which are closely integrated with doors, glazing assemblies and work specified in other Sections that require close coordination with the work of this Section.
2. Be responsible for coordination required to ensure correct installation procedures and results.
3. Verify actual locations of embeds and existing adjacent structural supports by field measurements before erection and indicate measurements on Shop Drawings. Coordinate tolerances of other trades that may affect the work of this Section prior to start of Shop Drawings preparation.

1.4 SUBMITTALS

A. Data: Manufacturer Product Data consisting of a complete list of materials together with brochures and descriptive data of all items proposed for use.
B. Load tables: Load tables and deflection table properly annotated for anticipated use for all studs.
C. Shop Drawings: Large scale, dimensioned Shop Drawings of all assemblies showing the following.

1. Component details, framing layout, framed openings, anchorage to structure, seismic bracing, type, and location of fasteners and welds, and accessories required of related requirements.
2. Framing member size and gage designations, number, type, location, and spacing.
3. Indicate attachments, clips, strapping, bracing, splices, bridging, accessories, and details required for proper installation. Show and dimension all concealed backing plates required for wall-attached or wall-mounted items indicated; obtain dimensions from trades that will provide these items.
4. Indicate and identify all fasteners and welds (with AWS symbols).

D. Certificates:

1. Mill certificates signed by framing member/accessory manufacturer certifying compliance with material requirements.
2. Welders' certificates.

1.5 QUALITY ASSURANCE

A. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified according to the product-certification program of the Certified Steel Stud Association, the Steel Framing Industry Association, or the Steel Stud Manufacturers Association.
B. Fire resistance: Where a fire resistance classification is indicated, provide materials, accessories, and application procedures listed by UL, or tested according to ASTM E 119 for the type of construction shown, and acceptable to authorities having jurisdiction.
C. Welding work qualifications:

1. Qualify welding procedures and welding operators in compliance with AWS "Qualification" requirements for AWS D1.3.
2. Use qualified welders experienced in welding light gage steel, and comply with AWS D1.1 and D1.3.
3. Verify that welders to be employed in this work have satisfactorily passed AWS qualification tests.
4. If recertification of welders is required, retesting will be Contractor's responsibility.

1.6 HANDLING

A. Store materials under cover, off the ground or floor, in a dry, ventilated space.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. General: One of the following systems of the size indicated and gage required to comply with criteria specified.
B. Shaftwalls:

1. ClarkDietrich Building Systems.
2. Marino\Ware.
3. USG J-runners, E and C-H studs.
4. SCAFCO Corp. Shaftwall Studs.

C. Elsewhere:

1. CEMCO.
2. ClarkDietrich Building Systems.
3. Marino\Ware.
4. SCAFCO Corp.

2.2 PERFORMANCE REQUIREMENTS

A. Unless otherwise indicated, NSMF requires deferred submittal (design/build). The Contractor is required to design, within the dimensional parameters indicated, engineer and install the NSMF assemblies to withstand the following loads, applied perpendicular to walls at the point of largest deflection, within the specified deflection limits.

1. At stairs, elevator hoistways, and other vertical shafts: 10 psf.
2. At ground floor lobbies opening to the outside: 15 psf.
3. At partitions to receive stone cladding and lath and plaster: 15 psf.
4. Elsewhere: 5 psf.

2.3 STUDS, RUNNERS AND FURRING

A. Studs:

1. Shaftwalls: As specified above.
2. For low (Pony) walls: Scafco Corp. “Pony Walls” assemblies, or equal.
3. Elsewhere: Channel type cold-formed steel members with punched web, complying with the following, as applicable.

a. Roll-formed from galvanized steel meeting ASTM A 653, Classification SQ, Grade 33; galvanized meeting G60 for 18-gage and lighter gage.
b. For 16-gage and heavier, provide ASTM A 653, Classification SQ, Grade 50; galvanized meeting G60.
c. Protective coating: ASTM A 653, G40 zinc coating.
d. Bracing: Where the wall finish does not adequately brace both flanges of studs, add bracing or reduce allowable stresses in computing stud heights in compliance with Code.

B. Top and bottom runner, and bridging:

1. As recommended by the manufacturer of each stud type and of same-gage as stud in same wall or partition, unless otherwise indicated on the Drawings. Provide unpunched, screwable tracks, gage to match studs, 1-1/2-inch flanges.
2. For shaftwalls: Where studs extend to the underside of floor or roof slabs, secure at top with “Fire Trak Cavity Shadowline” track by Fire Trak Corp. or other Code-compliant assemblies acceptable to the Architect.
3. For other fire-rated partitions: “MaxTrk” or “Blazeframe” both by ClarkDietrich Building Systems, “Fire Trak” by Fire Trak Corp., "Sliptrack Systems, Inc. "Slip-Trk" for fire-rated partitions, Fire Trak Corp. “VertiTrack VTD VTX” by the Steel Network, Runners by Blaze Frame, or other Code-compliant assemblies acceptable to the Architect.
4. Elsewhere: Use either “Slip Track 250” by ClarkDietrich Building Systems, or equal track matching (as a minimum) the stud gage in same wall but with a 2-1/2 inch leg, or a deep leg 54 mils thick (16-gage) minimum slip connection to accommodate slab deflection.

C. Joist framing:

1. Steel Joists: Manufacturer standard C-shaped steel joists, of web depths indicated, punched or unpunched, with stiffened flanges, and as follows.

a. Minimum base-metal thickness: 20-gage minimum.
b. Flange width: 1-5/8-inch, minimum.

2. Steel joist track: Manufacturer standard U-shaped steel joist track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:

   a. Minimum base-metal thickness: 20-gage minimum.
   b. Flange width: 1-5/8-inch, minimum.

D. Furring channels:

1. For gypsum board and soffit board:

   a. Zee furring channels: 30 mils thick (20-gage) model ZFN3 by Dietrich Industries, Inc. of depth to match insulation thickness, or equal.]
   b. All others (except resilient channels): 18 mils thick (25-gage) minimum, galvanized, hat-shaped.

2. For lath/plaster: 3/4-inch size as specified hereafter for runner channels.

E. Prefabricated headers: At the Contractor's option, ProX Header assemblies by Dietrich Industries or Cemco may be used in lieu of job-assembled headers.

F. Horizontal stiffener, runner channels and bridging: 54 mils thick (16-gage) channels fabricated of cold-rolled steel, ASTM A 366, with flanges not less than 7/16-inch wide. Minimum weights as follows:

Channel Size	Flange Width	Pounds/1000 linear foot
3/4-inch	7/16-inch	300
1-1/2-inch	7/16-inch	475
2-inch	19/32-inch	590

G. Resilient channels: RC-1 by USG, R/FC-1 by Dale Industries, Resilient Channels by Scafco, fabricated from steel sheet complying with ASTM A 924 or ASTM A 568.

H. Resilient sound clips: Super Soundproofing Co., "SSP Sound Isolation Clips" or Acoustical Surfaces, Inc. "Noise STOP clips RSIC-1."

2.4 FASTENERS AND ACCESSORIES

A. For low (Pony) walls: Use "Floor Anchor" stud reinforcement by Pinquist Tool & Die Co., Inc. at every stud.

B. Screws:

1. ASTM C 1002 for metal framing 18 mils thick (25-gage) and lighter, ASTM C 954 for heavier metal framing, 3/8-inch head diameter, corrosion-resistant pan head screws; length and gage required by Code, or recommended by the metal framing manufacturer when not prescribed by Code.
2. For soffits and overhead surfaces, use with appropriate washers but not less than one-inch OD by 1/4-inch ID by 54 mils thick (16-gage) cut washer.
3. Screws for gypsum board mounted on resilient channels shall have a maximum length of one-inch for one layer and 1-5/8-inch for 2 layers.

C. Shot pins: 0.140-inch diameter low velocity powder-actuated drive pins equivalent to Ramset/Red Head No. 1508, or equal, with 7/8-inch minimum penetration into concrete.

D. Anchor bolts: ASTM A 307, non-headed type.

E. Expansion shields: FS FF-S-325, except do not use lead, fiber and plastic shields.

F. Furring channel clips: Manufacturer standard clips for attaching gypsum board furring channels to runner channels.

G. Welding electrodes: ASTM A 233, as recommended by AWS for the conditions of use and the metals to be welded.
H. Wire: ASTM A 641, galvanized, soft-annealed steel, minimum gage as follows.

1. Ceiling and soffit suspension system: 8 BW gage.
2. Furring channel to runner channel: 16 BW gage.
3. Ties and splices in channels: 18 BW gage.

I. Pocket door framing: By Pemko, or equal, complete with extruded aluminum track and aluminum-reinforced studs.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions and measurements affecting the work of this Section at site.
B. Correct detrimental conditions before proceeding with installation.

3.2 PREPARATION

1. Ceiling anchorage:

   a. Coordinate installation of ceiling suspension systems with installation of overhead structural assemblies to ensure that inserts and other provisions for anchorage to building structure have been installed to receive ceiling hangers that will develop their full strength and at spacing required to support ceilings.
   b. Furnish concrete inserts and other devices indicated to other trades for installation well in advance of time needed for coordination with other construction.

2. Before fireproofing is applied, attach offset anchor plates or ceiling runners (tracks) to surfaces indicated to receive sprayed-on fireproofing. Where offset anchor plates are required, provide continuous units fastened to building structure not more than 24 inches o.c.
3. After fireproofing has been applied, remove only as much fireproofing as needed to complete installation of metal framing assemblies without reducing thickness of fireproofing below that required to obtain fire-resistive rating indicated. Protect remaining fireproofing from damage.

3.3 INSTALLATION VERTICAL FRAMING

A. General:

1. Erect metal framing systems in compliance with their manufacturer's recommendations, the reference standards, the Drawings and these Specifications.
2. Use minimum 33 mils thick (20-gage) studs at the following locations:

   a. Door openings.
   b. Studs supporting cement backer boards.
   c. Studs supporting backing plates, plumbing fixtures and wall-supported cabinets.
   d. Elsewhere as indicated.

3. Do not attach metal framing and suspension wires to ducts, conduits or pipes. Do not allow metal framing and suspension wires to contact pipes.
4. Isolate framing from transfer of structural loading, both horizontally and vertically. Provide slip or cushioned type joints to attain lateral support and avoid axial loading.

5. Cut framing components squarely for a tight fit against abutting members. Erect framing plumb and level to provide solid backing for finish materials. Install all steel studs in a wall/partition so that their flanges point in the same direction.
6. Do not exceed a 1/8-inch in 10 feet deviation (non-cumulative) from true lines and levels, or 1/4-inch from true position. Perform necessary remedial work on framing to achieve specified tolerances.

B. Wall/partition framing:

1. Layout partitions, soffits and ceiling breaks, and permanently mark on slabs and soffits.
2. Align and securely anchor ceiling and floor tracks to building construction.
3. Space anchors within 6 inches of ends of each track segment and at 24 inches o.c. maximum. Do not drive fasteners closer than 2 inches to slab or curb edge.
4. Frame all openings in stud walls. Provide double studs, closer spacing, and additional reinforcement as detailed or required at door frames, borrowed light frames (interior windows), and recesses for equipment.
5. Frame both sides of control joints in gypsum board surfaces, and Portland cement plaster surfaces with separate studs and discontinuous runner; do not bridge the joint with system components or accessories.
6. Assemble corners using a minimum of 3 studs.
7. Install studs in single length, without joints, extending from floor to underside of floor or roof structure above, except where indicated on the Drawings to stop at or above suspended ceilings. Splicing studs is not permitted without the Architect's approval.
8. Where studs stop at or above suspended ceilings, unless otherwise indicated, brace every fourth stud (maximum) with opposite stud bracing at 45-degree angle securely anchored to the floor or roof above.
9. Offset studs where required so that finished wall surface will be flush.
10. Where curved walls are indicated, space studs at no more than 9 inches o.c.; space stud closer where radius requires it. Cut outside leg and entire web of runners at 2 inches intervals for the length of the arc then attach a 1-inch wide by 18 mils thick (25-gage) steel strip securely inside the cut leg of runners lapping uncut leg a minimum of 4 inches.

    a. As an option to the above, Contractor may use curved runners by Radius Track or Flex-C Trac by Flex-Ability Concepts.
    b. Position a stud at the beginning and end of each arc, with intermediate studs equally spaced between end studs of arc.

11. Attaching studs to runner:

    a. +Attach studs to tracks by friction fit for single stud gypsum board partitions.
    b. Attach the following studs to runner tracks with screws or with a crimping tool in compliance with the stud manufacturer's printed instructions, except where indicated to be welded.

        1) Studs with gypsum board on only one side.
        2) Studs in curved walls.
        3) Studs supporting lath/plaster assemblies.
        4) Studs supporting stone veneer**.**
        5) Studs on each side of doors and windows.
        6) Studs supporting wall hung plumbing fixtures.
        7) Studs supporting wall hung urinal screens, toilet compartments, cabinets and equipment.

    c. Attach corner studs, partition intersections, studs on each side of door jambs, and other openings in walls/partitions as specified in Paragraph "b" above.
    d. Weld studs where indicated on the Drawings.

12. Unless otherwise indicated, provide horizontal stiffeners consisting of 3/4-inch channels spaced at not more than 54 inches o.c. maximum in all partitions/walls supporting wall supported cabinets and lath/plaster assemblies, and stone. Tack-weld stiffeners to each stud.

    a. Provide an additional 3/4-inch channel 6 inches above door head and extend 2 stud spaces beyond jamb studs.
    b. Install channels in longest possible lengths; lap 12 inches and wire-tie at joints. Do not tie channels on opposite sides of staggered and double stud partitions together.

13. Double gypsum board studs (face to face to form a tube) adjacent to doors and openings. Extend studs at door openings to slab or deck above and anchor securely to bottom track (as specified in subparagraph 10.b. above) and to top slab or deck with clip angles.

    a. Locate additional studs not more than 2 inches from door and window frames, abutting partitions, partition corners, and other construction.
    b. Install a section of track over door and window frames with a clip angle at each end and attach securely to the adjacent vertical studs.
    c. Install cut-to-length studs at the location of vertical joints and at standard spacing over the door frame header extending to the ceiling track.

14. Install studs 2 inches away from abutting concrete, steel columns or other structural elements. Extend the horizontal stiffeners and attach it to the structural element.
15. Provide additional framing, as required, for attachment of electrical boxes, fire extinguisher cabinets and similar items located in stud walls.

C. Resilient furring channels:

    1. Install, with mounting flange down, at right angle to studs, starting within 2 inches of floor and 6 inches from ceiling.
    2. Splice channels directly over studs and attach through both flange to studs.
    3. Space channels as indicated on the Drawings.
    4. Drive screws through channel attachment flange and studs at each intersection.

D. Resilient sound clips: Install the resilient clips in accordance with their manufacturer's instructions, and the following at the spacing indicated.

    1. Install clips level and aligned on each wall.
    2. Space bottom clips (and supported channel) no more than 3 inches from floor.
    3. Space top clips (and supported channel) no more than 6 inches from ceiling.
    4. Install furring channels securely in each clip.

3.4 SUSPENDED FRAMING FOR LATH/PLASTER AND GYPSUM BOARD ASSEMBLIES

A. Space 1-1/2-inch main runners not over 4 feet o.c. in any dimension so that hanger wires do not support more than 12 square foot of ceiling. Attach hanger wires from in-place floors and roof as indicated on the Drawings. Do not use shot pins.
B. Hang suspended framing independent of walls, columns, pipes, ducts, and conduits, and their insulation.
C. Do not attach wires to, or bend around, interfering material such as ductwork, pipes and conduits. Provide trapeze, or equivalent devices substantiated by detailed Shop Drawings and calculations, where obstructions interfere with direct suspension.
D. Space runner channels not more than 6 inches from parallel walls or beams. Align runner channels accurately relative to indicated ceiling height and saddle-tie with hanger wires. Lap channels 12 inches at splices and tie at each end of lap.

E. Attach furring channels to runner channels with 16-gage tie wire or clips. Space at not over 12 inches o.c. for lath/plaster assemblies, and 16 inches o.c. for gypsum board. Locate approximately 2 inches from parallel walls. Lap channels 12 inches at splices and tie at each end of lap.
F. Assemble and install metal grillage so that it is rigid, square, and free of movement, and level within the tolerances specified.
G. Provide seismic bracing and compression struts as required by Code.

3.5 FURRING

A. Provide furring attached to concrete and metal framing to conceal utilities, furred soffits, and other furring as indicated.
B. Furring to receive gypsum board shall be screw-on channels directly attached to backing material, or applied over runner channels as applicable.
C. Furring to receive plaster shall be 3/4-inch cold-rolled channels wire tied to 1-1/2-inch runner channels.
D. Space furring as indicated for studs.

3.6 WELDING

A. Perform welding in compliance with AWS recommendations. Welders shall be qualified to weld lightgage metal. Provide stitch plates where studs are burned-through.

3.7 BACKING PLATES

A. Backing plates may be omitted if anchorage for wall-hung items is directly into steel studs of 43 mils thick (18-gage) or heavier, or items are furnished with equal mounting devices.
B. Wall-mounted and wall-hung items that require backing plates, without limitation, include the following:

1. Wall supported railings.
2. Grab bars.
3. Toilet compartments and screens.
4. Toilet room accessories.
5. Lockers
6. Wall and base cabinets.
7. Plumbing fixtures.
8. Ladders.
9. Elevator screens.
10. Wall mounted door stops.
11. Bracket-mounted fire extinguishers.
12. Signage.
13. Window shades.
14. Wall mounted furniture.
15. Wall mounted bench in the shower stall.
16. Visual display and tack boards.

C. Unless otherwise indicated, plates not provided with fixtures and equipment shall be long enough to span, as a minimum, across 3 studs and may be one of the following:

1. Fifty-four mils thick (16-gage) minimum steel plate by 4 inches wide.
2. Fifty-four mils thick (16-gage) unpunched wide flange stud by 4 inches wide.

D. Notch studs so that backing plate will be flush with exterior face of stud.
E. Weld plates continuously along all contact surfaces at each stud crossing, or secure with 2 countersunk machine screws at each stud.

END OF SECTION

SECTION 09 22 26 - CEILING & SOFFIT SUSPENSION SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes ceiling and soffit suspension systems for gypsum wallboard assemblies.
B. Related requirements:

1. Division 08 for access panes and their frames.
2. Division 09 for the following:

a. Light gage metal support wall systems.

1.2 DESCRIPTION

1. Metal grillage suspended from floor structure above and designed to support a finished ceiling consisting gypsum boards and lath and plaster.

1.3 REFERENCES

A. Comply with the following:

1. DSA IR-25-2.
2. DSA IR 25-3.

1.4 SUBMITTALS

A. Shop Drawings:

1. Dimensioned Shop Drawings of all ceiling and soffit suspension and framing system at 1:48 scale for plans and 1:24 for details.
2. Show plan layout.
3. Detail attachment to overhead construction.
4. Identify and dimension adjacent materials and supports.

B. Data: Manufacturer’s Product Data, specifications and installation instructions for each type of suspension system, including provisions for fixture and equipment anchorage.

1.5 HANDLING

A. Store materials undercover, off the ground or floor, in a dry, ventilated space.

PART 2 - PRODUCTS

2.1 PERFORMANCE CRITERIA

A. Ceiling suspensions systems shall safely support dead loads (ceiling, work of other trades supported by the ceilings such as annunciators, fire alarm and their accessories) with a maximum deflection of finished ceilings of L/360 for lath/plaster and L/240 for gypsum board.
B. Ceiling suspensions systems shall be designed and constructed to safely resist seismic loads and movements without failure of their components, except minor damage (cracks) to the ceiling finish.

2.2 MATERIALS

A. Metal channels: ASTM C 645, galvanized in compliance with ASTM A 924, G60 coating designation.

1. Framing, furring and stiffening:

Size	Type	Pounds per 1,000 linear feet
3/4-inch with 7/16-inch flanges	Cold-rolled	300
One-inch	Hot-rolled	410
1-1/2-inch with 7/16-inch flanges	Hot-rolled	475
2-inches	Cold-rolled	590

2. Furring channels: Minimum 16 mils thick (26-gage) galvanized steel with knurled faces, hat-shaped or Zee section as required.

B. Hanger wire: Galvanized, soft, mild annealed steel, 0.145-inch diameter (8 BW gage) unless otherwise indicated.
C. Diagonal bracing wire: Galvanized, soft, mild annealed steel, 0.109-inch (12 BW gage) unless otherwise indicated.
D. Tie-wire: 0.0598-inch (16-gage), galvanized, single-strand annealed steel or 0.0478-inch (18-gage), galvanized, double-strand annealed steel.
E. Fasteners and attachments:

1. Screws: ASTM C 1002, 3/8-inch head diameter, cadmium-plated pan head screws; length and gage required by CBC or recommended by recommended by manufacturer for uses and materials involved.
2. Furring channel clips: Manufacturer standard clips for attaching gypsum board furring channels to runner channels.
3. Welding electrodes: ASTM A 233, as recommended by AWS for the conditions of use and the metals to be welded.
4. Hanger and bracing wire fasteners for concrete and metal deck with structural concrete fill: Unless otherwise indicated, provide ITT Phillips Drill Div., Red Head Sleeve Anchor No. TW-1614, 5/16-inch diameter, minimum 2-1/4-inch embedment.

F. Uplift stiffeners: 0.0209-inch (25-gage) channel studs, 1-1/2-inch or compression posts indicated on the Drawings.
G. Grid Suspension System for Gypsum Board Ceilings: ASTM C645, direct-hung system composed of main beams and cross-furring members that interlock.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions and measurements affecting the work of this Section at site.
B. Correct detrimental conditions before proceeding with installation.

3.2 CEILING SUSPENSION FRAMING

A. Space main runners as indicated so that hanger wires do not support more than 12 square feet of ceiling.
B. Hang suspended framing independent of walls, columns, pipes, ducts, and conduits, and their insulation.

C. Do not attach wires to, or bend around, interfering material such as ductwork, pipes and conduits. Provide trapeze, or equivalent devices substantiated by detailed Shop Drawings and calculations, where obstructions interfere with direct suspension.

D. Space runner channels not more than 6 inches from parallel walls or beams.

1. Align runner channels accurately relative to indicated ceiling height and saddle tie with hanger wires.
2. Lap channels 12 inches at splices and tie at each end of lap.

E. For gypsum board ceilings, install 7/8-inch hat channels perpendicular to carrying channels, spaced 16 inches o.c. and within 6 inches of walls.

1. Provide one-inch clearance between furring channels and abutting walls and partitions.
2. Attach to carrying channels with furring channel clips or wire-tie with triple wrap and triple twist.
3. At splices, nest furring channels with a minimum 8 inches overlap and wire-tie each end.

F. Install 4-way, 45-degree diagonal bracing wires in a 12-foot grid maximum.

G. Stiffener:

1. For gypsum board ceiling/soffits, install uplift stiffener for each 144 square feet of ceiling, consisting of a vertical metal stud occurring at the junction of the carrier and furring channel. Wire-tie to carrier or screw to channel and secure to overhead structure.
2. For exterior plaster ceilings/soffits, use either 2 channels back-to-back wire-tied together, or rigid electrical conduit. In both cases, make the stiffener shorter than the hanger wires to accommodate ceiling/soffit movement.

H. At control joints, provide discontinuous lap in main runners occurring over joints.

1. Do not bridge joints with cross furring where joints run perpendicular to furring.
2. Where joints run parallel to furring, provide furring to support each side of joint.

I. Provide recesses and openings where indicated for lighting fixtures, registers, access panels and other items to be installed in ceilings. Provide additional furring channels where required by opening condition.

J. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.

K. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION

SECTION 09 24 00 - LATH AND PORTLAND CEMENT PLASTER

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Lath and lathing accessories.
2. Portland cement plaster (ST-1, ST-2).

B. Related requirements:

1. Section 09 90 00 for field painting over integral color plaster.

1.2 SUBMITTALS

A. Data: Manufacturer Product Data for fiber reinforcement, additives, metal lath and metal trim members.
B. Shop Drawings: Dimensioned drawings showing the following.

1. Windows and other openings and penetrations in plaster walls.
2. Proposed locations and types of metal lathing accessories (screeds, control joints, etc.) in plaster surfaces.
3. Schedule of proposed control joints and metal trim items keyed to minimum 1/8-inch scale building elevations.

C. Affidavit: Signed by materials supplier stating that sand delivered to jobsite complies with the requirements of this Section.

1.3 QUALITY ASSURANCE

A. Mockups: Assist in building composite mockup for each glass product indicated below in accordance with the following requirements, using materials indicated for the completed Work.

1. See Section 01 48 38 for composite mockup.
2. Build mockup in the location and of the size indicated or, if not indicated, as directed by Architect; finish as specified.
3. The Architect will inspect the mockup for color and texture. Make all corrections required, including the construction of additional mockups if the first one is disapproved, until Architect's approval is secured.
4. Promptly remove rejected mockup(s) from the jobsite and dispose of it (them) off the site.
5. The remainder of the cement plaster installed on the job shall match the approved mockup finish.

1.4 HANDLING

A. Delivery: Deliver materials, except sand and water, to the site in sealed containers or bags clearly identified with manufacturer's name, brand, type and grade.
B. Storage: Store lathing materials on platforms under plastic sheeting. Store plastering materials, including sand, on platforms under plastic sheeting to prevent hydration or contamination.

1.5 JOB CONDITIONS

A. Protect adjacent surfaces from damage as a result of plastering operations.
B. Protect plaster against extreme climatic conditions, including uneven and excessive evaporation from hot dry air.

PART 2 - PRODUCTS

2.1 LATHING MATERIALS

A. Paper weather barrier: 2 layers complying with UBC 94 Standard y14-1 and FS UU-B-790, Type I, Grade D (vapor permeable), Style 2, except with a water resistance of 60 minutes; Fortifiber Corp. "Super Jumbo Tex" or equal.
B. Lath:

1. Comply with DSA's IR 25-4 requirements.
2. Vertical applications – three coat system: Structa-Mega Lath.

a. Weight 1.95 lb/yd² (1.1 kg/sq.m).
b. Finish – Class 1 Galvanized Coating complying with ASTM A641.
c. Alternate lath to 3.4 lb/yd² diamond mesh metal lath specified in ASTM C847.
d. As per IAPMO – UES 2017.

3. Horizontal applications without sheathing: V Truss Wall & Ceiling – Rib Lath.

a. Weight 2.2 lb/yd² (1.2 kg/sq.m).
b. Finish – Class 1 Galvanized Coating complying with ASTM A641.
c. Alternate lath to 3.4 lb/yd² rib metal lath specified in ASTM C847.
d. As per IAPMO – UES 2017.

4. Horizontal applications with sheathing: Structa-Mega Lath.

a. Weight 1.95 lb/yd² (1.1 kg/sq.m).
b. Finish - Class 1 Galvanized Coating complying with ASTM A641.
c. Alternate lath to 3.4 lb/yd² diamond mesh metal lath specified in ASTM C847.
d. As per IAPMO - UES 2017.

C. Tie-wire: Galvanized, annealed steel wire 16-gage for lath-to-supports and 18 gage for accessories-to-lath.
D. Fasteners for Attaching Metal Lath to Substrates: ASTM C1063.

2.2 PLASTERING MATERIALS

A. Pre-mixed, fiber-reinforced brown and scratch coats: "Fiber 47 Fastwall Scratch and Brown" by La Habra/Parex, "BMI 690 Plaster, Standard with Fibers" by Sika/BMI Products, or equal.
B. Pre-mixed finish coat:

1. 534 Sand Fine standard acrylic finish (16/20), custom colors selected by the Architect at specific locations shown on drawings.

C. Fiber glass reinforcing mesh: Heavy-duty glass fiber mesh with a coating compatible with Portland cement plaster, "CrackShield" by LaHabra, or equal by Omega Products International, Cota Industries, Inc., or Dryvit. Provide 48 inches wide rolls.
D. Acrylic admixture: "Acrylic Bonder" by La Habra, or equal by Synergy, C-Cure or Standard Drywall Products, Inc. Use same manufacturer's products for all plaster coats.
E. Reinforcing mesh adhesive: "Stucco Level Coat" by Parex, or equal compatible adhesive with brown and finish coats, as recommended by the mesh manufacturer.
F. Pipe and electrical boxes flashing: Quickflash assemblies by Quickflash Products – no known equal.
G. Sealant: Silicone sealant as specified in Section 07 92 00.
H. Water: Potable and fresh, from domestic source.

2.3 PLASTER MIXES

A. General:

1. Mix each batch for the same amount of time.
2. Mix batches the same size, using the same amount of water, to ensure consistency.
3. Briefly re-mix before using (approximately 2 minutes).
4. Use immediately after mixing. Do not retemper.
5. Add admixture after dry components and the majority of the water have been mixed. Mix no longer than required to provide a uniform mixture. DO NOT OVER-MIX.
6. Do not re-temper mixes over 20 minutes old.

B. Plaster proportions:

1. Base coats: Mix bagged sand/fibers with acrylic admixture (one quart for an 80 lbs bag of premixed scratch and brown coats, unless other proportions are recommended by the manufacturer.
2. Finish coat: Specified premixed finish coat.

C. Mixing: Mix as accurately as possible. Add ingredients to the mixer from calibrated containers. Do not use materials that are caked, lumpy, dirty or contaminated by foreign materials.

2.4 ACCESSORIES

A. General: Galvanized steel, unless otherwise specified.
B. Aluminum reveals molding: Fry-Reglet, sizes and location as shown on the drawings. Aluminum shall be extruded alloy 6063 T5. See RV-1 through RV-4 on Drawings for shapes.

1. Shop prime reveals to receive final paint under Section 09 90 00.

C. Reinforcement

1. Interior Corners: No. 30
2. Exterior Corners: V Truss Corners – Exterior Corner Reinforcements.

a. Bullnose, & One Coat profiles.
b. Finish – Class 1 Galvanized Coating complying with ASTM A641.
c. As per IAPMO – UES 2017.

3. Screeds and Molds: Per Plaster and Drywall Systems Manual, size and profile as indicated on the Drawings and as necessary to suit application.
4. 22-gauge galvanized steel. Hem exposed edges. Furnish in longest possible lengths.
5. Furnish drip screeds with weep holes every 2-inches.

D. Trim:

1. Hot-dip galvanized steel trim: Basis of design is for minimum 26-gage, supplied in longest obtainable sing lengths to minimize joints, by CEMCO or Stockton Products as indicated, or equal by Amico, Brand X Metals Inc., Keene/Metalex Corp., Superior or Unimast Inc.
2. At locations where new trim will contact or continuation of existing trim, shapes shall be identical.

a. Control joint expanded wing control joint: “No. XJ15” by CEMCO.
b. Drip: "DHF" by Stockton.
c. Casing: “J-B with 3-1/2-inch solid flange” by Stockton.
d. Weep screed: “WWW-S” by Stockton.

PART 3 - EXECUTION

3.1 EXAMINATION/PREPARATION

A. Examine conditions and measurements affecting the work of this Section at site.
B. Before plastering begins, insure that adjacent finish work is well protected with waterproof covers securely taped in place and Air & Water Barrier is installed to provide a watertight installation.
C. Before enclosing stud walls, thoroughly clean space of debris.
D. Correct other detrimental conditions before proceeding with installation.

3.2 GENERAL

A. The applicable provisions of ASTM C 1063 and ASTM C 926, govern the work of this Section, except as specified herein.

3.3 PAPER WEATHER BARRIER

A. Install over the gypsum sheathing and framing members with a minimum of fasteners.
B. Lap shingle fashion 2 inches at horizontal joints and 6 inches at vertical joints. No weather barrier is required on soffits. Stagger vertical joints.
C. Continue weather barrier uninterrupted behind control joints.
D. Lap over flange of accessories to prevent direct contact between lath and accessories and to ensure water tightness.
E. Interface weather barrier with flashing materials at windows, doors, and elsewhere, to properly discharge water to the exterior face of the wall. Absence of flashing must be corrected prior to installing weather barrier.
F. Interface weather barrier with flashing materials to properly discharge water to the exterior. Correct absence of flashing prior to installing weather barrier.
G. Seal unused holes from fasteners in weather barrier with silicone sealant specified in Section 07 92 00.

3.4 LATHING

A. Comply with ASTM C 1063, except as specified below, and where Code requirements are more stringent.
B. Apply lath taut, with long dimension at right angle to supports. Work from right to left, extend both horizontal and vertical factory flaps. Make sure that paper weather barrier encloses all surfaces to be plastered.
C. Apply first course at bottom and work up. Make overlaps shingle fashion to assure waterproof joints; lap paper-to-paper and lath-to-lath. Stagger vertical joints. Lap joints one-inch minimum and horizontal joints 1/2-inch minimum. Wire-tie intermediate horizontal joints at 9 inches o.c. maximum.
D. Vertical applications – three coat system: Structa-Mega Lath.

1. Attach lath to metal supports, thru weather barrier and waterproof membrane where applicable, at 6-inches o.c.
2. Installation as per UES 2017 - The lath shall be applied to vertical surfaces having metal supports. For use as an alternative to the 1.95 lb/yd² (0.993 kg./m²) welded wire lath specified in ASTM C933 the maximum support spacing shall be in accordance with Table 3 of ASTM C1063 for 1.95 lb/yd² (1.1 kg./m²) welded wire lath.
3. Fastener type and spacing shall be as specified in ASTM C1063 or IRC Section R703.6.1 as applicable for 1.95 lb/yd² (1.1 kg./m²) welded wire lath, except that the fasteners shall attach to the lath to the framing supports either between the primary and secondary

longitudinal wires, or there shall be a staple over any longitudinal wire. The lath shall be lapped a minimum of one mesh at sides.

4. Ends shall be lapped a minimum of one mesh and shall occur over supports. Refer to current manufacturer's instructions.

E. Horizontal applications without sheathing: V Truss Wall & Ceiling - Rib Lath.

1. Installation as per UES 2017 - The lath shall be applied to to horizontal metal supports. For use as an alternative to the 3/8-inch (9.6 mm), 3.4 lb/yd2 (1.8 kg/m2) rib metal lath, the maximum support spacing shall be in accordance with Table 3 of ASTM C1063 for 3/8-inch (9.6 mm), 3.4 lb/yd2 (1.8 kg/m2) rib metal lath.
2. Fastener type and spacing shall comply with ASTM C1063 or IRC Section R703.6.1 as applicable for rib metal lath, except that the fasteners shall attach the lath to the framing supports at every second rib, either at the furring crimps on the vertical cross wires, at the intersection of the longitudinal wire and cross wire, or at any point along the longitudinal wire that is welded to the furring crimp.
3. The lath shall be lapped a minimum of one mesh at sides. End laps shall be a minimum of one mesh and shall occur over supports. The ends of sheets shall be staggered between courses. Refer to current manufacturer's instructions.

F. Horizontal applications with sheathing: Structa-Mega Lath.

1. Attach lath to metal supports, thru weather barrier and waterproof membrane where applicable, at 6-inches o.c.
2. Installation as per UES 2017 - The lath shall be applied to vertical surfaces having metal supports. For use as an alternative to the 1.95 lb/yd² (0.993 kg./m²) welded wire lath specified in ASTM C933 the maximum support spacing shall be in accordance with Table 3 of ASTM C1063 for 1.95 lb/yd² (1.1 kg./m²) welded wire lath.
3. Fastener type and spacing shall be as specified in ASTM C1063 or IRC Section R703.6.1 as applicable for 1.95 lb/yd² (1.1 kg./m²) welded wire lath, except that the fasteners shall attach to the lath to the framing supports either between the primary and secondary longitudinal wires, or there shall be a staple over any longitudinal wire. The lath shall be lapped a minimum of one mesh at sides.
4. Ends shall be lapped a minimum of one mesh and shall occur over supports. Refer to current manufacturer's instructions.

G. At control joints, cut lath but continue paper backing uninterrupted behind lath.
H. Hold lath 1/4-inch clear of electrical boxes, columns and similar items projecting through the plaster.

3.5 METAL TRIM

A. Wire-tie at no more than 24 inches o.c. to metal lath or studs. Fastening accessories with screws is not acceptable.
B. Use trim in single length wherever length of run does not exceed longest standard stock length available. Miter or cope at corners with hairline joints, and seal with sealant specified in Section 07 92 00.
C. Set accessories level, plumb and true to line with a tolerance of not more than 1/8-inch in 5 feet. Shim as required and align joints with concealed splice or tie plates.

1. Where joints meet, make sure that design is uninterrupted, and that joints between accessories are flush, in-line and hairline tight. Where joints occur between parallel stud or channel supports, install an additional support for the individual flanges.
2. Accessories that butt each other need to be lapped, sealed, soldered or welded, and/or stripped with flexible flashing.

D. Install corner reinforcement at external corners.

E. Provide casing beads at the following locations:

1. Where plaster termination abuts other finishes, isolate casing bead from contact with adjacent finishes with 1/4-inch thick tape sealant specified in Section 07 92 00.
2. Where plaster termination is not covered by another finish or applied trim, provide cased opening by installing casing bead around perimeter of opening as detailed.

F. Control joints:

1. Install vertical control joint first, continuous from top to bottom of wall; install horizontal control joints second and split where it meets the vertical control joint.
2. Install joints plumb, level, evenly spaced where so indicated, and in one piece at the spacing indicated.
3. Follow manufacturer's directions for their installation.
4. Maximum area of plaster without control joints shall not exceed 144 sq. ft. within a ratio of 2 to 1.5 (width vs. height). Horizontal or vertical expansion joints shall be located and coordinated with Structural.

3.6 PLASTERING

A. General: Comply with ASTM 926, except as specified below, and where Code requirements are more stringent.
B. Type: Smooth-finished Portland cement plaster installed on metal lath; one-inch total thickness.
C. Allowable tolerances: Maximum deviation from true planes of finish plaster shall not exceed 1/8-inch in 10 feet when measured with a straightedge placed at any point on the plaster.
D. Protection:

1. Protect adjacent surfaces from damage as a result of plastering operations.
2. Protect plaster against extreme climatic conditions, including uneven and excessive evaporation from hot dry air.

E. Application - general:

1. Provide sufficient manpower and equipment to ensure a continuous operation free of cold joints, scaffold lines, texture variations, and other objectionable conditions.
2. Plaster surfaces in one operation once the application of any coat begins.
3. Stop plaster at control joints, edges or corners only. Plaster in one operation, full height and width between control joints.
4. Plaster flush with metal trim members and make corners square and true.
5. Where permanent grounds are too far apart to serve as guides for rodding, provide supplemental plaster screeds as required. Establish true surfaces with rods before setting the screeds. Keep grounds clean and free of plaster.
6. Finish plaster in a true, plumb or level plane flush with grounds.

F. Plastering:

1. Scratch coat: Apply with sufficient material and pressure to form good full keys, and to cover well.

a. Thickness of scratch coat shall be 1/2-inch when measured from backing to crest of scored plaster.
b. Scratch before plaster hardens to provide sufficient mechanical key for brown coat.
c. Cure acrylic-modified plaster in accordance with its manufacturer's instructions, including holidays and weekends. Do not over-wet by excessive curing, unless hot conditions exist.

2. Brown coat:

    a. Dampen the scratch coat thoroughly and apply the brown coat to a 3/8-inch thickness.
    b. Bring to a true, even surface by rodding and floating, and leave slightly rough to receive the reinforcing mesh.
    c. Begin floating only after hydration of the cement has commenced and sufficient moisture has evaporated, so that surface sheen has disappeared, but before plaster has become too rigid to be moved under the float.
    d. Cure acrylic-modified plaster in accordance with its manufacturer's instructions, including holidays and weekends. Do not over-wet by excessive curing, unless hot conditions exist.

3. Reinforcing mesh adhesive:

    a. After the brown coat is properly cured, apply a layer of reinforcing mesh over the brown coat in a 1/8-inch thick bed of cement adhesive.
    b. Cement adhesive may be a proprietary adhesive as specified, or a job-mixed preparation consisting of 48 lb. of common Portland cement, 10 lb. of plaster grit silica sand, and emulsified acrylic admixture mixed with water.

4. Reinforcing mesh: The mesh is required over the brown coat and shall be completely embedded as follows by 3 different methods as selected by the Contractor and successfully demonstrated on the approved mockup. In all cases, completely embed the mesh into the base coat free of wrinkles and fish mouths, and trowel smooth, ensuring that no mesh is visible. A minimum 2-inch overlap is required at mesh joints.

    a. Method One: After application of brown coat and before final set occurs, fully embed mesh into the brown coat.
    b. Method Two: After brown coat has properly cured, apply the base coat over the brown coat a minimum of 1/6-inch thick and completely embed mesh.
    c. Method Three: The finish surface must be clean and free of loose debris, dirt, dust, efflorescence, grease, oil, curing agents and cleaning solutions. Painted or glossy surfaces may need to be roughened to ensure proper bond of the base coat. The substrate must be structurally sound. Apply the base coat over the existing finish a minimum of 1/6-inch thick and completely embed mesh.
    d. After embedding mesh, the surface shall be left suitable for the application of the finish.

5. Finish coat: Apply finish coat when temperatures are between 65 and 90 degrees F.

    a. Apply the finish coat in a double back operation to a total minimum thickness of 3/16-inch.
    b. Trowel on a tight first finish coat a minimum of 1/16-inch thick and draw it up to an even surface before applying the double back coat.
    c. When the finish coat sets, trowel it to smooth and even surface free of tool marks, blemishes or cracks, matching the approved mockup in all respects, as approved by the Architect.

G. Plaster flush with metal frames and other built-in metal items or accessories which act as plaster grounds. Provide a "V" cut with the edge of the trowel where plaster abuts metal frames.

H. Where permanent grounds are too far apart to serve as guides for rodding, provide supplemental plaster screeds as required.

1. Establish true surfaces with rods before setting the screeds.
2. Keep grounds clean and free of plaster.
3. Finish plaster in a true, plumb or level plane flush with grounds.

I. Entire plaster must be flush with top of accessories; wavy finish (higher at accessories than in the field) is not acceptable.

3.7 FIELD QUALITY CONTROL

A. The curing periods recommended by the manufacturer shall be considered as minimum requirements. Be responsible for determining the most effective procedure for curing and time lapse between application of coats, based on climatic and job conditions.
B. Completed plaster shall match approved mockup, be within the tolerances specified, be uniform in thickness, texture and color when applicable, free of cracks, blisters, pits, checks and other defects.
C. Repair, or remove and replace, as determined by the Architect, lath/plaster that does not meet these requirements, with materials satisfactory to the Architect.

3.8 FINISH

A. Finishes for the cement plaster: Sand Float finish throughout the project.

3.9 REPAIRING/CLEANING/PROTECTING

A. Cut, patch, repair and point-up defective plaster. Repair cracks and indented surfaces by moistening plaster and filling with new material, troweled or tamped flush with adjoining surfaces. Point-up finish plaster surfaces around items built into or penetrating the plaster.
B. Promptly remove plaster spatter and droppings from adjacent surfaces. Repair surfaces which have been stained, marred or otherwise damaged during plastering operations at no additional cost to the Owner.

END OF SECTION

SECTION 09 28 13 – CEMENTITIOUS BACKER BOARDS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Waterproof board for [interior and exterior] [restroom] [countertops] [shower] [utility room] [steam room] [swimming pool] [mechanical rooms] [wet areas] where [tiling] is being installed.
   1. Install at [floor] [wall] [ceilings]

1.2 RELATED SECTIONS

A. Section 09 21 16.33 - Gypsum Board Area Separation Wall Assemblies

B. Section 09 30 00 – Tiling

C. Section 22 41 23 Residential Showers

D. Section 22 42 23 Commercial Showers

E. Section 22 43 23 Healthcare Showers

F. Section 22 45 13 Emergency Showers

G. Section 22 46 19 Security Showers

1.3 REFERENCES

A. American National Standards Institute (ANSI):
   1. A118.9 - Test Methods and Specifications for Cementitious Backer Units.
   2. A118.10 - American National Standard Specifications for Load Bearing, Bonded, Waterproof Membranes for Thin-set Ceramic Tile and Dimension Stone Installation.
   3. A108.11 - Interior Installation of Cementitious Backer Units.

B. ASTM International (ASTM):
   1. C947 Standard Test Method for Flexural Properties of Thin-Section Glass-Fiber-Reinforced Concrete
   2. C1325 Standard for Non-Asbestos Fiber-Mat Reinforced Cementitious Backer Units
   3. C1629 - Standard Classification for Abuse-Resistant Non-decorated Interior Gypsum Panel Products and Fiber-Reinforced Cement Panels

C. Tile Council of North America (TCNA):
   1. TCNA Handbook.

1.4 SUBMITTALS

A. Submit under provisions of Section [01 30 00] - Administrative Requirements.

B. Manufacturer's data:
   1. Each product to be installed
   2. Accessory data
   3. Installation requirements
   4. Installer acceptance

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Ten (10) years manufacturing moisture resistant backer boards.

B. Installer Qualifications: Five (5) years tiling, drywall or sheathing installation experience and approved by manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store and handle product following manufacturer and industry requirements.

B. Store indoors in manufacturer's packaging and protect from damage prior to installation.

C. Inspect panels for damage and notify manufacturer of materials requiring replacement.

1.7 PROJECT CONDITIONS

A. Weatherproof and enclose building to maintain a maintained a minimum of 60 degrees F (15 degrees C) and 60% relative humidity.

1.8 WARRANTY

A. Manufacturers Standard: Provide manufacturer's standard thirty (35) year repair or replacement warranty.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer: FinPan, Inc. Hamilton, OH 45015; (800) 544-7398; www.finpan.com

B. Substitutions: [Not permitted] [In accordance with Section 01 16 00]

2.2 MATERIALS

A. Lightweight Waterproof, Insulated Polystyrene Polymer Cement Coated Board
   1. Product: ProPanel by FinPan, Inc.
   2. Composition: High-density expanded polystyrene, double sided cement reinforced panel
   3. Areas of Use: Interior and exterior
   4. Tolerance: Moisture, mold and steam resistant
   5. ANSI A118.10: Section 4-5 Waterproofness
   6. Thickness: [1/4 inch (6mm)] [1/2 inch (13mm)]
   7. Weight: 6 pounds per panel
   8. Width: 3 feet (914 mm).
   9. Length: 5 feet (1524 mm).
   10. Edges: Square.
   11. Density: 2 lb. Density EPS Core
   12. ASTM D4068: Pass, hydrostatic Water Pressure Test
   13. ASTM G21: <10% , resistance to Fungi
   14. ASTM C-627: Light commercial and Residential

B. General High Density Waterproof, Moisture and Mold Resistant Backer Board
   1. Product: ProTec by FinPan, Inc.
   2. Use: Interior and exterior
   3. Tolerance: Moisture, mold and steam resistant
   4. Base: Reinforced cementitious board
   5. Thickness: [1/4 inch] [1/2 inch] [5/8 inch]

6. Width: 3 feet (914 mm)
7. Length: +5 feet (1524 mm)
8. Edges: Wrapped and tapered
9. Density: 88 lb. per cubic foot
10. ASTM C1325: Type A and B

C. High Impact Resistant, Water, Moisture and Steam Resistant board:
1. Product: Util-A-Crete by FinPan, Inc.
2. Base: Alkaline resistant reinforced cementitious board
3. Use: Interior and exterior
4. Tolerance: Moisture, mold and steam resistant
5. Thickness: [1/4 inch] [1/2 inch] [5/8 inch]
6. Width: 3 feet (914 mm).
7. Length: +5 feet (1524 mm).
8. Edges: Wrapped and Tapered
9. Density: 88 lb. per cubic foot
10. ASTM C1325: Type A and B
11. Compressive Strength: >2,600 psi
12. Flexural Strength: >1,500 psi
13. Fire Rating: 1-hr Rating (minimum 7/16 thickness)
14. Surface Burning: Flame Spread 5
Smoke Level 0

2.3 ACCESSORIES

A. Fasteners
1. Manufacturers recommended corrosion resistant screws.

B. Sealant/Adhesive:
1. Manufacturer recommended SIKA Flex 11 FC one part advanced polyurethane elastomeric sealant/adhesive.

D. Liquid Waterproofing:
1. Manufacturers Water Armor AWB VOC compliant, 100% acrylic air and water barrier for interior and exterior applications.

E. Seaming Tape:
1. Alkali-resistant 2-inch (51 mm) wide fiberglass mesh tape for joint reinforcement.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify framing is level, plumb and adjacent surfaces meet tolerances for installation.

B. For Floors, verify wall substrates are not to exceed maximum deflection allowed under all live, dead and impact and concentrated loads: "L" equals span length in inches.
1. L inches / 360 (L mm / 9144): For thin bed ceramic tile and brick installations.
2. L inches /480 (L mm / 12192): For thin bed stone installations.

C. Verify floor joists spacing do not exceed 19 inches on center.

D. For Countertops, verify surfaces are framed and within countertop manufacturers tolerances.

E. Do not proceed with installation until unsatisfactory conditions have been corrected.

Installation deems acceptance.

3.2 INSTALLATION

A. Review manufacturers instructions and review approved submittals prior to installation.

B. Apply boards horizontally, with ends occurring over supports. Stagger end joints in adjacent rows on walls, ceilings and floors.

C. Cut boards to fit around openings and projections.

D. Mechanically fasten boards, using manufacturers recommend fastener, 8 inches on center.

E. For Tile Installation:
   1. Install tile using a modified thinset, in accordance with the Tile Council of North America (TCNA) guidelines.
   2. Refer to related Division 09 Sections for installing tile using a modified thinset.

D. Apply manufacturers sealant, adhesive, seaming tape and liquid waterproofing as recommended by manufacturer for a warranted installation.

3.3 CLEANING

A. Repair or replace items damaged prior to installing final finished surfaces.

3.4 SCHEDULE

A. Levels of Finish:
   1. High Impact Resistant board [enter location] [showers] [swimming pool walls] [janitor closets] installed at up to 6’ room height and all exterior locations.
   2. General High Density board [at ceilings locations]
   3. Lightweight Waterproof Insulated board [at perimeter wall locations for improved insulation values]

END OF SECTION

SECTION 09 29 00 - GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:
   1. Gypsum board.
   2. Fasteners, joint reinforcing and finishing compound.
   3. Skim coating of concrete soffits and ceilings.

B. Related requirements:
   1. Division[**s 05 and**] 09 for metal framing supporting gypsum board (except for framing specified herein).
   2. Division 06 for gypsum sheathing board.
   3. Division 08 for access panels in gypsum board surfaces.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Scheduling and sequencing:
B. Pre-installation meeting:

1.3 SUBMITTALS

A. Data: Manufacturer Product Data for all materials to be used in gypsum board construction.
B. Shop Drawings: Show proposed locations of control joints. Joint locations is subject to the Architect’s approval and shall be relocated, when requested, at no cost to the Owner.
C. Samples: Three 24-inch square Samples with the medium orange peel spatter coat specified for architect’s approval. Approved sample will become Architect’s control sample.

1.4 QUALITY ASSURANCE

A. Requirements of regulatory agencies:
   1. Comply with fire resistance ratings indicated and required by Code.
   2. Provide materials, accessories and application procedures listed by UL or tested in compliance with ASTM E 119 for the type of construction shown.

B. Mockup:
   1. Where directed, construct a mockup of a gypsum board wall and ceiling inside the building. Make mockup full height (minimum 8 feet high by 8 feet wide) with a 4-foot return.
   2. Tape and finish joints, trim and screw heads as specified for Level 5 herein. Refer to Section 09 90 00 for painting of the mockup with a semi-gloss paint.
   3. The Architect will review the mockup under various light conditions for defects and improperly finished joints, trim and screw heads. Provide a portable light for that purpose when so requested.
   4. Make corrections requested by the Architect, or remove and replace mockup when the corrective work is not acceptable to the Architect.
   5. The approved mockup shall remain in the building until its removal is directed, and will be used as a standard for the gypsum board work for the Project.

1.5 HANDLING

A. Procedure: In accordance with GA 801 "Handling and Storage of Gypsum Panel Products."

B. Storage: Do not overload the floors with localized concentration of gypsum board.

1.6 JOB CONDITIONS

A. Comply with the gypsum board manufacturer's recommendations and GA “Application and Finishing of Gypsum Board” for temperature limitations and ventilation before, during and after installation of gypsum board.
B. Protect installed materials from drafts during hot, dry weather.
C. Illuminate work areas during installation to provide the same or greater level of illumination required to properly perform the work and as will occur in the room or space after the building is in operation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. American Gypsum.
B. CertainTeed Gypsum.
C. Continental Building Products LLC.
D. G-P Gypsum Products.
E. National Gypsum Co./Goldbond Building Products Division.
F. PABCO Gypsum.
G. US Gypsum Co.

2.2 INTERIOR GYPSUM BOARD

A. General:
   1. Provide boards complying with ASTM C 1396 as follows and in maximum lengths available to minimize end butt joints.
   2. Unless otherwise acceptable to the Architect, no end-to-end butt joints are allowed on walls or ceilings less than 12feet long or wide.

B. Gypsum Wallboard: ASTM C1396/C1396M.
   1. Thickness: 5/8-inch.
   2. Long Edges: Tapered.

C. Gypsum Board, Type X: ASTM C1396/C1396M.
   1. Thickness: 5/8 inch.
   2. Long Edges: Tapered.

D. Gypsum Ceiling Board: ASTM C1396/C1396M.
   1. Thickness: 1/2 inch.
   2. Long Edges: Tapered.

E. Abuse-Resistant Gypsum Board: ASTM C1396/C1396M gypsum board, tested according to ASTM C1629/C1629M.
   1. Core: 5/8 inch, Type X.
   2. Surface Abrasion: ASTM C1629/C1629M, meets or exceeds Level 2 requirements.
   3. Indentation: ASTM C1629/C1629M, meets or exceeds Level 2 requirements.
   4. Soft-Body Impact: ASTM C1629/C1629M, meets or exceeds Level 3 requirements.
   5. Hard-Body Impact Resistance: ASTM C1629, meets or exceeds Level 3.
   6. Long Edges: Tapered.
   7. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.

F. Glass-Mat Interior Gypsum Board: ASTM C1658/C1658M. With fiberglass mat laminated to both sides. Specifically designed for interior use.
   1. Core: [As indicated] [1/2 inch (12.7 mm), regular type] [1/2 inch (12.7 mm), Type C] [5/8 inch (15.9 mm), Type X] [5/8 inch (15.9 mm), abuse resistant].
   2. Long Edges: Tapered.
   3. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.
   4.

G. Under ceramic tile: CertainTeed “GlasRoc,” G-P Gypsum “Dens-Shield Fireguard Tile Backer,” or equal paperless, mold-resist gypsum board complying with ASTM D 3273. Gold Bond “eXP Tile Backer” by National Gypsum complying with ASTM C1178 is also acceptable.

H. In unlined air shafts and plenums: USG Sheetrock “Mold Tough,” National Gypsum “XP Mold & Moisture Resistant Gypsum Board, or equal meeting ASTM D 3273 for mold-resistance.

I. Core board: One-inch thick equivalent to USG “Sheetrock Brand Gypsum Liner Panels” or Gold Bond “Shaftliner”.

J. On ceilings: Contractor may use “Gypsum Ceiling Boards.”
   1. ASTM C 1658/C 1658M. With fiberglass mat laminated to both sides. Specifically designed for interior use.
   2. Thickness: 1/2 inch (12.7 mm).
   3. Long Edges: Tapered.

K. For surfaces to be painted in toilet rooms: CertainTeed “Glasroc,” National Gypsum eXP Tile Backer, or equal embedded glass mat gypsum panels.

L. Elsewhere where gypsum board is exposed and painted: Standard, Type X or C boards, as applicable to the assembly. Provide boards with paper face suitable to receive decorative finish, and long edges tapered to receive joint compound.

M. Within 8 feet of floor, except in closets: Abuse-resistant board equivalent to US Gypsum Co. “Fiberock Abuse-Resistant” or equal.

N. Flexible board for curved surfaces:
   1. USG Sheetrock Brand 1/4-inch “Flexible Gypsum Panels” (basis of design)
   2. National Gypsum Co. “High Flex Wallboard”.
   3. Lafarge “Gypsum Flexboard”.
   4. Celotex Flextek.
   5. CertainTeed “ProRoc ¼-inch thick Flex.”]
   6. Georgia-Pacific 1/4-inch “ToughRock Flexroc.

2.3 EXTERIOR GYPSUM BOARD FOR CEILINGS AND SOFFITS

A. Exterior Gypsum Soffit Board: ASTM C1396/C1396M, with manufacturer's standard edges.
   1. Core: [As indicated] [1/2 inch (12.7 mm), regular type] [5/8 inch (15.9 mm), Type X].

B. Glass-Mat Gypsum Sheathing Board: ASTM C1177/C1177M, with fiberglass mat laminated to both sides and with manufacturer's standard edges.
   1. Core: [As indicated] [1/2 inch (12.7 mm), regular type] [5/8 inch (15.9 mm), Type X].

2.4 TILE BACKING PANELS

A. Tile backing panels may be specified in this Section or in Section 093013 "Ceramic Tiling."
   1. Glass-Mat, Water-Resistant Backing Board: ASTM C1178/C1178M, with manufacturer's standard edges.
   2. Core: [As indicated on Drawings] [1/2 inch (12.7 mm), regular type] [5/8 inch (15.9 mm), Type X].
   3. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.

B. Cementitious Backer Units: ANSI A118.9 and ASTM C1288 or ASTM C1325, with manufacturer's standard edges.
   1. Thickness: [1/4 inch (6.4 mm)] [1/2 inch (12.7 mm)] [5/8 inch (15.9 mm)] [As indicated].
   2. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.
   3. According to the International Building Code, water-resistant gypsum backing board is not permitted for use as a backing board for tile in tub and shower areas or as wall board or ceiling panels in shower areas.

C. Water-Resistant Gypsum Backing Board: ASTM C1396/C1396M, with manufacturer's standard edges.
   1. Core: [As indicated on Drawings] [1/2 inch (12.7 mm), regular type] [5/8 inch (15.9 mm), Type X] [Type C as required by fire-resistance-rated assembly indicated on Drawings].
   2.

2.5 ACCESSORIES

A. Screws: The following sized in compliance with the gypsum board manufacturer's instructions and Code requirements.
   1. ASTM C 954 for fastening to supporting studs and furring.
   2. ASTM C 1002, Type G for gypsum board-to-gypsum board.

B. Metal trim: Except where extruded aluminum reveals are indicated, provide Galvanized steel of the types specified hereafter complying with ASTM C 1047.
   1. Extruded aluminum trim: Profiles and dimensions indicated, by Fry Reglet Corp., Stockton Products, or Gordon, Inc.
      a. Reveal picture hangers: Fry Reglet model DRMH-50, 3/4-inch wide aluminum heavy duty aluminum picture hanger track with one-inch wide snap-in clip for picture wires.
   2. LC-Bead: J-shaped; exposed long flange to receive joint compound; use at exposed panel edges.
   3. CB corner bead: Square corner bead.
   4. L-Bead: L-shaped; exposed long leg to receive joint compound; use where indicated.
   5. U-Bead: J-shaped; exposed short flange not to receive joint compound; use at exposed panel edges.
   6. Curved-edge cornerbead: With notched or flexible flanges; use at curved openings.
   7. Control joint: USG No. 093, Goldbond Building Products E-Z Strip or Trim-Tex 093V.

C. Resilient channels: RC-1/FC-1 by Dale Industries, or equal, fabricated from steel sheet complying with ASTM A 924 or ASTM A 568.

D. Zee furring members: Manufacturer's standard Z-shaped furring members with slotted or non-slotted web, fabricated from steel sheet complying with ASTM A 924 or ASTM A 568; with a minimum base metal (uncoated) thickness of 0.0179-inch, face flange of 1-1/4-inch, wall-attachment flange of 7/8-inch, and of depth required to fit insulation thickness indicated.

E. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate

F. Column and beam clips: “Claw” by Claw International, or equal.

G. Joint treatment for paperless assemblies: 2-inch wide fiberglass mesh tape and ToughRock 90 Setting Type joint compound, or equal.

H. Joint tape, compound and laminating adhesive: ASTM C 475, low or very low shrinkage, type recommended by the manufacturer, by Hamilton Materials, basis of design, USG or one of the gypsum board manufacturers named above.
   1. Taping, and fastener and metal trim concealment: Sheetrock Brand Taping Joint Compound, Ready-Mixed by USG.

2. Topping, finish and skim coats: Sheetrock Brand Topping Joint Compound, Ready-Mixed by USG.
3. Joint tape complying with ASTM C475: Sheetrock Joint Tape – Heavy by USG.

I. Gypsum board primer: Flat latex, USG Sheetrock Brand First Coat, Hamilton Prep Coat, La Habra Stucco Zygoplast, or Gold Bond Drywall Primer.
J. Spatter coats (orange peel): USG “Sheetrock Brand Wall and Ceiling Texture,” Beadex FasTex Ready Mix Texture,” or equal by one of the gypsum board manufacturers named above.
K. Skim coat (for concrete soffits/ceilings): Cover Coat or Durabond Setting Type Joint Compound by USG, or equal by one of the gypsum board manufacturers named above.
L. Sealants: As specified in Section 09 80 00.

PART 3 - EXECUTION

3.1 EXAMINATION/PREPARATION

A. Examine conditions affecting the work of this Section at site.
B. Verify framing members’ straightness and alignment.
C. Correct detrimental conditions before proceeding with installation.
D. Before enclosing stud walls and spaces that will be inaccessible after gypsum board is installed, thoroughly clean [**floor tracks and**]spaces of debris and dust.

3.2 RESILIENT FURRING CHANNELS

A. General:
1. Splice channels directly over studs and attach through flange to studs.
2. Space channels as indicated on the Drawings.
3. Drive screws through channel attachment flange and studs at each intersection.

B. Walls: Install channels, with mounting flange down, at right angle to studs, starting within 2 inches of floor and 6 inches from ceiling.
C. Ceilings:
1. Install channels perpendicular to the joists and space at 16 inches o.c. maximum, unless otherwise indicated.
2. Start perimeter channels no more than 2 inches from the intersection of ceiling-to-wall.

3.3 GYPSUM BOARD INSTALLATION - GENERAL

A. Comply with the applicable provisions of the references standards and the following.
B. Use only full size boards above door and window openings; joints at corners of heads are not acceptable.
C. Minimize butt joints and avoid butt joints centered on walls, over protruding studs, and above doors and windows. Avoid abutting end joints in the central area of each ceiling.
D. Install all panels, including those in non-rated applications, with joints in moderate contact.
E. Locate both edge or end joints over supports, except in ceiling applications where intermediate supports or gypsum board back blocking is provided behind end joints.
F. Position adjoining panels so that tapered edges abut tapered edges, and field-cut edges abut field-cut edges and ends.
1. Do not place tapered against cut edges or ends.
2. Where square (non-tapered) joints abut on ceilings, use Trim-Tex “Buttboard” behind the joint in accordance with Trim-Tex recommendations.

G. Stagger vertical joints over different studs on opposite sides of partitions.

H. Attach gypsum panels to steel studs so that the leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
I. Attach gypsum panels to framing provided at openings and cutouts.
J. Provide perimeter relief where board abuts structural decks, ceilings, vertical structural elements, or glazed assembly.
K. Install horizontal boards first. Butt joints between boards loosely. Do not force boards into place. Place tapered or wrapped edges next to one another.
L. Attach boards to all studs and furring members with power-driven screws securely engaging supporting member, and with fastener heads uniformly depressed not over 1/32-inch below surface of board (except for first layer of multiple layer assembly) without breaking face paper.
M. After boards have been installed over screws and backing plates, tap boards with a rubber mallet to depress backside of board over heads to eliminate unacceptable bulges.

3.4 SINGLE LAYER APPLICATION

A. Horizontal surfaces:
   1. Install board with long dimension at right angle to supports, with end joints located over supports.
   2. Use maximum practical length boards to minimize end joints. Stagger end joints in alternate boards.

B. Vertical surfaces: [**Except as specified for curved surfaces below, and**]Unless otherwise acceptable to the Architect, install board vertically. Use floor-to-ceiling length boards (unless height exceeds 12-foot) with vertical joints located over supports.
   1. At [**stairwells and other**] high walls, install panels horizontally, unless otherwise indicated or required by fire-resistance-rated assembly.
   2. Offset joints at least one stud on opposite sides of partition/walls.
   3. Extend gypsum board continuously from finish floor to underside of structure above, except where indicated otherwise on the Drawings.

3.5 MULTIPLE LAYER APPLICATION

A. On vertical surfaces:
   1. Install board vertically using floor-to-ceiling length boards (unless height exceeds 12 feet) with vertical joints located over studs.
   2. Offset joints at least one stud spacing on opposite sides of partitions and between subsequent layers of gypsum board.
   3. Fasten all layers of gypsum board to metal framing with screws.

B. Where gypsum board will be applied to curved surfaces, use multiple layers of 1/4-inch thick panels specified above.
   1. Select board length and cut board to allow one unbroken board to cover curved surface and 12-inch minimum tangents at each end.
   2. Install boards with long edge at right angle to framing on the convex side of the assembly and attach to support from one end to other; on the concave side start attaching the boards from the center to the edges.
   3. Make cutouts for penetrations after the boards are in place, not before installation.
   4. Completed installation shall present smooth, unbroken curves. Segmented surfaces are not acceptable.

3.6 ALLOWABLE TOLERANCES

A. Do not exceed 3/16-inch in 8 feet, and 1/8-inch in 4 feet from plumb, level and flat (all directions) in gypsum board surfaces.
B. Do not exceed 1/8-inch from geometry indicated for vaults and other curved surfaces.

C. Do not exceed 1/16-inch offset at joints between boards.
D. Shim boards as necessary to comply with these tolerances.

3.7 SEALANTS

A. The following is required at perimeter and penetrations of all gypsum boards in pressurized stair shafts and air plenums. These areas must be air-tight at the design pressures indicated.
   1. Clean space to be calked of debris, dust and powdered materials which would prevent the sealant from adhering properly.
   2. Seal openings between gypsum board and the perimeter of items penetrating gypsum board, such as electrical boxes, continuously using sealant specified.
   3. Seal openings between the gypsum board, and floors and ceilings along gypsum board assemblies continuously, and along those intersecting assemblies for a minimum distance of 3-foot on each side. When multiple layers occur, seal the perimeter of each layer continuously.

3.8 FINISHING

A. Finish gypsum board surfaces with exposed joints, corners and edges reinforced or trimmed in compliance with GA-216, the following and to match approved mockup where applicable.
B. General:
   1. Fill joints, fastener heads, trim accessory flanges and surface defects with joint compound in compliance with the gypsum board manufacturer's recommendations to obtain a smooth, flush surface.
   2. All joints, fastener heads and trim flanges in surfaces which will remain exposed to view in the building, shall be invisible after application of joint tape and compound.
   3. Fill and finish gypsum board-clad columns with a straightedge from corner bead to corner bead to eliminate concave surfaces between beads.

C. Trim: Install in single unjointed length, unless length exceeds manufacturer's standard. Attach to gypsum board in compliance with their manufacturer's instructions.
   1. Install Type CB trim at external corners.
   2. Install Type LC trim where gypsum board edges are exposed in the finish work.
   3. Install Type CB or LC trim where gypsum board abuts a different material, and the edges are not covered by a finish material.
   4. Install control joints at no more than 30 feet o.c. in any direction (full height door frames count as control joints). Joint locations are subject to the Architect's approval. When "through wall" control joints are required in fire-rated assemblies, comply with WH International, Inc. Report WHI 651-0318.1.

D. Joints: Reinforce joints between gypsum boards, and interior corners and angles with tape set in joint compound.
   1. Apply skim coat over tape in one application.
   2. Where space greater than 1/16-inch occurs between abutting gypsum boards (except at control joints and for concealed layers of multiple layer assemblies), pre-fill joints with joint compound and allow to dry before applying joint tape.
   3. All joints and interior angles shall have tape embedded in joint compound and 2 separate coats of joint compound applied over all flat joints and one separate coat of joint compound applied over interior angles.

E. Joint compound:
   1. Lap each coat not less than 4 inches over the preceding coat (2 inches on each edge). Width of joint compound on tapered board edges shall be not less than 12 inches; width of joint compound on square board edges not less than 18-inch.
   2. Cover fastener heads and accessories with 3 separate coats of joint compound.

3. Allow at least 24 hours drying time between applications of joint compound.
4. Finish joint compound so that little or no sanding is required. When sanding, use sandpaper or mesh cloth with grit as fine as possible; do not scuff face paper. Remove sanding dust before painting or applying other finishes.

F. Finishing levels:
1. Level 0: Use for first layer of multiple layer construction and gypsum board ledge guards in elevator shaft.
2. Level 1: Use in plenum areas above ceilings, interior faces of shafts, in attics, and in areas where the assembly will generally be concealed.
3. Level 2: Use where gypsum tile backer board is used as a substrate for tile, in storage and similar areas where surface appearance is not of primary concern.
4. Level 3: Use in areas to receive heavy or medium texture (spray or hand-applied) finishes before final painting, or where heavy grade wall coverings are to be applied as the final decoration.
5. Level 4: Use for all other areas to be painted and where light texture or backed lightweight wall covering will be applied.
6. Light orange peel wall and ceiling coat: Spray-apply in long, even strokes as uniformly as possible avoiding lap marks, and to achieve spatter sizes and density to match approved mockup.
7. Level 5 – skim coat (spray and roller-applied finish is not acceptable):

    a. Use for all other areas to be painted. Finish, including joints and fasteners as follows to match approved mockup.
    b. Apply a thin skim coat of joint compound to the entire surface to result in a smooth surface free of tool marks and ridges. Use setting-type, sandable topping compound or drying-type; do not use all-purpose compound consisting of high-build interior coating product designed for application by airless sprayer.

G. Skim coat on concrete surfaces: Apply over clean, dry concrete surfaces to a smooth, uniform finish free of trowel marks and other defects. Match approved mockup.
H. Leave gypsum board surfaces smooth, undamaged and ready to receive scheduled finishes.

END OF SECTION

SECTION 09 30 00 - TILING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Stone floor tile. (STF-1).
2. Stone wall base. (STB-1).
3. Exterior porcelain wall tile. (TL-1a, 1b, and 1c)
4. Interior porcelain floor tile and base. (TL-2, TLB-2 and TLB-2A)
5. Interior ceramic wall tile. (TL-3)
6. Interior Accent wall porcelain mosaic tile. (TL-4)
7. Interior porcelain mosaic tile. (TL-5)
8. Interior porcelain wall mosaic tile. (TL-6)
9. Waterproofing membrane.
10. Setting materials, grouts and sealants.
11. Floor sealer.

B. Related requirements:

1. Divisions 07 and 09 for sealants other than specified herein.
2. Division 09 for lath and scratch coat on walls.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Scheduling and sequencing:
B. Pre-installation meeting:

1. Prior to start of installation arrange a pre-installation meeting between the waterproofing manufacturer authorized representative, the Contractor, and the tile installer to review Project conditions, the Drawings, Specifications and the waterproofing manufacturer data. The Architect may attend.
2. If more than one trade will be responsible for the successful performance of the work of this Section, these trades shall attend the meeting.
3. Identify areas of concern and remedial measures.
4. Record meeting minutes and distribute copy to all concerned, including the Architect, within 48 hours after the meeting.

C. Manufacturer’s inspections:

1. Request the manufacturer's presence before start of this work to verify substrate acceptability, and as required thereafter to review installation procedures and completed work, and to issue warranty specified.
2. Unsatisfactory conditions disclosed by the manufacturer visits to the site shall be promptly and satisfactorily repaired and the areas re-inspected by the manufacturer before work starts or resumes in affected areas.

1.3 SUBMITTALS

A. Data: Manufacturer Product Data for waterproofing membrane, pre-mixed mortars and grouts, with certification that they meet ANSI standards specified.

B. Shop Drawings:

1. Show locations of each type of tile and tile pattern; widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.
2. If joints occur in substrate to be tiled, show their locations on the Shop Drawings.

C. Samples:

1. Twenty-four-inch square Samples of each type and color of tile glued to hardboard backing; grout joints, if less than 24-inch tiles.
2. Each type, color and shape of trim and base.
3. Six-inch long transition threshold between stone and sports flooring, finished as specified.

D. Test Results: Submit test results in accordance with the test methods specified performed by a certified testing laboratory for each material specified.

1.4 QUALITY ASSURANCE

A. Uniformity:

1. Obtain each color, grade, finish, type, composition, and variety of tile from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work.
2. Obtain materials of a uniform quality from one manufacturer for each cementitious and admixture component and from one source or producer for each aggregate.

B. Installer qualifications: Experienced firm who has successfully completed tile installations similar in material, design, and extent to that indicated for Project for at least 5 years.

C. Mockups: Before starting tile installation, erect one mockup for each form of construction and finish required. Build mockups complying with the following, using materials indicated for final Work.

1. Make each mockup a minimum of 6-foot square. Locate on site where directed by the Architect.
2. Mockups many remain part of the building where approved by the Architect.

D. Master grade certificate: Submit, bearing the Certification Mark of the Tile Council of North America, Inc. (TCNA), signed by the tile manufacturer, stating the type and quality of each type of tile delivered to the job site.

1.5 HANDLING

A. Procedure: In accordance with ANSI A137.1 for labeling sealed tile packages.
B. Delivery: Deliver tile cartons with grade seals unbroken.

1.6 JOB CONDITIONS

A. Set and grout this work when ambient temperature is at least 50-degree F or higher. Do not install materials on surfaces (or when ambient temperature) is less than 40-degree F.
B. Illuminate work areas during installation to provide the same or greater level of illumination required to properly perform this work and as will occur in the room or space after the building is in operation.

1.7 MANUFACTURER SPECIAL WARRANTY

A. Warrant tile installation, including grout and waterproofing (system warranty), against faulty materials and workmanship for 15 years after Substantial Completion.
B. Make repairs required during the warranty period at no cost to the Owner.

1.8 MAINTENANCE

A. Furnish one full box of each type, color and size of tile properly packaged and identified, by room or area.

PART 2 - PRODUCTS

2.1 PREFORMANCE REQUIRMENTS

A. Dynamic Coefficient of Friction: For tile installed on walkway surfaces, provide products with the following values as determined by testing identical products per ANSI B101.3:

1. Level Surfaces: Minimum 0.42 (Wet).
2. Step Treads: Minimum 0.42 (Wet).
3. Ramp Surfaces: Minimum 0.60 (Wet).

B. Static Coefficient of Friction: For tile installed on walkway surfaces, provide products with the following values as determined by testing identical products per ANSI B101.1:

1. Level Surfaces: Minimum 0.60 (Wet).
2. Step Treads: Minimum 0.60 (Wet).
3. Ramp Surfaces: Minimum 0.80 (Wet).

2.2 MATERIALS – GENERAL

A. All components of the waterproofing and tile setting assemblies must be made or distributed by the same manufacturer to obtain warranty specified.

2.3 TILE

A. Tile: Make, size, and colors indicated on Drawings.

1. Trim: Provide matching base, caps, stops, returns, trimmers required to complete the installation.

B. Factory-blending: For tile exhibiting color variations within the ranges selected during sample submittals, factory-blend tiles and package accordingly so that tiles taken from one package show the same color range as those taken from other packages, and match approved Samples.

2.4 STONE THRESHOLDS

A. White veined marble, MIA Group A complying with ASTM C 503 for exterior use and abrasion, uniform in color, with a minimum H_a of 12 when tested in accordance with ASTM C 1353.
B. Fabricate with a uniform honed (400 to 1,200 grit abrasive) finish on exposed surfaces for a tight fit against door jambs and a smooth transition between tile and adjoining floor surface.
C. Bevel edges at 1:2 slope, aligning lower edge of bevel with adjacent floor finish. Limit height of bevel to 1/2-inch or less.

2.5 SETTING MATERIALS AND GROUT

A. Portland cement: ASTM C 150, Type 1.
B. Sand: ASTM C 144.
C. Water: Potable, fresh.
D. Setting bed reinforcing mesh: 2-inch by 2-inch by 16/16, 3-inch by 3-inch by 13/13 or 1-1/2-inch by 2-inch by 16/13 wire complying with ASTM A 82 or A 185.
E. Thin set, latex modified dry-set mortar: The following or equal with physical properties equaling or exceeding those of the products specified. Do not apply more than 1/4 inch thick and do not use for tiles larger than 15 inches complying with ANSI A118.15, A118.4, A118.11 and ISO 13007 C2EP1.

1. Thin set:

a. MerKrete “705” and “735,” Mapei “Ultraflex 1 and 3,” or MerKrete “750 RS” or “Granirapid” as selected by the installer for the conditions of use.
b. MerKrete “Integra” or Mapei “Adesilex” white for glass tile, glass mosaic and marble mosaic.
c. MerKrete “200/211” or Mapei “Kerabond/Keralastic” for water features.

2. Medium bed: MerKrete “720 Marble Pro” or Mapei “Granirapid” for tiles over 15 inches in any dimension, and as specified for other locations.
3. Custom (basis of design): FlexBond.
4. Mapei: Ultra Flex III.
5. Laticrete: 254 Platinum.

F. Medium bed: latex modified dry-set mortar: The following or equal with physical properties equaling or exceeding those of the products specified. For setting bed from 1/4- to 3/4-inch thick and for tiles larger than 15 inches in any dimension complying with ANSI A118.15, A118.4, A118.11 and ISO 13007 C2EP1.

1. Custom (basis of design): ProLite Tile & Stone Mortar.
2. Mapei: Ultraflex LFT.
3. Laticrete: 220 Marble & Granite w/3701 Mortar Ad-Mix.

G. Portland cement grout: One of the following, or equal with physical properties equaling or exceeding those of the products specified, sanded or unsanded as applicable to the joint width and recommended by the grout manufacturer.

1. Custom (basis of design): Sure Color Grout.
2. Mapei: Ultracolor Plus.
3. Laticrete: Perma Color.

2.6 MISCELLANEOUS MATERIALS

A. Crack-Isolation Membrane: ANSI A118.12.
B. Transition strip between stone flooring and sports flooring: Schiene by Schluter or equal.

1. Material: Brushed stainless steel.

C. Wall outside corners: Schiene by Schluter or equal.

1. Material: Brushed stainless steel.

D. Acoustical underlayment: “Sound Shield 7000” by Merkrete/Parex USA, Inc., or equal with the following characteristics.

1.	Weight	30.15 oz./yard^2.
2.	Thickness	0.10-inch.
3.	Density	25.5 lbs./cubic foot.
4.	Compression resistance at 25 percent	145.4 psi.
5.	Compression resistance at 50 percent	exceeds machine limit.
6.	Breaking strength	Length 78.4 lbs.; width 63.3 lbs.
7.	Compression set at 25 percent	20.7 percent.
8.	R value at 0.10-inch thickness	4.2 inch.
9.	Custom (basis of design): Shower Slope System.	

E. Patching mortar: Quick-setting, polymer-modified, fiber-reinforced, cementitious rendering, patching, ramping and leveling mortar; can be applied from 1/8 inch to 1-1/4 inches (3 mm to 3.2 cm).

1. Product: MAPEI, Planitop 330 Fast, or equal.

F. Sealant and backup for control joints in tiles: Refer to Section 07 92 00.
G. Cleavage membrane: 10-mil thick polyethylene complying with ASTM D 2103, Type 13300.
H. Waterproof membrane: One of the following that complies with ANSI A118.10 and ANSI A118.12. Include reinforcement and accessories recommended by manufacturer at exterior applications.

1. Hydro-Guard SP-1 by MerKrete.
2. Mapei: Mapelastic 315.
3. Hydro Ban by Laticrete.
4. Redgard by Custom Building Products.
5. Custom 9240 by Custom Building Products.
6. Or equal.

I. Reinforcing fabric: Custom (basis of design): Antifracture Membrane Mesh.
J. Floor Sealer: Manufacturer's standard product for sealing grout joints and that does not change color or appearance of grout.

PART 3 - EXECUTION

3.1 EXAMINATION/PREPARATION

A. Examine conditions and measurements affecting the work of this Section at site.
B. Remove glaze and contaminants, including remaining adhesive and setting bed, from floors by scraping, wire-brushing or with a self-contained bead blasting apparatus.
C. Verify that surfaces to be tiled are firm, dry, clean, and free from oil or waxy films and curing compounds, and within the following tolerances:

1. Thin-set tiles:

a. 1/8-inch in 10 feet for floors and 1/8-inch in 8 feet for walls for tiles longer than 15 inches.
b. 1/4 inch for smaller tiles.

2. Mortar-set tiles: 1/4-inch in 10 feet for floors and 1/4-inch in 8 feet for walls.
3. Maximum deflection of walls to be tiled: L/360 under loads prescribed by Code. Coordinate this requirement with other design criteria specified in Section 09 22 16.

4. Maximum deflection of floors to be tiled: L/360 when measured under a 300 lb. concentrated load (ASTM C 627).

D. Examine that installation of grounds, anchors, recessed frames, electrical and mechanical work, and similar items located in or behind tile have been completed before installing tile.
E. At the Contractor's option, "Grout Easy" by Aldon Corp., or equal water-based, water soluble product may be used prior to installing porous and quarry tile.
F. Correct detrimental conditions before proceeding with installation.

3.2 WATERPROOFING MEMBRANE

A. General: Application: Comply with the waterproofing membrane manufacturer's instructions, ANSI A 108.13, and the following.
B. Surface preparation:

1. Mask adjacent areas not to be waterproofed.
2. Prepare surfaces to be waterproofed so that they are clean, smooth and free of contamination.
3. Repair defects such as honeycombs, rock pockets, cracks, gaps, penetrations and protrusions. Remove glaze from concrete as recommended by the waterproofing manufacturer.
4. Prime/seal concrete and vertical substrates.

C. Apply waterproofing in 2 coats when substrate temperature is above 40-degrees F.
D. Install reinforcing fabric, where recommended by the waterproofing manufacturer, in waterproofing liquid at drains, coves, corners, over cracks and gaps in substrate.
E. Avoid interruptions during installation of membrane; if interrupted, clean interface surfaces to assure adhesion.
F. Completed membrane shall be uniform in thickness and texture, monolithic and waterproof.
G. Keep traffic on completed membrane to a minimum. Cover traffic path until tile is installed.
H. Set tile no sooner than 24 but no more than 72 hours after membrane installation.

3.3 GENERAL TILE INSTALLATION REQUIREMENTS

A. General: Install proprietary materials in compliance with their manufacturer's instructions. Press or beat the tiles to obtain 90 percent coverage of mortar on back of tile, except for the following which requires 100 percent coverage:

1. Tiles in "wet" areas.
2. Edges and corners of all tiles regardless of location.
3. Back butter tile if necessary.

B. Environmental conditions: Maintain minimum temperature limits and installation practices recommended by waterproofing membrane, mortar and grout materials manufacturers in areas where this work is performed.
C. Terminations: Terminate work neatly at obstructions, edges and corners without disrupting pattern or joint alignment. Saw-cut and drill tiles to obtain tight fitting, clean, sharp, undamaged cut edges.

1. Rub cuts smooth with fine abrasive stone.
2. Cut and drill so that electrical outlets, plumbing fixtures, pipes, fixtures and fittings standard plates, escutcheon and collars will overlap the tile.
3. Do not cut or split tile at penetrations.

D. Visual requirements:

1. Install tile in patterns indicated with uniform joints and perimeter units not less than 1/2 unit wide. Adjust to minimize cutting.
2. Accurately set tile with flush well-fitted joints, finished in true planes, plumb, square, sloped or level as required.
3. Form corners, returns, and exposed tile edges with approved trimmers.
4. Where tiles selected by the Architect are installed in the same plane, but are of a different thickness, it is the Contractor responsibility to adjust the setting bed or mortar thickness so that all tiles are flush.
5. Under no circumstances will glazed tile installations be accepted if any part of unglazed tile body remains exposed after tile is installed.
6. Provide matching tile trimmers of all types required to prevent such condition.

E. Tolerances: Maximum deviation from true lines and levels shall not exceed 1/8-inch in 10 feet for floors, and 1/8-inch in 8-foot for walls.

F. Sealant: Calk penetrations in tile with sealant and backing rod specified in Section 07 92 00. Provide movement joints where indicated or as recommended by TCNA Method EJ171-13.

G. Tile blending:

1. For tile exhibiting color variations within the ranges selected during sample submittals, verify that tiles have been factory-blended and packaged accordingly so that tiles taken from one package show the same color range as those taken from other packages, and match approved Samples.
2. If not factory-blended, either return to manufacturer or blend tiles at Project site before installing.

H. Floor Sealer: Apply floor sealer to grout joints in tile and stone floors according to floor-sealer manufacturer's written instructions. As soon as floor sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.

3.4 TILE INSTALLATION METHODS

A. Exterior wall (vertical) installation: Apply a mortar bed over CMU, a crack-isolation membrane with a waterproof membrane under ceramic tile as described in TCNA W211.

B. Exterior soffit installation: Provide a cementitious backer board with bond coat and ceramic tile as described in TCNA C315.

C. Wall tile: Install over gypsum backer board over waterproofing membrane in compliance with ANSI A108.5 and TCNA installation method W245, modified to be used over waterproofing membrane.

D. Floor tile: Install over waterproof membrane (installed on a dry setting bed) and TCNA installation method F121. Lay setting bed on cleavage membrane on suspended slabs.

E. Floor tile: Install over waterproof membrane in compliance with ANSI A108.5 and TCNA installation method F122.

F. Sound tile after setting. Replace or reset hollow sounding units.

G. Install marble thresholds as specified for tiles above and in compliance with TCNA installation method TR611.

3.5 GROUTING/CURING

A. Grouting: Comply with ANSI A108.10. Finish joints of square edge tiles flush with tile surfaces; finish joints of cushion edge tiles to depth of cushion. Finish grout free of voids and pits.

1. Fill epoxy-filled joints flush with tile edges. The epoxy will cure to a slight depression.

3.6 SEALANTS

A. Comply with sealant manufacturer's instructions and ASTM C 1193.
B. Install backing rod and fill joints completely with sealant tooled below surface of tile. Do not disturb until fully cured.

3.7 FIELD QUALITY CONTROL

A. Plug drains and dam door and other openings after waterproofing is installed and flood the floor with approximately 2-inch of water.

1. Let the water stand undisturbed for 48 hours and check for leaks.
2. Repair discovered leaks and retest; repeat as necessary to stop leaks before proceeding with tile installation

3.8 CLEANING/PROTECTING

A. Cleaning:

1. Clean tile and repair faulty grouting. Sponge and clean surfaces with clean water and soft brushes.
2. Polish glazed tile after cleaning with clean, dry cloths.

B. Protect completed installations until acceptance by the Owner.
C. Protect floor tiles with reinforced Kraft paper or other heavy covering securely taped in place during the construction period to prevent damage and stains. Remove protection when no longer needed.
D. When recommended by tile manufacturer, apply a coat of neutral protective cleaner to completed tilework.
E. Prohibit foot and wheel traffic from tiled floors for at least 7 days after grouting is completed.
F. Before final inspection, remove protective coverings and rinse neutral cleaner from tile surfaces.
G. Leave finished installation clean and free of cracked, chipped, broken, unbonded, or otherwise defective tiles.

END OF SECTION

SECTION 09 51 13 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Acoustical ceiling panels. (ACT-1, ACT-1A, ACT-2, ACT-2A, ACT-3).
2. Metal suspension system.

B. Related requirements:

1. Other Section of Division 09 for metal suspension systems for gypsum board ceilings.
2. Divisions 21 and 26 for mechanical and electrical work in acoustical ceilings.

1.2 SUBMITTALS

A. Shop drawings:

1. Show ceiling layouts, seismic bracing (lateral and vertical), method of suspension where interference such as ducts and pipes exists, with light fixtures, grilles, sprinkler heads, speakers accurately located, and typical details of constructions and installation.
2. Where pipes, ducts and conduits prevent direct suspension, and trapezes have to be used, justify the suspension system with structural calculations.
3. Reproduction of the Contract Drawings as Shop Drawings is not acceptable; take necessary measurements at the job site.

B. Data:

1. Manufacturer product specifications and installation instructions for ceiling materials, and suspension system.
2. Include satisfactory test data certifying that the acoustical units comply with Code requirements.
3. Evidence that acoustical units comply with Code for flammability, combustibility and toxicity.

C. Samples:

1. Full size acoustical units showing the full range of color and texture to be expected in the completed work. Where actual size exceeds 2 ft by 2 ft, provide 2 ft by 2 ft samples.
2. Twelve-inch long Samples of each linear component of the suspension systems and Samples of connectors.

D. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Ceiling suspension-system members.
2. Structural members to which suspension systems will be attached.
3. Method of attaching hangers to building structure.
4. Carrying channels or other supplemental support for hanger-wire attachment where conditions do not permit installation of hanger wires at required spacing.
5. Size and location of initial access modules for acoustical panels.

6. Items penetrating finished ceiling and ceiling-mounted items including the following:

    a. Lighting fixtures.
    b. Diffusers.
    c. Grilles.
    d. Speakers.
    e. Sprinklers.
    f. Access panels.
    g. Perimeter moldings.

7. Show operation of hinged and sliding components covered by or adjacent to acoustical panels.
8. Minimum Drawing Scale: 1/8 inch = 1 foot (1:96).

E. Warranty: Proposed warranty form.
F. Closeout: Manufacturer recommendations for cleaning and refinishing ceiling materials, including precautions against materials and methods that may be detrimental to finishes and acoustical performances.
G. Seismic restraint: Include calculations for seismic restraints including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.3 QUALITY ASSURANCE

A. Design criteria: Suspension system shall have a “Heavy Duty” classification when tested in compliance with ASTM C 635.
B. Sample panel:

1. Install a 10-foot square sample panel of the acoustical ceiling for the Architect's approval before proceeding with this work.
2. Locate where directed by the Architect in the building.
3. Do not proceed with remainder of this work until Architect’s approval is obtained.
4. The finished work shall match approved sample panel and, if properly identified for future reference, may remain a part of the finished work, when approved by the Architect.

1.4 HANDLING

A. Delivery: Deliver UL labeled cartons of acoustical units bearing label classification of acoustical and flammability characteristics.
B. Storage:

1. Store acoustical panel cartons open at each end to stabilize moisture content and temperature, in fully enclosed space(s), in well-ventilated area protected from weather, moisture, soiling, extreme temperatures and humidity.
2. Before installing acoustical tiles, permit them to reach room temperature and a stabilized moisture content.

C. Handling: To avoid chipping edges or otherwise staining or damaging units.

1.5 JOB CONDITIONS

A. Do not install acoustical ceilings until the space to receive them is enclosed and weathertight, until work above ceilings is completed, and until ambient conditions of temperature and humidity will be continuously maintained at values near those indicated for final occupancy.

B. Illuminate work areas during installation to provide the same or greater level of illumination required to properly perform the work and as will occur in the room or space after the building is in operation.
C. Do not use ceiling panels in extreme or continuous high humidity, or areas exposed directly to weather or water.
D. Allow time for dimensional changes in ceiling panels stored at temperature/humidity conditions well outside of those recommended for service; with increases in temperature/humidity, these products expand (up to 1/64-inch/foot at 85-degree F and 90 percent RH) and may not fit into a fixed grid.

1.6 SPECIAL WARRANTY

A. Submit a warranty, on manufacturer’s letterhead, stating that manufacturer agrees to repair or replace acoustical panels that fail within the warranty period. Failures include, but are not limited to:

1. Acoustical panels: Sagging and warping.
2. Grid system: Rusting and manufacturer's defects.

B. Warranty period:

1. Acoustical panels: 10 years from date of Substantial Completion.
2. Grid: 10 years from date of Substantial Completion.

C. The warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under the requirements of the Contract Documents.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS:

A. Design ceiling components to ensure that light fixtures and installed accessories will not induce concentrated loads.
B. Where components may induce rotation of ceiling system components, provide stabilizing reinforcement.
C. Design ceiling components to limit deflection of completed ceilings to L/360.

2.2 ACOUSTICAL UNITS

A. Manufacturers:

1. Basis of Design: Armstrong World Industries.

a. See Drawings for list of ACT panels.

2. Or equal. Other manufacturer’s products must meet similar specified quality and be approved by Architect.

2.3 SUSPENSION SYSTEM

A. Grillage:

1. Configurations as indicated, by Armstrong World Industries, USG Corp., Chicago Metallic Corp., or equal. See Drawings for type of systems required.
2. Components die-cut and interlocking.
3. Cope cross runners to lay flush with main runners, except at edge moldings.

B. Hanger wires: Galvanized carbon steel, ASTM A 641 soft-temper, prestretched, yield-stress load of at least 3 times design load, 12-gage minimum.

C. Accessories:

1. Devices for attachment to overhead construction, secondary members, splines, splicers, connection slips, wall connectors and all other accessories required for a complete installation.
2. Field assembled compression post (strut):

    a. Cold-or hot-rolled angles, steel studs, EMT or rigid conduit, or black iron.
    b. Cold-rolled steel section with maximum L/R ratio of 200.

3. Seismic compression struts: As detailed in Drawings.

D. Trim:

1. As required by details, construction, and compatible with design and appearance of ceiling.
2. Provide perimeter trim not less than 2 inches wide at tile support point.

    a. Depth of trim a detailed.

3. Perimeter trim and trim in ceiling penetrations shall permit lateral adjustment of at least 1/2-inch to accommodate irregularities in vertical surfaces interrupting ceiling.

E. Finish:

1. Concealed ferrous metal surfaces: Galvanized, cadmium-plated or coated with a factory-applied rust-inhibitive paint.
2. Exposed metal surfaces: Prime and apply a satin baked-on enamel finish matching the color of the acoustical units, as approved by the Architect.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions and measurements affecting the work of this Section at site.
B. Correct detrimental conditions before proceeding with installation.

3.2 INSTALLATION

A. General:

1. Install materials in compliance with the approved Shop Drawings, the Specifications, and the ceiling panel and suspension system manufacturers' instructions. In case of conflict, the most stringent provisions apply.
2. Comply with ASTM C 636 and E 580, governing regulations and industry standards applicable to this work.
3. Install materials so that the sound insulation of adjacent construction materials and assemblies is not compromised by locally reducing their surface mass, or creating unsealed penetrations.
4. Plan layout to balance border widths at opposite edges of each ceiling area.
5. Avoid use of less than half-width acoustical units wherever possible.
6. Comply with reflected ceiling plans shown on the Contract Drawings.

3.3 SUSPENDED GRILLAGE INSTALLATION

A. Anchor hanger wires to overhead construction as indicated on the Drawings.
B. Attach hanger wires at not more than 4-foot o.c. along each member supported directly from hanger, with a hanger not more than 8 inches from wall and end of each member.
C. Hang ceiling system independent of walls, columns, pipes, ducts, and conduits, and their insulation; maintain minimum distance from end of grid to wall of 3/4-inch.
D. Do not attach wires to, or bend around, interfering material such as ductwork, pipes and conduits. Provide trapeze or equivalent devices where obstructions interfere with direct suspension.
E. Connection device from vertical wire to the structure above must sustain, without failure, a minimum of 100 lb. load.
F. Assemble and install metal grillage so that it is rigid, square, and free of lateral movement, level within the tolerances specified, with hairline, flush joints at abutting members, and with all members accurately aligned. Grid connection to perimeter must be attached on 2 adjacent walls.
G. Tie perimeter Tee ends together
H. Provide seismic bracing as indicated, (splay wires or rigid bracing) within 2 inches of intersection and splayed 90-degree apart at 45-degree angle.
I. Install perimeter and edge trim level with flush, hairline joints:

1. Screw-attach trim to studs at not over 16 inches o.c. and not more than 3 inches from ends, leveling with ceiling suspension system to a tolerance of 1/8-inch in 12 feet. Miter corners accurately and connect securely.
2. Do not use exposed fasteners, including pop rivets, on moldings and trim.

J. Tolerance of completed grillage shall be limited to 1/8-inch for entire ceiling in each area.

3.4 ACOUSTICAL UNITS

A. Match tile for color and pattern by using tile from cartons in the same sequence as manufactured.
B. Scribe and cut acoustical units for accurate fit at borders and around work which penetrates ceilings. Install with flush, tight joints.
C. For square-edged units, install units with edges fully hidden from view by flanges of suspension system runners and moldings.
D. For reveal-edged units on suspension system runners, install units with bottom of reveal in firm contact with top surface of runner flanges.

E. For reveal-edged units on suspension system members with box-shaped flanges, install units with reveal surfaces in firm contact with suspension system surfaces and panel faces flush with bottom face of runners.
F. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended for this purpose by acoustical panel manufacturer.
G. Duplicate Tegular edges at partial panels with straight, square cuts.

3.5 ERECTION TOLERANCES

A. Suspended Ceilings: Install main and cross runners level to a tolerance of 1/8 inch in 12 feet, non-cumulative.
B. Moldings and Trim: Install moldings and trim to substrate and level with ceiling suspension system to a tolerance of 1/8 inch in 12 feet, non-cumulative.

3.6 FIELD QUALITY CONTROL

A. Remove and replace units that are damaged or cannot be cleaned, to the Architect's satisfaction.

3.7 CLEANING

A. Clean soiled acoustical units and their suspension systems in compliance with their manufacturer's instructions.

END OF SECTION

SECTION 09 64 40 – WOOD ATHLETIC FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Athletic wood flooring (WDF-1).
2. Floor Inserts

1.2 REFERENCES

A. Maple Flooring Manufacturer's Association (MFMA): MFMA Hardwood Flooring Installation Manual.

1.3 SYSTEM DESCRIPTION

A. Athletic wood strip anchored flooring system applied directly over structural concrete slab

1. Floor system nominal thickness: 3-inches.

B. Concrete and Concrete Finishing Refer to Section 03 30 00.

1. Concrete Slab Depression: 3-inches using 25/32” flooring and subfloor.
2. Surface Finish: steel troweled and finished smooth.
3. Concrete Tolerance: +/-1/8” in radius of 10 feet.
4. Floor Flatness and Floor Levelness (FF and FL) numbers are not recognized.
5. Compressive strength: Concrete shall be a minimum of 3,000 psi and a maximum of 4000 psi compressive strength after 28 days. Concrete shall be free of washed river gravel, pea gravel, flint or hardener additives. No lightweight concrete.
6. High spots shall be ground level and low spots shall be filled in with approved leveling compound by the general contractor to meet the tolerance above.

1.4 SUBMITTALS

A. Product Data: Manufacturer’s specifications and technical data including the following.

1. Detailed specification of construction and fabrication.
2. Manufacturer's installation instructions.
3. Manufacturer's detailed recommendations for handling, storage, installation, finishing, protection, and maintenance.
4. Concrete guidelines: Submit MFMA recommendations for correct preparation, finishing and testing of concrete subfloor surfaces to receive wood flooring.
5. Submit a copy of maintenance guidelines.

B. Shop Drawings: Manufacturers shop drawings.

C. Samples: Submit 2 sets of the following:

1. Color samples: For color selection or verification for the following.
2. Submit one sample of specified floor system.
3. Submit samples of border units where borders of different color, texture, or pattern are indicated using finish products specified.

D. Quality Control Submittals:

1. Statement of qualifications.
2. Manufacturer's field reports.

E. Contract Closeout Submittals: Comply with Division 01.

1. Operating and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Manufacturer's Qualifications:

1. Not less than 5 years of experience in the actual production of specified products.
2. Manufacturer must be a member in good standing with the MFMA.

B. Installer's Qualifications: Firm with 3 experiences in installation of systems similar in complexity to those required for this Project, including specific requirements indicated.

1. Acceptable to or licensed by manufacturer.
2. Submit a list of at least three completed projects of similar magnitude and complexity.

C. Field Mock-Ups: Installer to provide mock-ups using the products specified. Mock-ups may be created as part of the actual floor installation and used in the final floor installation. Approval by Owner is required before proceeding installation past mock-up.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Packing and Shipping: Deliver products in original unopened packaging with legible manufacturer's identification.

B. Storage and Protection: Comply with manufacturer's recommendations.

1. Store in a cool, dry place out of direct sunlight.
2. Protect from the elements and from damage.
3. Store at a temperature range of 55 degrees to 80 degrees.
4. Materials shall not be stored at the install site if moisture content of concrete slab exceeds 4 percent.

1.7 PROJECT CONDITIONS

A. Environmental Requirements:

1. Maintain room temperature above 65 degrees F. and below 80 degrees F. for 7 days prior to delivery of materials, during installation and continuous after installation.
2. Do not install wood flooring system until wet construction work is completed and surrounding air has a moisture content less than 35 percent or above 50 percent relative humidity.
3. Do not install floor system until concrete has been cured 60 days.
4. Contractor is responsible to ensure slab is clean and free of all dirt and debris prior to floor installation beginning.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers and Products:

1. Specifications are written around manufacturer's proprietary specifications from Connor Sports. Other manufacturer's products must meet similar specified quality and be approved by Architect. See the Interior Finish Materials sheet on Drawings.

a. Connor-Permaflex wood flooring system (WDF-1).

2.2 MATERIALS (Anchored floor)

A. Vapor Barrier - 6-mil polyethylene.
B. Resilient Pads

1. Connor 1/2-inch Rezill DIN pads

C. PermaFlex Sleepers

1. Upper Flex Sleeper – 8-feet X 3-3/4-inch X 25/32-inches APA rated plywood Exposure 1.
2. Lower Perma Base Sleeper – 8-feet X 4-inches X 23/32-inches APA rated plywood Exposure 1.
3. PermaFlex Channel - 16 gauge coated steel.
4. PermaFlex channel anchor clips.
5. 16-gauge (1.5mm) steel Z clips.

D. Subfloor

1. Subfloor sheeting shall be 15/32-inches APA rated plywood sheathing Exposure 1.
2. Optional (specify or delete) - Subfloor sheeting shall be 23/32-inches APA rated sheathing Exposure 1.

E. Flooring (Connor Laytite Maple)

1. 25/32-inches X 2-1/4-inches, Second & Better Grade, Northern Hard Maple Flooring, TGEM, MFMA Grade marked and stamped as manufactured by Connor Sports, Amasa, MI.
2. Optional grades (specify above or delete) - First Grade, Third Grade

F. Fasteners

1. Flooring Fasteners - 1-3/4-inch barbed cleats or coated staples.
2. Subfloor Fasteners - 1-1/4-inch subfloor staples or screws, and PL400 adhesive or equal. Substitute
3. 1-1/2-inch subfloor staples when installing 23/32-inches plywood.
4. Clip Anchors - 1-1/4-inch long steel pins, or length as dictated by site conditions, achieving a minimum 900 lbs. pullout strength applied with an air driven or low velocity powder actuated tool.

G. Finish Materials - Connor oil modified polyurethane seal and finish or equal.
H. Game Lines - Game line paint shall be compatible with finish.
I. Wall Base – 3-inches X 4-inches, heavy duty, molded, vented cove base with pre-molded outside corners.

2.3 ACCESSORIES

A. Finish: Manufacturer recommended and approved finish. (Must be compatible with Game-line paint and must meet VOC limits).
B. Game line paint: High gloss paint approved for use by flooring manufacturer. (Must be compatible with Finish and must meet VOC limits stated in applicable code.
C. Perimeter Wall Base: 3/4-inches ventilating type. Color selected by Architect.
D. Aluminum Threshold Plate with Ventilation: Model #8147. See Drawings for installation.
E. Refer to Drawings for locations and details of removable flooring/ cover plates for access to power/data boxes.
F. Volleyball Floor Sleeves: 3-1/2-inches diameter x 8-1/2-inches cast-in steel floor sleeve.

2.4 ALLOWANCE

A. Painted logo at center court (12-feet square)

1. Provide allowance of $2,500 for (1) 12-feet square logo to be painted on floor
2. Logo will be two (2) colors.
3. Final graphic image and location on floor to be coordinated with Owner.

B. Custom border around court

1. Provide an allowance for a custom 3’-0” wide border around court. There will be 2’-0”H lettering at each baseline and sideline.
2. Final graphic image and location on floor to be coordinated with Owner.

C. Painted logo at half court

1. Provide an allowance of $2,500 for (4) 6-feet square logos to be painted on floor.
2. Logo will be two (2) colors.
3. Final graphic image and location on floor to be coordinated with Owner.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions: Examine areas and conditions under which Work is to be performed and identify conditions detrimental to proper or timely completion.
B. Inspect concrete slab for proper tolerance and dryness. Report any discrepancies to the contractor and Architect in writing. Slab will be level to within 1/8 inch in 10 feet. Moisture content of the concrete slab not exceed 85% in accordance to an in-slab relative humidity test.
C. All work required to put the concrete subfloors in acceptable condition shall be the responsibility of the Contractor.
D. Subfloor shall be broom cleaned by Contractor.
E. Installer shall document all working conditions provided in the Specifications prior to commencement of installation.

3.2 PREPARATION

A. Surface Preparation: As recommended by flooring manufacturer plus the following:

1. Brush, clean, and vacuum substrate to remove mortar droppings, dust, and miscellaneous debris.

2. Patching and leveling: If patching or leveling is required, use latex patching compound as recommended by wood flooring manufacturer.

    a. Do not use asphalt underlayment.
    b. Do not skim coat over large or entire areas.
    c. Use leveling compounds when substrate floor tolerances exceed 1/8 inch in 10'-0".

B. Conditioning: Place material in open cartons within room scheduled for installation at least 72 hours before starting installation.

3.3 INSTALLATION

A. Comply with manufacturer's recommendations.
B. Cover concrete floor with vapor barrier and lap joints minimum of 6 inches.
C. PermaFlex Channels

1. Place PermaFlex channels 16-inches on center at right angle to finished flooring, staggering end joints by 4-feet in adjacent rows. Provide 1-1/2-inches expansion void at perimeter and at all vertical obstructions. Install solid blocking at doorways, under bleachers in the stacked position, and below portable goals.
2. Attach plywood subfloor with 8-feet edges parallel to and resting on sleepers. Set plywood in staggered brick pattern with ends offset by 4-feet in adjacent rows. Offset plywood ends by 2-feet) from sleeper end joints, and space 1/4-inches at all edges. Fasten plywood to sleepers using a single ribbon of adhesive and 1-1/4-inches staples fastened 12-inches on center. Provide 1-1/2-inches expansion void at perimeter and at all vertical obstructions.

D. Subfloor:

1. Install shock absorbing pad per manufacturer’s recommendations over 6 mil poly.
2. Following manufacturer’s guidelines, place subfloor assembly in end-to-end manner, staggering end joints in adjacent rows. Allow for a 1/4 gap between panels. Panels shall be placed on a 45-degree angle to the direction of the maple flooring. Provide 1-1/2 to 2-inch expansion void at perimeter and all vertical obstructions.
3. Install solid blocking at doorways, under bleachers in the stacked position, and below portable goals.
4. Install bleacher blocking per manufacturers recommendations.
5. Place metal anchor channel in each factory-prepared location in the panel.
6. Anchor each anchor channel in the center pre-routed hole only., unless trimming at wall or vertical obstruction requires relocation in adjacent location to anchor.

E. Flooring:

1. Install maple flooring parallel to main playing court by power nailing or stapling approximately 12-inches on center. Do not allow flooring fasteners to contact steel channel.
2. If required, size joints between flooring strips to allow for intermediate expansion in accordance with local humidity conditions.
3. Provide 1-1/2-inch expansion voids at perimeter and at all vertical obstructions.

F. Finishing: (Refer to manufacturer’s published recommendations)

1. Sanding

    a. Sand per manufacturer’s recommendations.
    b. After sanding, buff entire floor using 100 grit screen or equal grit sandpaper, with a heavy-duty buffing machine.

c. Inspect entire area of floor to ensure the floor presents a smooth surface without drum stop marks, gouges, streaks or shiners.
d. Vacuum and/or tack floor before first coat of seal.
e. Floor should be clean and completely free of dirt and sanding dust.

2. Finishing

a. Apply two (2) coats of approved seal and two (2) coats of approved finish per manufacturer’s instructions.
b. Buff and clean floor between coats.
c. Buff and vacuum and/or tack between each coat after it dries.
d. Apply custom colored game lines accurately after the buffing and vacuuming the coated surfaces. Game lines shall be painted between seal coats and finish coats. Layout in accordance with Drawings and review with College. For game lines, use current NCAA rules and guidelines. Lines shall be straight with sharp edges in colors selected by Architect.

3.4 BASE INSTALLATION

A. Install vent cove base to walls with base cement or screws. Use pre-molded outside corners and mitered inside corners.

3.5 FIELD QUALITY CONTROL

A. Inspections: Test moisture content of concrete substrate prior to installation of wood flooring to ensure moisture content of substrate is within manufacturer's recommendations.

3.6 CLEANING

A. Clean up all unused materials and debris and remove it from premises.

END OF SECTION

SECTION 09 65 10 - RESILIENT WALL BASE

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Rubber base. (RB-1 and RB-1)
2. Adhesive.

B. Related requirements: Other Sections of Division 09 for resilient flooring.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Scheduling and sequencing:
B. Pre-installation meeting:

1.3 SUBMITTALS

A. Samples: 12-inch long Samples of each type and color of base.
B. Data: Proof of compliance with specified requirements.

1.4 HANDLING

A. Store materials indoors at a temperature above 60-degree F for at least 24 hours before use.

1.5 JOB CONDITIONS

A. Illuminate work areas during installation to provide the same or greater level of illumination required to properly perform the work and as will occur in the room or space after the building is in operation.
B. Maintain temperature in spaces to receive resilient bases between 70-degree and 90-degree F for not less than 24 hours before and 48 hours after its installation.
C. Maintain minimum temperature of 60-degree F after bases have been installed, except as specified above.

1.6 MAINTENANCE

A. Furnish 100 feet of each type and color of base for future maintenance.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Rubber bases at perimeter of wood floor: Vented rubber base with premolded corners, color selected by the Architect, 1/8-inch thick by 4-inch high with a 4-inch toe, by Johnsonite, Horner Flooring Co. or equal.

1. One-eight-inch thick, by height indicated on the Drawings, ASTM F 1861, Type TS (thermoset vulcanized rubber), Group 1 (homogeneous).
2. Top set base where no flooring and resilient flooring occur; straight (carpet) base at all other locations; do not use preformed corners.
3. In rolls minimum 100-foot long. Walls 20-foot or less in one piece; do not use short pieces.
4. Base shall be from same batch and run number for each color.

B. Rubber bases elsewhere: See Drawings,
C. Adhesive: Type and brand recommended by base manufacturer for the conditions of use.

PART 3 - EXECUTION

3.1 EXAMINATION/PREPARATION

A. Examine walls for excessive moisture content and unevenness which would prevent the proper execution of the work of this Section. Fill cracks and sand down bumps.
B. Remove dirt, oil, grease, or other foreign matter from surfaces to receive bases.
C. Correct detrimental conditions before proceeding with installation.
D. Do not install bases until they are same temperature as space where they are to be installed. Move bases and installation materials into spaces where they will be installed at least 48 hours in advance of installation.

3.2 ADHESIVE

A. Mix and apply adhesive in compliance with its manufacturer’s instructions.
B. Provide safety precautions during mixing and application as recommended by the adhesive manufacturer.
C. Apply adhesive uniformly over backing surfaces, but only on areas which can be covered by bases within the recommended working time of the adhesive.
D. Tape adjacent surfaces to prevent migration and misapplication of adhesive.
E. Remove adhesive which dries or films over. Do not soil walls, bases, and other adjacent surfaces with adhesive. Promptly remove spillage from adjacent surfaces without damaging those surfaces.

3.3 BASE

A. At masonry surfaces, fill voids along top edges of base with base manufacturer’s recommended adhesive filler material.
B. Match edges at seams or double cut adjoining lengths. Install with hairline, flush butt joints.
C. Locate end of runs not less than 36 inches from a corner, except where impossible due to length of wall.
D. Do not use pieces less than 6-foot long, except where impossible due to length of wall.

E. Do not use preformed corner pieces, except for vented base.

1. Form inside corners on job from straight pieces of maximum lengths possible by cutting an inverted V-shaped notch in toe of wall base at the point where corner is formed. Shave back of base where necessary to produce snug fit to substrate.
2. Form outside corners on job from straight pieces of maximum lengths possible by shaving back of base at point where bending will occur. Remove a strip perpendicular to length of base and only deep enough to produce a snug fit without bends whitening or removal of more than half the thickness of base.
3. Form without producing discoloration (whitening) at bends.

F. Scribe base accurately to abutting materials.

3.4 FIELD QUALITY CONTROL

A. After adhesive sets, clean bases with a neutral cleaner recommended by the base manufacturer.
B. Verify that there are no open joints and that base is completely adhered for its full length. Re-install in fresh adhesive where applicable.
C. Protect completed installations from damage until final acceptance.

END OF SECTION

SECTION 09 65 19 - RESILIENT TILE FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Luxury vinyl tile. (LVT-1, LVT-2)
2. Edging and reducer strips.
3. Accessories, and installation and finishing materials.

B. Related requirements: Section 09 65 10 for Resilient base.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Pre-installation meeting: Prior to start of installation, survey floors with the concrete finisher to verify acceptability of concrete substrate to receive flooring. Refer to Part 3 for corrective work.

1.3 SUBMITTALS

A. Data: Manufacturer Product Data and test reports for the flooring and adhesive.
B. Samples: Full size Samples of each type of floor tile, and 12-inch long Samples of each linear material.
C. Tests: Moisture and pH tests results.
D. Closeout:

1. Furnish the Owner 2 copies of the tile manufacturer recommended maintenance products, and recommended maintenance methods and procedures.
2. Include precautions against cleaning materials and methods detrimental to finishes and their performance.

1.4 QUALITY ASSURANCE

A. Uniformity:

1. Provide tile, adhesive and maintenance materials from one manufacturer.
2. If required, provide accessories including leveling and patching compounds supplied from one manufacturer.

B. Installer: Firm competent in installation of resilient flooring, with a minimum of 5 years of successful experience installing flooring of the kind and scope specified.

1.5 HANDLING

A. Store materials indoors above 60 degrees F for at least 24 hours before use.

1.6 JOB CONDITIONS

A. Illuminate work areas during installation to provide the same or greater level of illumination required to properly perform the work and as will occur in the room or space after the building is in operation.
B. Maintain temperature in spaces to receive resilient flooring between 70 and 90 degrees F for not less than 24 hours before and 48 hours after installation.
C. Maintain minimum temperature of 60 degrees F after resilient flooring has been installed, except as specified above.

1.7 MAINTENANCE

A. Furnish the Owner one percent of the quantity of tiles and planks installed on the Project, but not less than 1/2 box, properly boxed and labeled.
B. Coordinate selection of floor polish with the Owner's maintenance service.

1.8 SPECIAL WARRANTY

A. Manufacturer shall warrant materials and workmanship for 5 years and agree to make repairs and replacements due to faulty materials and workmanship during the warranty period at no cost to the Owner.

PART 2 - PRODUCTS

2.1 RESILIENT PLANKS

A. See Finish Schedule on Drawings.
B. Materials: ASTM F 1066, Composition 1, Class 2. ADA-compliant, with a coefficient of friction of finish flooring, with the applied finish, of 0.6 minimum when tested in compliance with ASTM D 2047.

2.2 ACCESSORIES

A. Accessories:

1. Edging and reducer strip: Tapered hard rubber edging strip made specifically for termination of resilient tile flooring, by Mercer Products Co., Inc., Macklanburg-Duncan, Johnsonite or equal of the color selected by the Architect.

2.3 ADHESIVES AND FLOOR FINISH

A. Primer, adhesive and crack filler: Type and brand recommended by floor covering manufacturer for the conditions of use.
B. Patching, smoothing, and leveling compound: As specified in Section 09 65 15.
C. Floor finish: Commercially available product acceptable to flooring manufacturer which, when cured, shall have a coefficient of friction of 0.6 or greater when tested in accordance with ASTM D 2047.

PART 3 - EXECUTION

3.1 EXAMINATION/PREPARATION

A. Prepare substrates according to adhesive manufacturer's instructions and the following to ensure adhesion of floor coverings.
B. Concrete: Prepare according to ASTM F 710.

1. Verify that substrate is dry and free of curing compounds, sealers, and hardeners.
2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
3. Perform alkalinity and adhesion tests recommended by manufacturer. Proceed with installation only after substrates passes testing.
4. Moisture testing: Perform tests recommended by manufacturer and as follows. Proceed with installation only after substrates pass testing.

    a. Perform anhydrous calcium chloride test, ASTM F 1869, or equivalent test recommended by the flooring manufacturer. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 square foot in 24 hours.
    b. Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.

5. Check pH level and correct until it is within range recommended by the adhesive manufacturer.
6. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.
7. Level surfaces to be covered with flooring by grinding bumps and filling-in depressions to a tolerance an overall value of flatness, F(F) 35; and levelness, F(L) 25; with minimum local values of flatness, F(F) 24; and levelness, F(L) 17. Use fill material compatible with both substrates.

C. Sweep and vacuum clean substrates to be covered with flooring before installation.
D. Move resilient flooring and installation materials into spaces where they will be installed at least 48 hours in advance of installation. Do not install resilient flooring until materials are the same temperature as space where they will be installed.
E. Correct other detrimental conditions before proceeding with installation.

3.2 ADHESIVES

A. Mix and apply adhesives in compliance with their manufacturer's instructions.
B. Apply adhesive uniformly over backing surfaces, but only on areas that can be covered by flooring material within the recommended working time of the adhesive.
C. Remove adhesive that dries or films over. Do not soil adjacent surfaces with adhesive, and promptly remove spillage without damaging those surfaces.

3.3 PLANKS

A. Match units for color and pattern, when applicable, by using units from cartons in the same sequence as manufactured and packaged.
B. Install units working from centerlines of each room or space and work outward towards the perimeter. Lay out units so none are less than 1/2 the width of a full size.
C. Fit units neatly and tightly into breaks and recesses, against bases, around pipes and penetrations, under metal thresholds and around permanent fixtures and equipment.
D. Lay units in grid pattern with the patterns running in the same direction, parallel to room axis in straight lines, except where impractical because of room shape.

E. As units are installed and within adhesive's recommended working time, roll floor with a clean, smooth, 100-pound roller in both directions.

1. As the rolling proceeds, replace loosened, defective, or damaged tile with new and finish to the specified condition.
2. Take particular care to roll edges and corners thoroughly.

3.4 REDUCER AND EDGING STRIPS

A. Install reducer and edging strips at termination of floor tile where tile is not covered by another material. Glue securely to clean, dry subfloor.
B. Install in one piece between door jambs, and in longest possible length elsewhere with no piece less than 6 feet long.
C. Butt tightly to resilient tiles, where applicable, and scribe accurately to doorframe and other abutting surfaces.

3.5 FINISHING/CLEANING/PROTECTING

A. Protect flooring against mars, marks, indentations, and other damage immediately after installation and polishing.
B. Use protection methods recommended by flooring manufacturer.
C. Do not move heavy and sharp objects directly over resilient flooring. Place hardboard panels over flooring and under objects being moved. Slide or roll objects over panels without moving panels.
D. Cover traffic paths with undyed, untreated building paper taped securely in place. Remove at final cleaning.
E. Apply protective polish to floor surfaces that are free from soil, visible adhesive and surface blemishes.
F. Clean resilient floors not more than 4 days before dates scheduled for inspections intended to establish Substantial Completion in each area of the Project.

1. If required to restore polish finish, and if recommended by flooring manufacturer, strip protective floor polish applied after completing installation before cleaning.
2. After cleaning, reapply polish to floor to restore floor finish according to flooring manufacturer instructions. Coordinate with Owner's maintenance program.

G. Remove and replace materials that are damaged or cannot be cleaned.

END OF SECTION

SECTION 09 65 66 – RESILIENT ATHLETIC FLOORING SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes the following resilient flooring systems:

1. Flooring system at Weight Room. (SF-1)
2. Flooring system at TRX / Training Room. (SF-3)
3. Flooring system at Yoga / Training Room. (SF-4)
4. Wall system at TRX / Training Room. (SF-5)
5. Indoor running track including installation of a prefabricated sheet rubber sports surfacing system. (SF-2, SF-2A)

1.2 SUBMITTALS

A. Product Data: Provide current printed data sheets for all products supplied including installation instructions.

B. Shop Drawings: Submit shop drawings illustrating layouts, seam locations, details, dimensions, and other pertinent details.

C. Samples: Submit samples, 6 inches x 6 inches, for verification of such characteristics as color and surface texture for each Manufactured Product specified.

D. Maintenance Literature: Submit maintenance instructions.

1.3 QUALITY ASSURANCE

A. Manufacturer: Shall be an established firm with a minimum of 10 years in business specializing in manufacturing prefabricated sheet rubber for athletic surfaces.

B. Flooring Contractor:

1. Complete installation of the flooring system shall be performed only by an experienced flooring contractor with a minimum of three years of experience installing athletic surfaces and approved by the manufacturer.
2. Work will be performed in accordance with the most recent printed installation instructions of the manufacturer.

C. Mockup: Provide independent, out of sequence mockup on site for each flooring system as required by Architect to review installed system. Remove and dispose of upon final acceptance of each system.

1.4 HANDLING

A. Products Supplied must be delivered in Manufacturer’s original, unopened and undamaged packaging with identification labels intact.

B. Products Supplied must be protected from exposure to harmful weather conditions and must be safely stored on a clean, dry, flat surface. Store rolls of Resilient Track Surfacing upright.

C. Climate controlled storage is recommended. Storage temperature must not be below 40 degrees F and must not exceed 100 degrees F. Materials must be delivered to site a minimum of 24 hours before work is scheduled to begin so that they may acclimate.

D. Avoid storing Manufactured Product for extended periods of time or additional material trimming may be required.

E. Products Supplied need not suffer damage during delivery, storage and handling (i.e. dents/scratches, excessive compression or warping, chipped edges, etc.).

1.5 SITE CONDITIONS

A. The prefabricated rubber sheet flooring specified herein shall not be installed until all trades including, but not limited to, masonry, painting, plaster, tile, marble, terrazzo, carpentry, overhead mechanical trades', goals, scoreboard, electrical, and painters have finished in the installation area.

B. The area will be closed and secured from all foot traffic and trades for duration of the installation and curing period.

C. The building shall be enclosed, weather-tight, with permanent windows and lockable doors.

D. Permanent heat, light and ventilation shall be installed and operating prior to, during and after installation.

E. Subfloors shall be broom clean, dry and free from dirt, dust, oil, grease, paint, and alkali, concrete curing agents, hardening and parting compounds, old adhesive residue or other foreign materials.

F. Concrete tolerance of 1/8 inch (3mm) in ten foot (3m) shall be maintained throughout. High spots shall be ground level and low spots filled with a Portland base compound such as Ardex Feather Finish. No concrete curing, hardening or sealing agents shall be applied to concrete.

G. Concrete must dry for a minimum of 30 days and slab moisture levels shall not exceed 85% in accordance with “Determining Relative Humidity in Concrete with In-Situ Probes” respecting ASTM F2170. HVAC must be operational and with a constant temperature for 7 days prior to testing.

H. The installation area shall be closed to all traffic and activity during installation and for seven days following to allow drying/curing.

I. After completion, area to be kept locked by general contractor. No other trades or personnel to be allowed on floor until accepted by owner.

1.6 WARRANTY

A. Manufactured Product is warranted against excessive wear under normal usage for a period of ten (10) years from the date of Substantial Completion, except SF-4 which shall be warranted against excessive wear under normal usage for a period of five (5) years.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Manufacturers:

1. Basis for design, see Interior Finish Material Schedule on Drawings: SF-1, SF-3, SF-4 and SF-5, or equal.

2.2 MATERIALS

A. Material shall be prefabricated sheet rubber athletic flooring and highly resistant to UV or atmospheric agents.

1. Only vulcanized, dual durometer sheet rubber with each layer having independent physical properties and biomechanical attributes will be accepted.
2. Flooring must be highly resistant to UV and atmospheric agents.
3. The surface layer shall be free of recycled rubber granules and free of any different color fillers.
4. Flooring surface shall be manufactured to maintain performance criteria, as stated by manufacturer, without defects, damage, or failure.

5. Finish and tickness: As indicated on Interior Material Finishes Schedule.
6. Color shall be determined.
7. Finish: Track Embossing

B. Adhesive: As recommended by flooring manufacturer.

C. Transition Strip: Trakett, or equal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Inspect concrete slab for proper tolerance of 1/8 inch (3mm) in ten foot (3m). Report discrepancies to general contractor for correction.

1. High spots shall be ground level and low spots filled with a Portland base compound such as Ardex Feather Finish.

B. Perform moisture testing of the slab. “Determining Relative Humidity in Concrete with In-Situ Probes” not to exceed 85% respecting ASTM F2170. Report results to the general contractor. See addendum in installation guides for details.

1. HVAC must be operational and with a constant temperature for 7 days prior to testing.
2. Allow further drying time if moisture tolerances are exceeded.

C. Ensure all requirements from section 1.6 SITE CONDITIONS are completed and satisfied.

D. All work required to put the concrete slab in an acceptable condition and provide correct working conditions for a successful installation is the responsibility of the General Contractor or Construction Manager.

3.2 PREPARATION

A. Prepare substrate surface in accordance with Manufacturer’s current printed guidelines.

3.3 INSTALLATION

A. Install athletic flooring and accessories in accordance with current manufacturer's installation instructions

B. Wall Base: Install vinyl base anchored to walls with base cement.

3.4 CLEANING

A. For surfaces having received newly painted lines, wait a minimum of 30 days after the application of the paint before going over the surface with a scrubber/scrubbing the lines, in order to ensure proper curing of the paint.

3.5 FIELD QUALITY CONTROL

A. Adjust hardware so panels operate freely, but not loosely, without sticking or hinge binding.

B. Adjust hardware for proper function.

END OF SECTION

SECTION 09 65 71 – INDOOR RUNNING TRACK

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes an indoor running track including installation of a prefabricated sheet rubber sports surfacing system. (SF-2)

B. System shall include game-line striping by manufacturer.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Field verification: Verify actual locations of supports.

1.3 SUBMITTALS

A. Manufacturers Product Information

1. Submit (1) copy of I.A.A.F. Certification of surface to be installed.
2. Submit (3) copies of Connor Sports ProTraxx System Specification Sheets or as requested.

B. Shop Drawings: Submit (1) set of shop drawings reflecting side seam placement and layout.

C. Samples: Submit (1) set of samples showing colors and texture of ProTraxx surface or as requested.

D. Maintenance Literature: Submit (3) copies of Connor Sports ProTraxx maintenance instructions.

1.4 QUALITY ASSURANCE

A. Manufacturer: Shall be an established firm with a minimum of 10 years in business specializing in manufacturing prefabricated sheet rubber for athletic surfaces.

B. Flooring Contractor:

1. Complete installation of the flooring system shall be performed only by an experienced flooring contractor with a minimum of three years of experience installing athletic surfaces and approved by the manufacturer.
2. Work will be performed in accordance with the most recent printed installation instructions of the manufacturer.

C. Line Marker:

1. Shall be approved by the Surfacing Contractor.
2. Painting must be done by professionals with proper experience and qualifications to effectively perform the work.
3. Line Marker to have painted a minimum of twenty (20) track and field facilities in North America that have been properly certified (when applicable) to meet specified Association requirements for desired level of competition.

D. Mockup: Provide independent, out of sequence mockup on site as required by Architect to review installed system. Remove and dispose of upon final acceptance of walking/running track.

1.5 HANDLING

A. Products Supplied must be delivered in Manufacturer’s original, unopened and undamaged packaging with identification labels intact.

B. Products Supplied must be protected from exposure to harmful weather conditions and must be safely stored on a clean, dry, flat surface. Store rolls of Resilient Track Surfacing upright.

C. Climate controlled storage is recommended. Storage temperature must not be below 40 degrees F and must not exceed 100 degrees F. Materials must be delivered to site a minimum of 24 hours before work is scheduled to begin so that they may acclimate.

D. Avoid storing Manufactured Product for extended periods of time or additional material trimming may be required.

E. Products Supplied need not suffer damage during delivery, storage and handling (i.e. dents/scratches, excessive compression or warping, chipped edges, etc.).

1.6 SITE CONDITIONS

A. The prefabricated rubber sheet flooring specified herein shall not be installed until all trades including, but not limited to, masonry, painting, plaster, tile, marble, terrazzo, carpentry, overhead mechanical trades', goals, scoreboard, electrical, and painters have finished in the installation area.

B. The area will be closed and secured from all foot traffic and trades for duration of the installation and curing period.

C. The building shall be enclosed, weather-tight, with permanent windows and lockable doors.

D. Permanent heat, light and ventilation shall be installed and operating prior to, during and after installation.

E. Subfloors shall be broom clean, dry and free from dirt, dust, oil, grease, paint, and alkali, concrete curing agents, hardening and parting compounds, old adhesive residue or other foreign materials.

F. Concrete tolerance of 1/8 inch (3mm) in ten foot (3m) shall be maintained throughout. High spots shall be ground level and low spots filled with a Portland base compound such as Ardex Feather Finish. No concrete curing, hardening or sealing agents shall be applied to concrete.

G. Concrete must dry for a minimum of 30 days and slab moisture levels shall not exceed 85% in accordance with “Determining Relative Humidity in Concrete with In-Situ Probes” respecting ASTM F2170. HVAC must be operational and with a constant temperature for 7 days prior to testing.

H. The installation area shall be closed to all traffic and activity during installation and for seven days following to allow drying/curing.

I. After completion, area to be kept locked by general contractor. No other trades or personnel to be allowed on floor until accepted by owner.

1.7 WARRANTY

A. Manufactured Product is warranted against excessive wear under normal usage for a period of ten (10) years from the date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Manufacturers:

1. Basis for design, see Finish Schedule on Drawings: SF-2, or equal.

2.2 MATERIALS

A. Athletic surface must be certified by I.A.A.F. (International Association of Athletic Federation).

B. Material shall be prefabricated sheet rubber athletic flooring and highly resistant to UV or atmospheric agents.

1. Only vulcanized, dual durometer sheet rubber with each layer having independent physical properties and biomechanical attributes will be accepted.
2. Flooring must be highly resistant to UV and atmospheric agents.
3. The Shore Hardness of the top layer surface will be greater than that of bottom layer with differentiated elasticity between the two layers.
4. The surface layer shall be free of recycled rubber granules and free of any different color fillers.
5. Flooring surface shall be manufactured to maintain performance criteria, as stated by manufacturer, without defects, damage, or failure.
6. Thickness shall be 8mm.
7. Color shall be determined.
8. Finish: Track Embossing
9. Material shall be provided in rolls only.
10. Flooring must have IAAF Class 1 certification performance.

C. Adhesive: Two-component polyurethane adhesive as recommended by track manufacturer.

D. Game Line Paint: Two-component polyurethane selected from standard colors.

E. Transition Strip: Trakett, or equal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Inspect concrete slab for proper tolerance of 1/8 inch (3mm) in ten foot (3m). Report discrepancies to general contractor for correction.

1. High spots shall be ground level and low spots filled with a Portland base compound such as Ardex Feather Finish.

B. Perform moisture testing of the slab. “Determining Relative Humidity in Concrete with In-Situ Probes” not to exceed 85% respecting ASTM F2170. Report results to the general contractor. See addendum in installation guides for details.

1. HVAC must be operational and with a constant temperature for 7 days prior to testing.
2. Allow further drying time if moisture tolerances are exceeded.

C. Ensure all requirements from section 1.6 SITE CONDITIONS are completed and satisfied.

D. All work required to put the concrete slab in an acceptable condition and provide correct working conditions for a successful installation is the responsibility of the General Contractor or Construction Manager.

3.2 INSTALLATION

A. Install athletic flooring and accessories in accordance with current manufacturer's installation instructions

1. Disc sand concrete in preparation to receive flooring material.
2. Unroll flooring and allow to relax overnight while maintaining a constant room temperature.
3. Thoroughly mix two-component polyurethane adhesive per manufacturer’s instructions and apply directly to substrate.
4. Install flooring into freshly applied adhesive, scribing and fitting neatly at walls, around columns and around door frames. Use matching urethane caulk at tight fit locations.

5. Roll material in multiple directions with a 100-pound (45.4 kg) roller to remove entrapped air.
6. Clean any adhesive that migrates between seams with recommended product.
7. Hold and weight all seams in place with cinder bricks. Leave weight in place for a minimum of 12 hours.

B. Game Lines

1. Use only high-quality masking tape approved by track manufacturer.
2. Carefully layout and mask game lines as indicated on drawings.
3. Prime area to receive paint per manufacturer's instruction.
4. Thoroughly mix two-component game line paint.
5. Apply paint by spray method

C. Wall Base: Install vinyl base anchored to walls with base cement.

3.3 CLEANING

A. For surfaces having received newly painted lines, wait a minimum of 30 days after the application of the paint before going over the surface with a scrubber/scrubbing the lines, in order to ensure proper curing of the paint.

3.4 FIELD QUALITY CONTROL

A. Adjust hardware so panels operate freely, but not loosely, without sticking or hinge binding.

B. Adjust hardware for proper function.

END OF SECTION

SECTION 09 67 23 - RESINOUS FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Resinous flooring.
2. Primer, resin, mortar, undercoat, sealants, and sealer.

B. Related requirements: All other waterproofing membranes.

1.2 SUBMITTALS

A. Samples: 24-inch square of the selected colors of each type of resinous flooring mounted on plywood or hardboard. Step application to show all the components.
B. Shop drawings: Large scale details of floor patterns and striping, coves and corners. Dimension terminations and penetrations through resinous flooring.
C. Data: Manufacturer Product Data for system proposed for use.
D. Letter of acceptance: From the manufacturer to verify its acceptance of the applicator and acceptance of substrates as satisfactory to receive this work.
E. Closeout: Copy of care and maintenance recommendations.

1.3 QUALITY ASSURANCE

A. Single source responsibility: Obtain primary resinous flooring materials from a single manufacturer with not less than 10 years experience in manufacturing and installing principal materials described in this Section.
B. Applicator qualifications: Firm acceptable to flooring manufacturer, with a minimum of 5 consecutive years of experience in application of the floor systems proposed for use on projects of similar size and scope.
C. Pre-installation meeting: Prior to start of installation arrange a meeting between the manufacturer of the resinous flooring and the trade responsible for the installation, Contractor and Architect to review conditions of substrate and review installation and curing instructions.

1.4 HANDLING

A. Materials used shall be factory pre-weighed and pre-packaged in single, easy to manage batches to eliminate on site mixing errors. No on site weighing or volumetric measurements are allowed.
B. Store materials in a dry, enclosed area protected from exposure to moisture. Maintain temperature of storage area between 60- and 85-degree F.

1.5 JOB CONDITIONS

A. Cure concrete substrate for a minimum of 30 days prior to starting the work of this Section unless manufacturer states otherwise during pre-conference meeting.
B. Illuminate work areas during installation to provide the same or greater level of illumination, as required to properly perform this work, as will occur in the room or space after the building is in operation.

PART 2 - PRODUCTS

2.1 MANUFACTURE/SYSTEMS

A. Durastone flexible polished flooring by Duracryl.

2.2 EPOXY PATCHING MORTAR

A. As recommended by manufacturer, to be used to fill all cracks less than 1/8-inch prior to application of flooring systems

2.3 JOINT SEALANT MATERIALS

A. Flexible sealant used where concrete expansion/isolation joints are carried thru the resinous flooring system as recommended by manufacturer.
B. Divider strips and other accessories: As recommended by the resinous flooring manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION/PREPARATION/PROTECTION

A. Examine surfaces to receive flooring for conditions that could adversely affect its permanence and appearance.
B. Examine substrate for excessive moisture content and unevenness, which would prevent the proper execution of the work of this Section.
C. Check floors for moisture content. Verify that they are sufficiently dry to receive flooring by testing in compliance with ASTM D 4263.

1. Allow sufficient time in the construction schedule to allow slabs to dry sufficiently, force dry slabs, or provide a compatible surface coating so that water vapor emission will be at a level acceptable to the floor covering manufacturer.
2. Concrete slab with water vapor pressure exceeding 6 lb. shall receive waterproofing membrane specified before installation of resinous flooring system.

D. Fill cracks and grind down bumps that would telegraph through the flooring so that a 10-foot straightedge placed anywhere on the surface touches the floor with no more than a 1/8-inch gap.
E. Remove dirt, oil, grease, or other foreign matter from surfaces to receive flooring, including curing compounds or laitance by mechanical means include use of a scabbler, scarifier or shot blast machine.
F. pH test:

1. Perform pH tests on concrete floors regardless of the age or grade level.
2. If pH is greater than 10, neutralize the floor prior to beginning installation.

G. Do not start installation until subfloor temperature is 60-degree F or above.
H. Correct other conditions detrimental to the proper and timely completion of this work before proceeding with installation.
I. Protect adjacent surfaces with waterproof covers, securely taped in place, to prevent staining and other damage caused by this work. Restore damaged surfaces to their original condition.

3.2 INSTALLATION

A. Install resinous flooring system in compliance with its manufacturer's instructions and these Specifications.

B. Apply each component of resinous flooring system to produce a uniform monolithic wearing surface of thickness specified, uninterrupted except at divider strips, sawn joints or other types of joints as indicated.
C. Take thickness readings as the installations progress to make sure that the proper amounts of materials are being applied.
D. The installed flooring shall be smooth, uniform in thickness and color, and free from other defects. Top edges of self-coved bases shall be straight and level, finished neatly. Trowel marks are unacceptable.
E. Install integral 6-inch high coved base as indicated.
F. Cure resinous flooring in compliance with its manufacturer's instructions.

3.3 PROTECTING

A. Protect the installed flooring against damage, including misuse by other trades.
B. Repair damaged areas to match adjacent undamaged areas.

END OF SECTION

SECTION 09 68 13 - CARPET TILE

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Carpet planks. (CPT-1).
2. Adhesive.
3. Accessories.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Pre-installation conference:

1. Prior to start of installation, arrange a pre-installation meeting between the carpet installer, Contractor, Architect and electrical trade responsible for wire access, where applicable.
2. Mark chalk lines on the slab, showing pattern alignment for placement and pattern layout. Spray lacquer on chalk lines, after Architect has approved the locations.
3. Review the suitability of the subfloor to receive carpet. Verify flatness and levelness, pH and latent water content of slabs.
4. Identify areas of concern and remedial measures.
5. Photograph areas of concerns before and after remedial measures are taken.
6. Record meeting minutes and distribute PDF copy to all concerned, including the Architect, within 48 hours of the meeting.

1.3 SUBMITTALS

A. Data:

1. Manufacturer Product Data for carpet, adhesive and accessories.
2. Manufacturer′s recommended cleaning and maintenance instructions for carpet.

B. Samples:

1. Full size Samples of each type and color/pattern of carpet tile.
2. Twelve-inch long Samples of carpet edge guard profile.

C. Layout drawings: Three-eight-inch minimum layout drawings showing tile layout, pattern direction, if any, and pile direction.

D. Tests results:

1. Evidence that the carpet, accessories and adhesives to be used comply with Code requirements for combustibility, flammability and toxicity.
2. Results of test conducted on concrete (refer to Part 3 below) slabs prior to start of installation.

E. Manufacturer warranties: Published warranties as specified below.

1.4 QUALITY ASSURANCE

A. Installer qualifications: FCIB or IFCI certified carpet installers, unless otherwise acceptable to the Architect.

1.5 HANDLING

A. Procedure: In accordance with CRI 104 Section 5. Store carpet indoors in a protected location.
B. Delivery: Deliver carpet with manufacturer registry number attached and intact.
C. Storage: Sore carpet in bins to prevent pile crush. Temporary storage shall be in flat bins with a maximum height not to exceed 3 rolls.
D. Handling:

1. Transport carpet on flat dollies equipped with carpet cradles. Equip fork lifts with booms.
2. Bending or folding of individual carpet rolls is not recommended, however, if it is absolutely necessary for delivery purposes, under no circumstances shall carpet be left bent or folded for longer than 4 hours.

E. Conditioning:

1. Condition carpet and adhesive on site in a heated, dry space at a minimum temperature of 65-degree and a relative humidity between 10 percent and 65 percent for at least 48 hours before installation.
2. Maintain these conditions night and day during installation and for at least 72 hours after completion.

1.6 JOB CONDITIONS

A. Temperature: Maintain a uniform temperature, in the space being carpeted, in the range of 65 to 75 degrees F during and after carpet installation.
B. Lighting: Illuminate work areas during installation to provide the same or greater level of illumination required to properly perform the work and as will occur in the room or space after the building is in operation.
C. Ventilation:

1. Maintain fresh air ventilation in installation spaces in accordance with current guidelines of ASHRAE standard 62 published by American Society of Heating, Refrigerating and Air Conditioning Engineers.
2. During installation, maintain fresh air ventilation by utilizing exhaust fans, and by operating the ventilation system at full capacity. Exhaust air to the outside and avoid recirculation of air.
3. After installation, maintain fresh air ventilation for 48-72 hours at normal room temperatures by operating ventilation or exhaust fan system at full capacity. Open doors and windows, if possible to dissipate, and eliminate lingering odors from the installation.

1.7 WARRANTIES

A. Carpet manufacturer shall warrant the carpet as follows:

1. The life of the carpet shall be 15 years under normal conditions.
2. Primary and secondary backing shall not delaminate for the life of the carpet.
3. Twenty-pound tuft-bind, wet and dry, shall be warranted for the life of carpet.
4. Stain resistant properties shall be permanent and inherent in the fiber. Topically applied stain resistant treatments are not acceptable. Stain resistant properties shall not be removed by commercial cleanings and abrasive wear.
5. Carpet shall be warranted to be impervious to water damage.
6. There shall be no more than 10 percent face yarn loss for the life of the carpet.

1.8 MAINTENANCE

A. Furnish the following full-size units equal to 2 percent of amount installed for each type indicated, but not less than 2 full boxes.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. ADA requirements for new carpet:

1. Provide glue-down installation that complies with CBC Section 11B-302..
2. Carpet shall have a level loop, textured loop, or level-cut/uncut pile texture and maximum pile height of 1/2-inch per CBC Section 11B-302.
3. Carpet edges shall comply with CBC Section 11B-303.

B. Environmental Impact Standards for the Carpet and Rug Institute's Indoor Air Quality testing program:

1. Less than 0.05 mg/square meter/per hour of formaldehyde.
2. Less than 0.3 mg/square meter/hour of total volatile organics compounds (TVOC).
3. Less than 0.4 mg/square meter/hour of styrene.
4. Less than 0.05 mg/square meter/hour of 4-PC.
5. Conduct test over 24-hour time period.

C. State of Washington Protocol for Indoor Air Quality testing.

1. Provide Class I products as determined by testing identical products for critical radiant flux classification in accordance with ASTM E 648.
2. Testing shall be conducted by an independent testing and inspecting agency acceptable to authorities having jurisdiction.

D. NBS smoke chamber test: Less than 450.
E. Static propensity:

1. 3 KV or less as tested in accordance with AATCC-134 (70-degree F at 20 percent R.H.).
2. Carpet shall retain its static control for the useful life of the installation.

F. Radiant panel (ASTM E 648): Class I.

2.2 CARPET TILE

A. Make: See Interior Finish Materials on drawings.

2.3 CARPET ACCESSORIES AND INSTALLATION MATERIALS

A. Carpet edge guard: Rubber or vinyl extrusion by Mercer Plastics Co. or Johnson Rubber Co., designed specifically as carpet edge guard. The Architect will select Color(s).
B. Seaming tape: Roberts Industries No. 50-330 Supertape, or Orcon CT-3 Super Tape.
C. Adhesives:
D. Edge sealer: USG Durabond Carpet Square Adhesive D2, WW Henry Peach Glue, 3M Blue Glue, or equal adhesive formulated for heavy commercial approved by the carpet manufacturer.
E. Floor leveling material:

1. Provide a minimum of one 10 lbs. bag of Portland cement-based floor prep material for every 100 square yard of carpet to be installed.
2. Do not use gypsum-based materials.

F. Other miscellaneous materials: As recommended by the carpet manufacturer for the conditions of installation and use.

PART 3 - EXECUTION

3.1 EXAMINATION/PREPARATION

A. Comply with the applicable specifications and recommendations of the Carpet and Rug Institute (CRI), Standard for Installation of Textile Floor covering Materials CRI 104, except as noted.
B. Vacuum substrate immediately prior to carpeting and remove deleterious substances, which would interfere with the installation or be harmful to this work.
C. Prepare concrete surfaces in accordance with CRI 104 Section 6.1.1 and 6.2.

Check floors for moisture content. Be sure that they are sufficiently dry to receive carpet by testing for moisture emission rate per ASTM F 1869 relative humidity per ASTM F 2170 and alkalinity-pH in accordance with ASTM F 710. Allow sufficient time in the construction schedule to allow slabs to dry sufficiently, force dry slabs, or provide a compatible surface coating so that water vapor emission will be at a level acceptable to the floor-covering manufacturer. Do not install carpet in areas above the following limits or exceed the limint published by the manufacturer:

1. Moisture emission rates above 3.0 lbs.
2. Relative Humidity rates above 75%RH.
3. Digital Alkalinity-pH readings above 9.0 pH.
1. Notify Architect of excessive results in writing. Installation deems acceptance of on-site conditions.

D. Test the alkalinity level of the concrete using a Litmus test. If the pH is above a level unacceptable to the adhesive manufacturer, treat the surface so that the floor PH is within acceptable levels.
E. Remove dirt, oil, grease, or other foreign matter from surfaces to be carpeted and/or to receive floor filler.
F. Use a floor filler, recommended by the carpet manufacturer, to fill-in cracks, holes and other indentation marks; grind down bumps to flat surface. Floor under carpet shall not exceed an Ff of 25.
G. Correct other detrimental conditions before starting installation.

3.2 INSTALLATION

A. General:

1. Comply with the carpet manufacturer's instructions and recommendations, except as modified herein.
2. Align carpet with centerline of room or space, and adjust at edges for wall variations.
3. Dry lay carpet in one room before going further to verify side match, dye sequence, pattern and defects. Obtain Architect’s approval of dry lay before installing the remainder of carpet tile.
4. Install carpet edge guard, where edge of carpet is exposed to traffic, in single length without joints except at changes in direction. Cut for a tight fit against abutting surfaces. Center under doors when applicable.

5. Extend carpet at the following locations:

    a. Under open-bottomed and raised bottomed obstructions, and under removable flanges of obstructions.
    b. Into closets and alcoves of spaces scheduled to be carpeted, unless another floor finish is indicated for such space.
    c. Under movable furniture and equipment.

6. Install carpet in one direction in each room and do not reverse direction at any locations.
7. Carpet shall have full adhesion to subfloor without loose edges.

B. Carpet tile installation:

1. Install in accordance with CRI 104 Section 14 and the following.
2. Terminate work neatly at obstructions, edges and corners without disrupting pattern or joint alignment. Cut tiles to obtain clean, sharp edges.
3. Install tile by the stair step method in full bed of adhesive, with tight joints and perimeter units not less than 1/2 tile wide. Adjust to minimize cutting.
4. Install tiles so that the arrows on the back point in the same direction.
5. Fit tiles snugly to prevent gaps, but do not force into place so as to cause buckles. Align tiles to avoid trapping pile yarns in the joint.
6. Roll completed installation with a 35 to 75 lb. linoleum roller in both directions to ensure uniform bond everywhere.
7. Installation tolerance: Comply with appropriate Sections of CRI 104.

3.3 CLEANING/PROTECTING

A. Remove debris from installation, carefully sorting pieces to be saved from scraps to be disposed of.
B. Vacuum carpet with a commercial machine, with a rotating agitator or beater in the nozzle. Remove soiled spots.
C. Close areas to traffic during installation. Cover carpet in traffic areas with protective non-staining building paper. Do not use plastic sheeting.
D. Prior to acceptance of the Work, replace damaged and stained carpet with new carpet.

END OF SECTION

SECTION 09 78 00 - FRP WALL PANELS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Fiberglass reinforced polyester (FRP) wall panels.
2. Matching moldings, fasteners, adhesive, and sealant.

B. Related requirements: All other sealants.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Scheduling and sequencing:
B. Preinstallation meeting:

1.3 SUBMITTALS

A. Samples: 12-inch square Samples of panel and 12-inch lengths of each profile of moldings.
B. Shop Drawings: Shop Drawings showing panel joint locations and details. Joint locations are subject to the Architect’s approval.
C. Data: Manufacturer Product Data including testing laboratory certification of fire hazard classification on each package.
D. Maintenance instructions:

1. Copy of the panel manufacturer’s maintenance instructions.
2. Include recommended cleaning materials and methods of application therefore together with precautions in cleaning materials' use if such are improperly applied.

1.4 HANDLING

A. Store panels indoor, and flat to avoid distortion. Maintain storage area temperature above 60-degree F.

1.5 JOB CONDITIONS

A. Comply with wall panel manufacturer recommendations for temperature and humidity in installation areas.
B. Illuminate work areas during installation to provide the same or greater level of illumination required to properly perform the work and as will occur in the room or space after the building is in operation.

PART 2 - PRODUCTS

2.1 MATERIALS

A. FRP wall panel: By one of the following, furnished in longest length available to minimize joints, of the color selected by the Architect.

1. Marlite Standard FRP panels, P 100 white, pebbled finish, basis of design.

2. Fire-X Glasbord by Crain Composites.
3. Sequentia Inc.
4. Or equal.

B. Trim: Manufacturer standard vinyl division bar, insider corner, outside corner and cap as required, matching the color of wall panel.
C. Fasteners: Manufacturer standard rivets matching the color of the wall panel.
D. Adhesive: Titebond “Fast Grab”, or equal non-toxic, non-allergenic adhesive recommended by the wall panel manufacturer and meeting Code requirements for flammability and toxicity.
E. Sealant: White, low gloss silicone, as specified in Section 07 92 00 unless otherwise recommended by panel manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces scheduled to receive wall panel for conditions that will adversely affect execution, permanence and quality of work. Verify that substrates are:

1. Clean, smooth, dry, free of irregularities.
2. Straight within a maximum tolerance of 1/8-inch in 10 feet, and not greater than 1/16-inch each running foot.

B. Correct detrimental conditions before proceeding with installation.

3.2 MOLDING INSTALLATION

A. Provide molding at top and bottom edges of panels. Use full-length stock moldings for run equaling, or less than, the stock length. Miter corners.
B. Butt vertical edges tight and flush.
C. Install panels plumb and level, and with hairline joints.

3.3 INSTALLATION OF PANELS

A. Except as modified in this Section, comply with the panel manufacturer's installation instructions.
B. Establish the top of the wainscot, or vertical terminations, in a straight line.
C. Avoid contamination of panel faces.
D. Butt joints for an even and tight fit along entire length of joint. Make joints plumb and level.
E. Balance sheet width symmetrically about centerline of wall so that no sheet is less than 2-foot wide.
F. Glue panels securely to substrate.
G. Square cut and sand smooth edges that will not be covered by trim. Do not damage exposed face.
H. Carefully locate penetrations and openings through the panels, including electrical outlets and piping, and provide minimum sized openings as required. Size openings so they will be covered by switch plates, flanges and other required trim.

3.4 CLEANING

A. Remove excess sealant and adhesive from joint immediately.
B. Clean installation immediately after installation with manufacturer recommended cleaner.
C. Replace damaged or permanently contaminated units.

END OF SECTION

SECTION 09 90 00 - PAINTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Painting and finishing all interior and exterior exposed surfaces throughout the Project, except as excluded in Paragraphs B and C below.
2. Surface preparation, priming and coats of paint specified herein are in addition to shop priming and surface treatment specified in other Sections.
3. Paint all exposed surfaces whether or not colors are designated, except where the natural finish of the material is obviously intended or specifically noted as a surface not to be painted. Where items or surfaces are not specifically mentioned, paint these the same as adjacent similar materials or areas.
4. This Section also includes sealing joints between surfaces to be painted, except for joints designed to be expressed in the Work and joints between a natural finish and a painted surface.
5. Section also includes preparation of existing surface to be painted and painting these surfaces.

B. Painting specified elsewhere:

1. Shop priming of ferrous metal items included under miscellaneous metal fabrications, hollow metal work, and similar work.
2. Deck coating.
3. Finished (not primed) mechanical and electrical equipment including light fixtures, switchgear and distribution cabinets, except as specified in Article 3.4 below.
4. Prefinished glazed assemblies, including skylights.
5. Pavement markings.
6. Toilet compartments and screens.
7. Exterior wall louvers.
8. Flagpoles.
9. Signage.
10. Postal equipment.
11. Loading dock equipment.
12. Parking control equipment.
13. Piping identification.

C. Painting not included: Do not paint the following surfaces.

1. Insulation and its facing.
2. Wood flooring.
3. Concrete and CMU.
4. Sprayed fireproofing.
5. Roofing.
6. Steel decking.
7. Chain link partitions.
8. Finish hardware, except those items noted USP.
9. Flexible door and window seals and weatherstripping (paint exposed metal to match door frame).
10. Finished metal surfaces such as anodized aluminum, stainless steel, chromium-plating, copper, bronze, brass and similar finished materials will not require finish painting.

11. Painting is not required on walls or ceilings in concealed and inaccessible areas, such as furred areas, pipe spaces, duct shafts and elevator shafts.
12. Operating parts, labels and nameplates:

    a. Do not paint moving parts of operating units, mechanical and electrical parts, such as valve and damper operator linkages, sinkages, sensing devices, motor and fan shafts.
    b. Do not paint over any nameplates, Code required labels, such as UL and FM, or any equipment identification, performance rating, name, or nomenclature plates.

1.2 DEFINITIONS

A. Paint: The term, as used in this Section, means all coating system components, including primers, emulsions, enamels, varnishes, stains, lacquers, sealers, fillers, and other applied materials whether used as prime, intermediate or finish coat.
B. Definitions of painting terms: ASTM D 16, unless otherwise specified.
C. Dry film thickness (DFT): Thickness of a coat of paint in fully cured state measured in mils (1/1000-inch).
D. Sheen: The terms used in these Specifications refer to the following gloss ranges when tested in accordance with ASTM D 523 test method.

Name	Test Method	Gloss Range
Flat	60-degree meter	0 to 7
Low sheen	60-degree meter	10 to 15
Eggshell	60-degree meter	25 to 30
Semi-gloss	60-degree meter	55 to 60
Gloss	60-degree meter	85 to 90

E. Coat: As used in this Section means a layer of paint, varnish, lacquer, or other material applied, then allowed to dry. To backroll or apply a wet-on-wet film still constitutes a single coat.
F. Finish: As used in this Section means the entire coating system including the texture, color, and sheen of a surface.
G. Refinish: As used in this Section implies a new finish will be applied to a surface that has been finished as defined above.
H. Touchup: As used in this Section means correction of deficiencies in the specified work to achieve a properly painted surface.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Phasing: Program cleaning and painting so that dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.

1.4 SUBMITTALS

A. Materials:

1. Copies of a complete materials list, identified by manufacturer name and product label or stock number.
2. Prepare list in the form of a repetition of the specified paint finishes, with the addition of the specific product intended for each coat.

B. Color samples:

1. Eight-and-one-half- by 11-inch samples of each color for painted finishes.

2. Provide stepped samples, defining each separate coat, including block fillers and primers. Identify paint system on back of control Samples.
3. Use representative colors when preparing samples for review.
4. Provide a list of materials and applications for each coat of each sample. Label each sample for location and application.
5. For transparent finishes, prepare the samples on wood specie, which will be used for the Project; 12-inch for lumber; 12-inch square for veneered panels.
6. Resubmit until required sheen, color, and texture are achieved.

C. Data: Manufacturer product data as follows.

1. Data for paint products, including paint label analysis, application instruction, and VOC content in grams/liter.
2. Duplicate copies of manufacturer affidavit with each shipment of materials delivered to the job site certifying that each material furnished complies with specified requirements.

1.5 QUALITY ASSURANCE

A. Painter’s qualifications: Firm and individuals experienced in applying paints and coatings similar in material, design, and extent to those specified for the Project, whose work has resulted in applications with a record of successful in-service performance.
B. SCAQMD Rule 1113: Submit paint manufacturer's certificate stating that provided coatings meet or exceed current SCAQMD Rule 1113 requirements.
C. Mockups:

1. Apply sample paint finishes (approximately 10-foot square) of each color scheme to wall areas, as directed by the Architect. Refer to Section 09 24 00 for painting cement plaster mockup and to Section 09 29 00 for painting gypsum board mockup.
2. Obtain Architect's approval of mockups before proceeding further. Approved mockups will be used as a standard for the Project, and if properly identified may remain a part of the Work.
3. Final acceptance of colors will be from job-applied samples.

1.6 JOB CONDITIONS

A. Environmental requirements:

1. Comply with paint manufacturer’s recommendations for environmental conditions and the following.
2. Provide adequate heating and ventilating to maintain environmental conditions recommended by paint manufacturer.
3. Do not apply finish in areas where dust is being generated.
4. Apply paint under the following prevailing conditions.

a. Air and surface temperatures are not below 40-degree F. or above 120-degree F.
b. Surface temperature is at least 5-degree F. above the dew point.
c. When there is not threat of impending rain.

B. Protection:

1. Protect adjacent whether being painted or not against damage from painting operation. Correct damage by cleaning, repairing, replacing, and repainting, as approved by Architect, and leave in an undamaged condition.
2. Use protective methods and materials, including temporary covering, recommended in writing by deferred (finish) flooring manufacturer.

3. Provide "Wet Paint" signs to protect newly coated finishes. After completing coating operations, remove temporary protective wrappings provided by others to protect their work. Post signs immediately after painting.
4. Provide drop cloths, shields, barricades and other protection necessary to safeguard adjacent surfaces not to be painted.
5. Provide and maintain protection as required to protect finished work from damage until its acceptance.

C. Illuminate work area during painting to provide the same or greater level of illumination required to properly perform the work and will occur in the room or space after the building is in operation.

1.7 HANDLING

A. Store materials indoors and mix only in spaces suitable for such purpose. Protect adjacent surfaces when mixing.
B. Store paint containers so the manufacturer's labels are clearly visible.

1.8 WARRANTY

A. Color of exterior surfaces painted, as part of the work of this Section shall, at the end of one year, have remained free from serious fading when compared to a control sample of the original paint.
B. Interior and exterior paint shall have its original adherence at the end of one year and there shall be no evidence of blisters, running, peeling, scaling, chalking, streaks, or stains at the end of this period.
C. Washing painted surfaces with alkali-free soap and water shall remove surface dirt from painted surfaces without producing deteriorating effects.

1.9 MAINTENANCE MATERIAL

A. With closeout submittals deliver one identified unopened gallon of each type and color of paint material used on the Project to the Owner for future paint touchup.
B. In addition to manufacturer label, identify with room number, floor or area, type of paint, color and sheen, as applicable, for future identification.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Specified and approved manufacturers:

1. Catalog names and numbers refer to products manufactured or distributed by the Vista Paint Corp. Dunn Edwards Corp. and Sherwin Williams, except as otherwise specified.
2. Equivalent acceptable products by Benjamin Moore, and PPG may be substituted when approved by the Architect.

2.2 PAINT

A. General:

1. Provide coating systems meeting or exceeding current SCAQMD Rule 1113 requirements.
2. Biocide content shall not exceed 0.025 percent by weight or volume.

3. Paint shall not contain fungicides or bactericides classified as mercury acetates, phenol phenates, or phenol formaldehyde.
4. Water-based paints shall not be formulated or manufactured with chemicals listed by Green Seal to be hazardous including, but not limited to, formaldehyde, halogenated solvents, aromatic hydrocarbons, mercury, and mercury compounds.
5. Paints shall not be tinted with pigments of lead, cadmium, chromium, and their oxides.

B. Quality and manufacture: Insofar as practicable, each paint shall be factory-mixed to match approved samples and colors and be of a consistency permitting immediate application. Use best quality grade regularly manufactured by one of the manufacturers listed in the schedule at the end of the Section.
C. Clear interior wood coatings: McCloskey's, Sikkens and Deft
D. Paint uniformity and compatibility:

1. Box at the job site or factory-batch paint to ensure color uniformity and consistency. This includes the required maintenance materials.
2. Provide finish coats compatible with the prime coats used.

a. Review other Sections of these Specifications, in which prime coats are specified, and manufacturer data for shop-primed surfaces to be painted.
b. Be responsible for the compatibility of the total coating system.

3. Provide barrier coats over incompatible primer or remove and reprime.
4. Products of more than one approved manufacturer may be used, except that all products applied on a surface shall be by the same manufacturer.

2.3 MISCELLANEOUS MATERIALS

A. Joint sealant: Paintable sealant as specified in Section 07 92 00.
B. Galvanized etching product: One of the following.

1. Jasco Prep N Prime.
2. Oakite 747 LTS.
3. Henkel Galvaprep 5.

2.4 COLOR SCHEDULE

A. Refer to the Finish and Materials Schedule for paint colors.
B. Number of colors to be used will be determined by the Architect.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces to be painted for conditions that would adversely affect the permanence and quality of this work.
B. Correct unsuitable conditions before proceeding with painting.

3.2 SURFACE PREPARATION

A. General: Prepare surfaces to receive the specified finishes in compliance with the paint manufacturer's instructions and the following. Extend painting on all surfaces visible from any angle.

B. Galvanized steel: Comply with American Galvanizers Association recommendations, ASTM D 2092, ASTM D 6386 - 10 Standard Practice for Preparation of Zinc (Hot-Dip Galvanized) Coated Iron and Steel Product and Hardware Surfaces for Painting, and the following.

1. Clean with commercial phosphoric acid solution or one of the products named above for pretreatment or by brush off blast cleaning with a fine abrasive to achieve a uniform anchor profile of 1.5 to 2 mils.
2. Recoat within the time limit recommended by the primer manufacturer.

C. Shop-primed metal: Remove oil, grease, dirt and foreign matter. Spot prime abraded surfaces with compatible primer.
D. Shop-painted metal: Sand to provide a mechanical bond with field applied finishes, or use a commercial preparation specifically formulated to improve paint bond.
E. Unprimed ferrous metal: Remove rust, mill scale, oil and other foreign matter.
F. Aluminum: Remove foreign matters and clean with mineral spirit.
G. Factory-primed equipment: Repair damaged primer; remove rust and clean to bright metal where appropriate. Sand or etch primer to permit bonding of finish coats. Clean surfaces thoroughly before applying additional coats.
H. Plaster, concrete and CMU:

1. Clean surfaces of dirt, laitance, encrustations and foreign matter. For concrete, comply with SSPC-SP13, “Surface Preparation of Concrete.”
2. In plaster and concrete, patch cracks, holes, pits and other imperfections, not patched under other Sections, flush and smooth with adjacent surfaces.
3. Do not apply sealer or paint when the moisture content of the surfaces to be painted exceeds 8 percent.
4. Touchup suction spots after priming with an additional prime coat until all surfaces show a uniform coating.

I. Gypsum board:

1. Remove dust, loose particles or other matter that would prevent proper paint adhesion.
2. Check to see that joints and screw heads are properly covered with joint compound and sanded smooth and flush with adjacent surfaces.

J. Wood:

1. Sandpaper smooth and dust clean. Remove handling marks and raised grain.
2. Fill nail holes, cracks and depressions with wood filler , colored to match finish for wood scheduled to receive a transparent finish. Use a tack cloth on wood to receive a transparent finish to remove sanding dust.

K. Other materials not covered above: Prepare to receive paint in compliance with the paint manufacturer instructions.
L. Existing painted surfaces:

1. General:

a. Wash surfaces with biodegradable detergent to remove dirt, dust and contaminants. Rinse clean. Use bleach on mildew; remove mildew completely.
b. Patch dents, gouges and other imperfections in painted surfaces and sand smooth and flush with adjacent undamaged surfaces so that patching will be invisible after painting.

c. Remove dust, rust and other surface contaminates, loose and unsound paint coatings, etc. as required to provide clean and sound surfaces to receive new paint.
d. Remove gloss from enamel paints with steel wool or by treating them with a commercial de-glosser used in compliance with its manufacturer's instructions.
e. Where paint is missing, damaged, or dented and where bare substrate is exposed, remove all surfaces contamination and featheredge all edges to zero. Sand surfaces smooth and prime.
f. Additionally, paint that is loose or is not otherwise tightly adhered to the substrate must be removed back to sound paint and down to the substrate, and all edges feathered to zero. When 40 percent or more of the paint on a given substrate is loose, damaged, or otherwise unsound, all the paint down to the substrate must be removed.

2. Wood:

a. Verify that substrate is smooth and free of dirt, oil, and other foreign substances, while knots shall be seasoned, clean, dry, and sealed.
b. Holes and imperfections must be filled with putty or plastic wood filler and sanded smooth, with the edges, ends, faces, undersides, and backsides primed.
c. There shall be neither signs of steel wool (used for smoothing) nor blue stain.

3. Galvanized surfaces:

a. Clean of soil, cement spatter, weld flux and spatter, oil grease, grime, and other surface dirt.
b. Additionally, repair damaged zinc coating on galvanized surfaces with high zinc content cold-galvanizing repair.
c. Remove grease, oil, dust, grime, and loose dirt are removed;
d. Abrade surfaces sufficiently and roughen to provide a sound-anchoring base for new paint.

4. Rust: Remove down to bright metal and prime surfaces with rust-inhibitive primer.
5. Test: Test a small area of the previously painted finish with the new coating by applying to specified thickness and then continuing the test for the manufacturer's recommended published length of time before re-coating. If the previously painted surface blisters, wrinkles, dissolves, and/or delaminates, it will not work with the new finish. Where the previously painted surface is incompatible with the finish coat, one should apply a proper barrier coat to the prime coat. It is important to allow the manufacturer's suggested drying time between the succeeding coat, and to check the film of the previous coat be certain it is cured.

M. Hardware:

1. Remove hardware, hardware accessories, machined surfaces, plates, lighting fixtures and similar items in place and not to be painted, or provide surface- applied protection prior to surface preparation and painting.
2. Coat cutouts for hinges, edges of lockset holes and same as for first coat.
3. Following completion of painting each space or area, reinstall the removed item by workmen skilled in the trades involved.

N. Fire extinguishers and fire hose cabinets: Apply 2 coats of paint finish, inside and out, matching finish and color of adjoining areas, unless otherwise noted for directed.
O. Weatherstripping and sound seals. Paint exposed metal surfaces to match the door frame, whether or not unfinished, furnished with factory prime coat, or factory treated for paint adhesion.

P. Access doors and panels: Generally, paint the same color as surrounding walls and ceiling.
Q. Registers: Paint exterior of register same color as adjacent wall. Paint interior of connected duct flat black for a distance of 18 inches.

3.3 PAINT PREPARATION

A. Open paint containers only as required for use. Mix paint in designated areas.
B. Thoroughly stir and agitate paint to uniformly smooth consistency suitable for proper application.
C. Do not reduce, change or use any materials except in compliance with manufacturer printed instructions.
D. In all cases, prepare and handle paint to prevent deterioration and inclusion of foreign matter.

3.4 APPLICATION

A. General:

1. Seal interior joints between wood or wood composite materials, trim, baseboard, molding, and casements and adjacent materials with paintable sealant specified in Section 07 92 00.
2. On prefinished wood doors, finish bottom after trimming and cutouts with 2 coats of high solids clear urethane varnish promptly upon delivery to the jobsite. This requirement applies also to plastic laminate faced doors.
3. Where the 2 faces of doors differ in color or finish, finish the edges to match the face visible when the door is open.
4. Apply paint only under conditions that will insure finishes free from blemishes and defects. Leave corners with no undue amount of paint buildup.
5. Use a slightly different shade for each coat of paint so that it may be readily identified.
6. Primer and intermediate coats shall be unscarred and completely integral when succeeding coats are applied. Sand and dust between each coat to remove defects visible from a distance of 5 feet.
7. Give particular attention to edges, angles, flanges, and other similar areas, where insufficient film thicknesses are likely to be present, and ensure proper millage in these areas.
8. Remove paint spillage and spatters on adjacent surfaces so as not to damage the surface being cleaned.

    a. Perform patching and repairs required because of painting operations.
    b. Refinish entire panel or assembly where portion of finish has been damaged or is not acceptable to the Architect.

9. Paint interior surfaces of ducts, where visible thru registers and grilles, with a flat nonspecular black paint.
10. Unless otherwise directed by the Architect, spray-paint exposed surfaces of ceiling diffusers, air return grilles, speakers and other electrical and mechanical items, except smoke detectors and sprinkler heads, in painted ceilings to match the ceilings, whether these items are primed or factory-finished.
11. Number of coats:

    a. The number of coats and paint film thickness required is the same regardless of the application method. Do not apply succeeding coats until the previous coat has completely dried.
    b. The number of coats specified is the minimum required for complete coverage and uniformity of color.
    c. Apply additional coats when undercoats, stains, or other conditions show through the final finish until the finish is of uniform color and appearance.

12. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Paint surfaces behind permanently fixed equipment or furniture with prime coat only.
13. Paint interior surfaces, which are a continuation of exterior surfaces, subject to exterior exposure (such as an out-swinging door), with the applicable exterior coating system.
14. For opaque finishes, completely cover surfaces to be painted to provide an opaque, smooth surface film uniform in finish, color, appearance, and coverage. Painted surfaces with cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness and other imperfections are not acceptable. Cut paint in sharp lines and color breaks.
15. For transparent finishes, apply multiple coats to produce a glass-smooth surface film of even luster, free of laps, cloudiness, color irregularity, runs, brush marks, orange peel, nail holes, and other surface imperfections.
16. Completed work shall match approved samples, as determined by the Architect. Remove, refinish, or repaint work not complying with specified requirements.

B. Labeling rated (fire and smoke walls and partitions): Identify both sides of rated walls and partitions above finished and decorative ceilings (plenum) with minimum 2-inch high, bright red letters spaced at 10 feet o.c. maximum, as follows. Identification can be painted using a stencil or by using pre-printed self-adhesive labels.

1. Fire rated partitions: "FIRE PARTITION - DO NOT PENETRATE."
2. Smoke barrier partitions: "SMOKE PARTITION - DO NOT PENETRATE."

C. Painting fire suppression, plumbing, HVAC, electrical, communication, and electronic safety and security work: Paint the following and their hangers and accessories where exposed to view:

1. Uninsulated metal piping.
2. Uninsulated plastic piping.
3. Pipe hangers and supports.
4. Ductwork.
5. Metal conduit.
6. Plastic conduit.
7. Tanks that do not have factory-applied final finishes.

D. Application method: Contractor's option provided applied coatings match approved samples. The Architect reserves the right to require that paint be sprayed for smoothness and uniformity.

E. Priming:

1. Prime bare metal scheduled to be painted, and not embedded in concrete and masonry, immediately upon delivery to the site.
2. Time lapse between priming and application of second coat shall be as short as possible.

F. Shop-primed metal:

1. Apply 2 finish coats of paint to match adjoining surfaces, as directed by the Architect, to shop primed mechanical and electrical equipment. This work includes but is not limited to interior of fire hose cabinets, air grilles, ceiling diffusers, electrical and telephone panels, and access panels.
2. Paint conduits, outlets and pull boxes, and mechanical equipment exposed to view, such as covered and uncovered piping and ductwork, pumps, compressors, air conditioning equipment and tanks as specified in this Section.
3. Paint the back side of access panels, removable or hinged covers to match the exposed surfaces.

G. Miscellaneous painting: Surfaces to be painted and not specifically described herein, shall be painted with a product specifically manufactured or prepared for the material and surface to be painted with a prime and 2 finish coats.

3.5 TOUCHUP/CLEANING

A. At completion of construction activities of other trades, touchup and restore damaged or defaced painted surfaces. Comply with procedures specified in PDCA P1.

3.6 PAINT FINISH SCHEDULE

A. Finish all surfaces in compliance with the schedule in Section 09 90 00A, following this Section. Catalog names and numbers refer to products by the Vista, Dunn Edwards, Sherwin Williams, Monochem and Carboline except as otherwise specified.

END OF SECTION

SECTION 09 90 00A – PAINT FINISH SCHEDULE

1.1 EXTERIOR SURFACES

A. Wood: 100 percent Acrylic Flat

1. Primer (1 coat):

a. 4200 Terminator II by Vista Paint.
b. UGPR00 Ultra Grip Primer by Dunn-Edwards.
c. ProBlock Latex Primer/Sealer, B51-600 Series by Sherwin-Williams.

2. Finish Coat (2 coats):

a. 2000 Duratone by Vista Paint.
b. EVSH10 Evershield by Dunn-Edwards.
c. Duration Flat K32 Series by Sherwin-Williams.

B. Wood: 100 percent Semi-Gloss Acrylic

1. Primer (1 coat):

a. 4200 Terminator II by Vista Paint.
b. UGPR00 Ultra Grip Primer by Dunn-Edwards.
c. ProBlock Latex Primer/Sealer, B51-600 Series by Sherwin-Williams.

2. Finish Coat (2 coats):

a. 8400 Carefree SG by Vista Paint.
b. EVSH50-0 Evershield SG by Dunn-Edwards.
c. Duration Semi-Gloss A98 Series by Sherwin-Williams.

C. Wood: 100 percent Gloss Acrylic

1. Primer (1 coat):

a. 4200 Terminator II by Vista Paint.
b. UGPR00 Ultra Grip Primer by Dunn-Edwards.
c. ProBlock Latex Primer/Sealer, B51-600 Series by Sherwin-Williams.

2. Finish Coat (2 coats):

a. 8500 Carefree Gloss by Vista Paint.
b. EVSH60-0 Evershield GL by Dunn-Edwards.
c. Duration Gloss K38 Series by Sherwin-Williams.

D. Wood: Semi-Transparent Stain

1. 2 Coats:

a. Olympic Maximum Semi-Transparent Stain by Vista Paint.
b. Okon WPT-3 Semi-Transparent Stain by Dunn-Edwards.

SuperDeck Exterior Waterborne Semi-Transparent Stain, SD3T00015 by Sherwin-Williams.

E. Concrete and Brick: 100 percent Acrylic Flat

1. Primer (1 coat):

a. 4600 Uniprime II by Vista Paint.
b. ESPR00 Eff-Stop by Dunn-Edwards.
c. Loxon Concrete & Masonry Primer/Sealer, A24W8300 by Sherwin-Williams.

2. Finish Coat (2 coats):

a. 2000 Duratone by Vista Paint.
b. EVSH10 Evershield by Dunn-Edwards.
c. Duration Flat K32 Series by Sherwin-Williams.

F. Portland Cement Plaster: 100 percent Acrylic Flat

1. Primer (1 coat):

a. 4600 Uniprime II by Vista Paint.
b. ESPR00 Eff-Stop by Dunn-Edwards.
c. Loxon Concrete & Masonry Primer/Sealer, A24W8300 by Sherwin-Williams.

2. Finish Coat (2 coats):

a. 2000 Duratone by Vista Paint.
b. EVSH10 Evershield by Dunn-Edwards.
c. Duration Flat K32 Series by Sherwin-Williams.

G. CMU: 100 percent Acrylic Flat

1. Primer (1 coat):

a. 018 Acrylic Block Filler by Vista Paint.
b. SBPR00 Blocfil by Dunn-Edwards.
c. Loxon Block Surfacer, A24W200 by Sherwin-Williams.

2. Finish Coat (2 coats):

a. 2000 Duratone by Vista Paint.
b. EVSH10 Evershield by Dunn-Edwards.
c. Duration Flat K32 Series by Sherwin-Williams.

H. CMU: 100 percent Acrylic Elastomeric

1. Primer (1 coat):

a. 018 Acrylic Block Filler by Vista Paint.
b. SBPR00 Blocfil by Dunn-Edwards.
c. Loxon Block Surfacer, A24W200 by Sherwin-Williams.

2. Finish Coat (2 coats):

    a. 1900 Weather Master at 8 to 10 MILS per coat DFT by Vista Paint.
    b. DE Enduralastic, 10 EDLX10-0 Elastomeric at 11 to 13 MILS per coat DFT by Dunn-Edwards.
    c. Loxon XP, A24W1451 at 8 to 10 MILS per coat DFT by Sherwin-Williams.

I. CMU, Concrete, Brick: Graffiti-Resistant Coating (Permanent Matte Flat)

1. See Section 09 96 23

J. Painted Surfaces

1. Finish Coat (2 coats):

    a. Monochem 6100 Clear or 6150 Pigmented TDFT Base at 4-6 MILS by Vista Paint.
    b. Monochem 6100 Clear or 6150 Pigmented TDFT Base at 4-6 MILS by Dunn-Edwards.
    c. Monochem 6100 Clear or 6150 Pigmented TDFT Base at 4-6 MILS by Sherwin-Williams.

2. Finish Coat (2 coats):

    a. Monochem 5600 Permashield Premium at 4-6 MILS TDFT by Vista Paint.
    Monochem 5600 Permashield Premium at 4-6 MILS TDFT by Dunn-Edwards.
    Monochem 5600 Permashield Premium at 4-6 MILS TDFT by Sherwin-Williams.

K. Clear Water Repellent

1. Monochem Aquaseal ME12 by Vista Paint.
2. Okon S-20 by Dunn-Edwards.
3. Loxon 7% Siloxane Water Repellent, A10T7 by Sherwin-Williams.

L. Unpainted Surfaces: Permanent (Matte Flat)

1. Finish Coat (2 coats):

    a. Monochem 6100 Clear Base at 4-6 Mils TDFT by Vista Paint.
    Monochem 6100 Clear Base at 4-6 Mils TDFT by Dunn-Edwards.
    Monochem 6100 Clear Base at 4-6 Mils TDFT by Sherwin-Williams.

2. Finish Coat (2 coats):

    a. Monochem 5600 Permashield Premium at 4-6 MILS TDFT by Vista Paint.
    Monochem 5600 Permashield Premium at 4-6 MILS TDFT by Dunn-Edwards.
    Monochem 5600 Permashield Premium at 4-6 MILS TDFT by Sherwin-Williams.

M. Iron and Steel: 100 percent Gloss Acrylic

1. Primer (1 coat):

    a. 9600 Protec Primer by Vista Paint.
    b. BRPR00 Block Rust by Dunn-Edwards.
    c. Pro Industrial Pro-Cryl Universal Primer, B66-310 Series by Sherwin-Williams.

2. Finish Coat (2 coats):

    a. 8500 Carefree Gloss by Vista Paint.
    b. EVSH60-0 Evershield GL by Dunn-Edwards.
    c. Duration Gloss K38 Series by Sherwin-Williams.

N. Iron and Steel: 100 percent Semi-Gloss Acrylic

1. Primer (1 coat):

    a. 9600 Protec Primer by Vista Paint.
    b. BRPR00 Block Rust by Dunn-Edwards.
    c. Pro Industrial Pro-Cryl Universal Primer, B66-310 Series by Sherwin-Williams.

2. Finish Coat (2 coats):

    a. 8400 Carefree SG by Vista Paint.
    b. EVSH50-0 Evershield GL by Dunn-Edwards.
    c. Duration Semi-Gloss A98 Series by Sherwin-Williams.

O. Aluminum and Galvanized Steel: 100 percent Gloss Acrylic

1. Pretreat:

    a. Jasco Prep N Prime by Vista Paint.
    b. SCME-01 Supreme Etch by Dunn-Edwards.
    c. Great Lakes Clean & Etch by Sherwin-Williams.

2. Primer (1 coat):

    a. 4800 Metal Pro Primer by Vista Paint.
    b. UGPR00 Ultra Grip Primer by Dunn-Edwards.
    c. Pro Industrial DTM Acrylic Primer/Finish, B66W11 by Sherwin-Williams.

3. Finish Coat (2 coats):

    a. 8500 Carefree Gloss by Vista Paint.
    b. EVSH60-0 Evershield GL by Dunn-Edwards.
    c. Duration Gloss K38 Series by Sherwin-Williams.

P. Aluminum and Galvanized Steel: 100 percent Semi-Gloss Acrylic

1. Pretreat:

    a. Krud Kutter by Vista Paint.
    b. SCME-01 Supreme Etch by Dunn-Edwards.
    c. Great Lakes Clean & Etch by Sherwin-Williams.

2. Primer (1 coat):

    a. 4800 Metal Pro Primer by Vista Paint.
    b. UGPR00 Ultra Grip Primer by Dunn-Edwards.
    c. Pro Industrial DTM Acrylic Primer/Finish, B66W11 by Sherwin-Williams.

3. Finish Coat (2 coats):

    a. 8400 Carefree SG by Vista Paint.
    b. EVSH50-0 Evershield SG by Dunn-Edwards.
    c. Duration Semi-Gloss A98 Series by Sherwin-Williams.

Q. Fiber Cement Board: 100 percent Acrylic Flat

1. Primer (1 coat):

    a. 4600 Uniprime II by Vista Paint.
    b. ESPR00 Eff-Stop by Dunn-Edwards.
    c. Loxon Concrete & Masonry Primer/Sealer, A24W8300 by Sherwin-Williams.

2. Finish Coat (2 coats):

    a. 2000 Duratone by Vista Paint.
    b. EVSH10 Evershield by Dunn-Edwards.
    c. Duration Flat K32 Series by Sherwin-Williams.

R. Zinc Alloy: 100 percent Semi-Gloss Acrylic

1. Pretreat:

    a. Krud Kutter by Vista Paint.
    b. SCME-01 Supreme Etch by Dunn-Edwards.
    c. Great Lakes Clean & Etch by Sherwin-Williams.

2. Primer (1 coat):

    a. 4800 Metal Pro Primer by Vista Paint.
    b. UGPR00 Ultra Grip Primer by Dunn-Edwards.
    c. Pro Industrial DTM Acrylic Primer/Finish, B66W11 by Sherwin-Williams.

3. Finish Coat (2 coats):

    a. 8400 Carefree SG by Vista Paint.
    b. EVSH50-0 Evershield SG by Dunn-Edwards.
    c. Duration Semi-Gloss A98 Series by Sherwin-Williams.

S. Ferrous Metal: Heavy Duty

1. Primer (1 coat):

    a. Carboline Carboguard 890 VOC at 5 MILS DFT by Vista Paint.
    b. Carboline Carboguard 890 VOC at 5 MILS DFT by Dunn-Edwards.
    c. Macropoxy 646-100 Fast Cure Epoxy, B58W620 at 5 MILS DFT by Sherwin-Williams.

2. Primer (1 coat):

    a. Carboline Carbothane 133MC at 5 MILS DFT by Vista Paint.
    b. Carboline Carbothane 133MC at 5 MILS DFT by Dunn-Edwards.
    c. Hi-Solids Polyurethane 100, B65-600 Series at 4 MILS DFT by Sherwin-Williams.

T. Gypsum Soffit Board: 100 percent Acrylic Flat

1. Primer (1 coat):

a. 4600 Uniprime II by Vista Paint.
b. UGPR00 Ultra Grip Primer by Dunn-Edwards.
c. ProBlock Latex Primer/Sealer, B51-600 Series by Sherwin-Williams.

2. Finish Coat (2 coats):

a. 2000 Duratone by Vista Paint.
b. EVSH10 Evershield or Enduralastic 10 by Dunn-Edwards.
c. Duration Flat K32 Series or A80-1100 Series by Sherwin-Williams.

1.2 INTERIOR SURFACES

A. Wood: Low Sheen 100 percent Acrylic

1. Primer (1 coat):

a. 4200 Terminator II by Vista Paint.
b. UGPR00 Ultra Grip Primer by Dunn-Edwards.
c. ProBlock Latex Primer/Sealer, B51-600 Series by Sherwin-Williams.

2. Finish Coat (2 coats):

a. 8200 Carefree by Vista Paint.
b. SPMA20 Suprema Velvet Sheen by Dunn-Edwards.
c. Duration Matte A96 Series by Sherwin-Williams.

B. Wood: Semi-Gloss 100 percent Acrylic

1. Primer (1 coat):

a. 4200 Terminator II by Vista Paint.
b. UGPR00 Ultra Grip Primer by Dunn-Edwards.
c. ProBlock Latex Primer/Sealer, B51-600 Series by Sherwin-Williams.

2. Finish Coat (2 coats):

a. 8400 Carefree Semi-Gloss by Vista Paint.
b. SPMA50 Suprema Semi-Gloss by Dunn-Edwards.
c. Duration Semi-Gloss A98 Series by Sherwin-Williams.

C. Wood: ST Stain & Clear Lacquer Finish (275 g/liter VOC)

1. Primer (1 coat):

a. VWS0250 Series ST Stain by Vista Paint.
b. Old Masters Stain [? ? ?] by Dunn-Edwards.
c. Minwax Water-based Wood Stain by Sherwin-Williams.

2. Primer (1 coat):

   a. NRS 1620 [? ? ?] by Vista Paint.
   b. Contractor's Edge Sanding Sealer by Dunn-Edwards.
   c. Sher-Wood NC Lacquer Sealer, T65FV14 Sanding Sealer by Sherwin-Williams.

3. Primer (1 coat):

   a. NRF 1626 Satin Lacquer by Vista Paint.
   b. Contractor's Edge Sanding Sealer by Dunn-Edwards.
   c. Sher-Wood 275 Lacquer, T75FH100 Series by Sherwin-Williams.

D. Wood: Stained, Water White Finish (for light colored stains) (275 g/liter VOC)

1. Primer (1 coat):

   a. VW0250 Series ST Stain by Vista Paint.
   b. Old Masters Stain, Mission White Satin by Dunn-Edwards.
   c. Minwax Water-based Wood Stain by Sherwin-Williams.

2. Primer (1 coat):

   a. NAF 1420 Satin Sealer by Vista Paint.
   b. Contractor's Edge WW Sanding Sealer by Dunn-Edwards.
   c. Sher-Wood NC Lacquer by Sherwin-Williams.

3. Primer (1 coat):

   a. NAF 1426 Satin Lacquer by Vista Paint.
   b. Contractor's Edge Satin Lacquer by Dunn-Edwards.
   c. Sher-Wood 275 Lacquer, T75FH100 Series by Sherwin-Williams.

E. Wood: Varnish Flat Clear

1. Finish Coat (2 coats):

   a. McCloskey's 6701 Flat by Vista Paint.
   b. McCloskey's 6701 Flat by Dunn-Edwards.
   c. Minwax Water based Wood Stain by Sherwin-Williams.

2. Finish Coat (2 coats):

   a. Varnish Satin Clear McCloskey's 6702 Satin by Vista Paint.
   b. Varnish Satin Clear McCloskey's 6702 Satin by Dunn-Edwards.
   c. Wood Classics Waterborne Polyurethane Varnish Satin by Sherwin-Williams.

3. Finish Coat (2 coats):

   a. Varnish Gloss Clear McCloskey's 6703 Gloss by Vista Paint.
   b. Varnish Gloss Clear McCloskey's 6703 Gloss by Dunn-Edwards.
   c. Wood Classics Waterborne Polyurethane Varnish Gloss by Sherwin-Williams.

F. Wood: Varnish Flat Clear

1. Finish Coat (2 coats):

a. DF 12 Dryfall Flat by Vista Paint.
b. AQUA10 Aquafall Dry Fall by Dunn-Edwards.
c. Waterborne Acrylic Dryfall Flat, B42W1 by Sherwin-Williams.

G. Rough Sawn Wood: Stain, Semi-Transparent

1. Finish Coat (2 coats):

a. Olympic Semi-Transparent Stain by Vista Paint.
b. Okon WPT-3 Semi-Transparent Stain by Dunn-Edwards.
c. Transparent Stain Waterborne Semi-Transparent Stain, SD3T00015 by Sherwin-Williams.

H. Concrete, Plaster, CMU: Flat Acrylic

1. Concrete Primer (1 coat):

a. 4600 Uniprime II by Vista Paint.
b. ESPR00 Eff-Stop by Dunn-Edwards.
c. ProBlock Interior/Exterior Latex Primer/Sealer, B51-600 Series by Sherwin-Williams.

2. Plaster Primer (1 coat):

a. 4600 Uniprime II by Vista Paint.
b. ESPR00 Eff-Stop by Dunn-Edwards.
c. ProBlock Interior/Exterior Latex Primer/Sealer, B51-600 Series by Sherwin-Williams.

3. CMU Primer (1 coat):

a. 018 Acrylic Block Filler by Vista Paint.
b. SBPR00 Blocfil by Dunn-Edwards.
c. Loxon Block Surfacer, A24W200 by Sherwin-Williams.

4. Finish Coat (2 coats):

a. 8100 Carefree Flat by Vista Paint.
b. SPMA10 Suprema Flat by Dunn-Edwards.
c. Duration Flat A95 Series by Sherwin-Williams.

I. CMU, Concrete, Plaster: Eggshell Acrylic

1. Concrete Primer (1 coat):

a. 4600 Uniprime II by Vista Paint.
b. ESPR00 Eff-Stop by Dunn-Edwards.
c. ProBlock Interior/Exterior Latex Primer/Sealer, B51-600 Series by Sherwin-Williams.

2. Plaster Primer (1 coat):

    a. 4600 Uniprime II by Vista Paint.
    b. ESPR00 Eff-Stop by Dunn-Edwards.
    c. ProBlock Interior/Exterior Latex Primer/Sealer, B51-600 Series by Sherwin-Williams.

3. CMU Primer (1 coat):

    a. 018 Acrylic Block Filler by Vista Paint.
    b. SBPR00 Blocfil by Dunn-Edwards.
    c. Loxon Block Surfacer, A24W200 by Sherwin-Williams.

4. Finish Coat (2 coats):

    a. 8200 Carefree VS by Vista Paint.
    b. SPMA30 Suprema EG by Dunn-Edwards.
    c. Duration Matte A96 Series by Sherwin-Williams.

J. CMU, Concrete, Plaster: Semi-Gloss Acrylic

1. Concrete Primer (1 coat):

    a. 4600 Uniprime II by Vista Paint.
    b. ESPR00 Eff-Stop by Dunn-Edwards.
    c. ProBlock Interior/Exterior Latex Primer/Sealer, B51-600 Series by Sherwin-Williams.

2. Plaster Primer (1 coat):

    a. 4600 Uniprime II by Vista Paint.
    b. ESPR00 Eff-Stop by Dunn-Edwards.
    c. ProBlock Interior/Exterior Latex Primer/Sealer, B51-600 Series by Sherwin-Williams.

3. CMU Primer (1 coat):

    a. 018 Acrylic Block Filler by Vista Paint.
    b. SBPR00 Blocfil by Dunn-Edwards.
    c. Loxon Block Surfacer, A24W200 by Sherwin-Williams.

4. Finish Coat (2 coats):

    a. 8400 Carefree SG by Vista Paint.
    b. SPMA50 Suprema SG by Dunn-Edwards.
    c. Duration Semi-Gloss A98 Series by Sherwin-Williams.

K. CMU, Concrete, Plaster: 100 percent Acrylic

1. Concrete Primer (1 coat):

    a. 065 Acry-Prime by Vista Paint.
    b. ESPR00 Eff-Stop by Dunn-Edwards.
    c. ProBlock Interior/Exterior Latex Primer/Sealer, B51-600 Series

by Sherwin-Williams.

2. Plaster Primer (1 coat):

   a. 4600 Uniprime II by Vista Paint.
   b. ESPR00 Eff-Stop by Dunn-Edwards.
   c. ProBlock Interior/Exterior Latex Primer/Sealer, B51-600 Series by Sherwin-Williams.

3. CMU Primer (1 coat):

   a. 018 Acrylic Block Filler by Vista Paint.
   b. SBPR00 Blocfil by Dunn-Edwards.
   c. Loxon Block Surfacer, A24W200 by Sherwin-Williams.

4. Finish Coat (2 coats):

   a. 8500 Carefree Gloss by Vista Paint.
   b. EVSH60 Evershield GL by Dunn-Edwards.
   c. Duration Gloss K38 Series by Sherwin-Williams.

L. Masonry: Gloss Acrylic Epoxy

1. Concrete Primer (1 coat):

   a. 4600 Uniprime II by Vista Paint.
   b. ESPR00 Eff-Loc or Carboline 120 Primer with Carboline Sanitile 555 by Dunn-Edwards.
   c. ProBlock Interior/Exterior Latex Primer/Sealer, B51-600 Series by Sherwin-Williams.

2. Plaster Primer (1 coat):

   a. 4600 Uniprime II by Vista Paint.
   b. ESPR00 Super-Loc by Dunn-Edwards.
   c. ProBlock Interior/Exterior Latex Primer/Sealer, B51-600 Series by Sherwin-Williams.

3. CMU Primer (1 coat):

   a. 018 Acrylic Block Filler by Vista Paint.
   b. SBPR00 Blocfil by Dunn-Edwards.
   c. Loxon Block Surfacer, A24W200 by Sherwin-Williams.

4. Finish Coat (2 coats):

   a. S60 WB Gloss Epoxy at 2 to 3 MILS DFT by Vista Paint.
   b. S60 WB Gloss Epoxy at 2 to 3 MILS DFT or Carboline Sanitile 555 by Dunn-Edwards.
   c. Pro Industrial Water Based Catalyzed Epoxy Gloss, B73-300/B73V300 at 2 to 4 MILS DFT by Sherwin-Williams.

M. Gypsum Board: Flat

1. Finish Coat (2 coats):

    a. 8100 Carefree Flat by Vista Paint.
    b. SPMA10 Suprema Flat by Dunn-Edwards.
    c. Duration Flat A95 Series by Sherwin-Williams.

N. Gypsum Board: Eggshell

1. Primer (1 coat):

    a. 1100 Hi-Build PVA Primer by Vista Paint.
    b. VNPR00 Vinylastic Primer by Dunn-Edwards.
    c. ProMar 200 Zero VOC Interior Latex Primer, B28W2600 by Sherwin-Williams.

2. Finish Coat (2 coats):

    a. 8200 Carefree Velva Sheen by Vista Paint.
    b. SPMA30 Suprema EG by Dunn-Edwards.
    c. Duration Matte A96 Series by Sherwin-Williams.

O. Gypsum Board: Low Sheen 100 percent Acrylic

1. Primer (1 coat):

    a. 1100 Hi-Build PVA Primer by Vista Paint.
    b. VNPR00 Vinylastic Primer by Dunn-Edwards.
    c. ProMar 200 Zero VOC Interior Latex Primer, B28W2600 by Sherwin-Williams.

2. Finish Coat (2 coats):

    a. 8300 Carefree Eggshell by Vista Paint.
    b. SPMA40 Suprema Low Sheen by Dunn-Edwards.
    c. Duration Satin A97 Series by Sherwin-Williams.

P. Gypsum Board: Semi-Gloss Acrylic

1. Primer (1 coat):

    a. 1100 Hi-Build PVA Primer by Vista Paint.
    b. VNPR00 Vinylastic Primer by Dunn-Edwards.
    c. ProMar 200 Zero VOC Interior Latex Primer, B28W2600 by Sherwin-Williams.

2. Finish Coat (2 coats):

    a. 8400 Carefree Semi-Gloss by Vista Paint.
    b. SPMA50 Suprema Semi-Gloss by Dunn-Edwards.
    c. Duration Semi-Gloss A98 Series by Sherwin-Williams.

Q. Gypsum Board: 100 percent Gloss Acrylic

1. Primer (1 coat):

a. 1100 Hi-Build PVA Primer by Vista Paint.
b. VNPR00 Vinylastic Primer by Dunn-Edwards.
c. ProMar 200 Zero VOC Interior Latex Primer, B28W2600 by Sherwin-Williams.

2. Finish Coat (2 coats):

a. 8500 Carefree Gloss by Vista Paint.
b. EVSH60 Evershield Gloss by Dunn-Edwards.
c. Duration Gloss K38 Series by Sherwin-Williams.

R. Gypsum Board: Gloss Acrylic Epoxy

1. Primer (1 coat):

a. 1100 Hi-Build PVA Primer by Vista Paint.
b. VNPR00 Vinylastic Primer by Dunn-Edwards.
c. ProMar 200 Zero VOC Interior Latex Primer, B28W2600 by Sherwin-Williams.

2. Finish Coat (2 coats):

a. Carboline Sanitile 255 at 2 to 3 MILS DFT by Vista Paint.
b. Carboline Sanitile 255 at 2 to 3 MILS DFT by Dunn-Edwards.
c. Pro Industrial Water Based Catalyzed Epoxy Gloss, B73-300/B73V300 at 2 to 4 MILS DFT by Sherwin-Williams.

S. Plaster: Gypsum, Portland Cement, Flat

1. Primer (1 coat):

a. 4600 Uniprime II by Vista Paint.
b. ESPR00 Eff-Stop by Dunn-Edwards.
c. ProBlock Interior/Exterior Latex Primer/Sealer, B51-600 Series by Sherwin-Williams.

2. Finish Coat (2 coats):

a. 8100 Carefree Flat by Vista Paint.
b. SPMA10 Suprema Flat by Dunn-Edwards.
c. Duration Flat, A95 Series by Sherwin-Williams.

T. Plaster: Gypsum, Portland Cement, Eggshell

1. Primer (1 coat):

a. 4600 Uniprime II by Vista Paint.
b. ESPR00 Eff-Stop by Dunn-Edwards.
c. ProBlock Interior/Exterior Latex Primer/Sealer, B51-600 Series by Sherwin-Williams.

2. Finish Coat (2 coats):

    a. 8200 Carefree Velva Sheen by Vista Paint.
    b. SPMA30 Suprema EG by Dunn-Edwards.
    c. Duration Matte A96 Series by Sherwin-Williams.

U. Plaster: Gypsum, Portland Cement, Semi-Gloss Acrylic

1. Primer (1 coat):

    a. 4600 Uniprime II by Vista Paint.
    b. ESPR00 Eff-Stop by Dunn-Edwards.
    c. ProBlock Interior/Exterior Latex Primer/Sealer, B51-600 Series by Sherwin-Williams.

2. Finish Coat (2 coats):

    a. 8400 Carefree SG by Vista Paint.
    b. SPMA50 Suprema SG by Dunn-Edwards.
    c. Duration Semi-Gloss A98 Series by Sherwin-Williams.

V. Plaster: Gypsum, Portland Cement, Gloss 100 percent Acrylic

1. Primer (1 coat):

    a. 4600 Uniprime II by Vista Paint.
    b. ESPR00 Eff-Stop by Dunn-Edwards.
    c. ProBlock Interior/Exterior Latex Primer/Sealer, B51-600 Series by Sherwin-Williams.

2. Finish Coat (2 coats):

    a. 8500 Carefree Gloss by Vista Paint.
    b. EVSH00 Evershield GL by Dunn-Edwards.
    c. Duration Gloss A38 Series by Sherwin-Williams.

W. Particleboard, Hardboard: Flat

1. Primer (1 coat):

    a. 4600 Uniprime II by Vista Paint.
    b. ESPR00 Eff-Stop by Dunn-Edwards.
    c. ProBlock Interior/Exterior Latex Primer/Sealer, B51-600 Series by Sherwin-Williams.

2. Finish Coat (2 coats):

    a. 8100 Carefree Flat by Vista Paint.
    b. SPMA10 Suprema Flat by Dunn-Edwards.
    c. ProMar 200 Zero VOC Interior Latex Flat, B30-2600 by Sherwin-Williams.

X. Particleboard, Hardboard: Semi-Gloss Acrylic

1. Primer (1 coat):

a. 4600 Uniprime II by Vista Paint.
b. ESPR00 Eff-Stop by Dunn-Edwards.
c. ProBlock Interior/Exterior Latex Primer/Sealer, B51-600 Series by Sherwin-Williams.

2. Finish Coat (2 coats):

a. 8400 Carefree SG by Vista Paint.
b. SPMA50 Suprema SG by Dunn-Edwards.
c. ProMar 200 Zero VOC Interior Latex Semi-Gloss, B31-2600 by Sherwin-Williams.

Y. Particleboard, Hardboard: Gloss 100 percent Acrylic

1. Primer (1 coat):

a. 4600 Uniprime II by Vista Paint.
b. ESPR00 Eff-Stop by Dunn-Edwards.
c. ProBlock Interior/Exterior Latex Primer/Sealer, B51-600 Series by Sherwin-Williams.

2. Finish Coat (2 coats):

a. 8500 Carefree Gloss by Vista Paint.
b. EVSH60 Evershield GL by Dunn-Edwards.
c. Duration Gloss A38 Series by Sherwin-Williams.

Z. Ferrous Metal: Semi-Gloss 100 percent Acrylic

1. Primer (1 coat):

a. 9600 Protec Primer by Vista Paint
b. BRPR00 Block-Rust by Dunn-Edwards.
c. Pro Industrial Pro-Cryl Universal Primer, B66-310 Series by Sherwin-Williams.

2. Finish Coat (2 coats):

a. 8400 Carefree SG by Vista Paint.
b. SPMA50 Suprema SG by Dunn-Edwards.
c. Duration Semi-Gloss A98 Series by Sherwin-Williams.

AA. Ferrous Metal: Gloss 100 percent Acrylic

1. Primer (1 coat):

a. 9600 Protec Primer by Vista Paint
b. BRPR00 Block-Rust by Dunn-Edwards.
c. Pro Industrial Pro-Cryl Universal Primer, B66-310 Series by Sherwin-Williams.

2. Finish Coat (2 coats):

    a. 8500 Carefree Gloss by Vista Paint.
    b. EVSH00 Evershield GL by Dunn-Edwards.
    c. Duration Gloss A38 Series by Sherwin-Williams.

BB. Ferrous Metal: Heavy Duty

1. Primer (1 coat):

    a. Carboline Carboguard 890 VOC at 5 MILS DFT by Vista Paint.
    b. Carboline Carboguard 890 VOC at 5 MILS DFT by Dunn-Edwards.
    c. Macropoxy 646-100 Fast Cure Epoxy, B58W620 at 5 MILS DFT by Sherwin-Williams.

2. Primer (1 coat):

    a. Carboline Carbothane 133MC at 5 MILS DFT by Vista Paint.
    b. Carboline Carbothane 133MC at 5 MILS DFT by Dunn-Edwards.
    c. Hi-Solids Polyurethane 100, B65-600 Series at 4 MILS DFT by Sherwin-Williams.

CC. Aluminum: Semi-Gloss 100 percent Acrylic

1. Primer (1 coat):

    a. 9600 Protec Primer by Vista Paint
    b. BRPR00 Block-Rust by Dunn-Edwards.
    c. Pro Industrial Pro-Cryl Universal Primer, B66-310 Series by Sherwin-Williams.

2. Finish Coat (2 coats):

    a. 8400 Carefree SG by Vista Paint.
    b. SPMA50 Suprema SG by Dunn-Edwards.
    c. Duration Semi-Gloss A98 Series by Sherwin-Williams.

DD. Aluminum: Gloss 100 percent Acrylic

1. Primer (1 coat):

    a. 4800 Metal Pro Primer by Vista Paint
    b. UGPR00 Ultra Grip Primer by Dunn-Edwards.
    c. Pro Industrial Pro-Cryl Universal Primer, B66-310 Series by Sherwin-Williams.

2. Finish Coat (2 coats):

    a. 8500 Carefree Gloss by Vista Paint.
    b. EVSH60 Evershield GL by Dunn-Edwards.
    c. Duration Gloss K38 Series by Sherwin-Williams.

EE. Stainless Steel, Copper, Brass: Semi-Gloss 100 percent Acrylic

1. Primer (1 coat):

    a. 4800 Metal Pro Primer by Vista Paint

b. UGPR00 Ultra Grip Primer by Dunn-Edwards.
c. Pro Industrial Pro-Cryl Universal Primer, B66-310 Series by Sherwin-Williams.

2. Finish Coat (2 coats):

a. 8400 Carefree SG by Vista Paint.
b. SPMA50 Suprema SG by Dunn-Edwards.
c. Duration Semi-Gloss A98 Series by Sherwin-Williams.

FF. Stainless Steel, Copper, Brass: Gloss 100 percent Acrylic

1. Primer (1 coat):

a. 4800 Metal Pro Primer by Vista Paint
b. UGPR00 Ultra Grip Primer by Dunn-Edwards.
c. Pro Industrial Pro-Cryl Universal Primer, B66-310 Series by Sherwin-Williams.

2. Finish Coat (2 coats):

a. 8500 Carefree Gloss by Vista Paint.
b. EVSH60 Evershield GL by Dunn-Edwards.
c. Duration Gloss K38 Series by Sherwin-Williams.

GG. Fiberglass or Glass: (All Finishes)

1. Primer (1 coat):

a. XIM Clear Primer by Vista Paint
b. XIM Clear Primer by Dunn-Edwards.
c. Extreme Bond Bonding Primer, B51W150 by Sherwin-Williams.

2. Finish Coat (2 coats):

a. Finish as specified by Vista Paint.
b. Finish as specified by Dunn-Edwards.
c. Finish as specified by Sherwin-Williams.

HH. Acoustical Tile: Flat

1. Primer (1 coat):

a. 013 Acoustic Kote by Vista Paint
b. W 615 Acoustikote by Dunn-Edwards.

2. Finish Coat (2 coats):

a. 013 Acoustic Kote by Vista Paint.
b. W 615 Acoustikote by Dunn-Edwards.

II. Intumescent Paint on Plywood Backing Panel: Latex

1. Primer (1 coat minimum):

a. “Intumescent Latex” (thin film) by Contego International

b. “Flame Stop IM” by Flame Stop, Inc., or equal.

JJ. Concrete Epoxy Flooring System in Elevator Machine Rooms, and Electrical and Telephone Closets: Track blast or bead floor prior to application (ASTM D 4260)

1. Finish Coat (2 coats):

a. Carboline Carboguard 890 VOC at 5 MILS DFT by Vista Paint
b. Carboline Carboguard 890 VOC at 5 MILS DFT by Dunn-Edwards.
c. Armorseal 8100 Water Based Epoxy Floor Coating, B70-8000/B70V8100 Series by Sherwin-Williams.

END OF SECTION

SECTION 09 96 00 - HIGH-PERFORMANCE COATINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes the following:

1. Surface preparation and field application of high-performance coating systems to exterior steel surfaces, except for stainless steel and prefinished surface.
2. Establishing requirements for shop priming specified assemblies/materials. Coordinate surface preparation and shop priming with the requirements of this Section.

B. Related requirements:

1. Division 05 for shop-primed ferrous metal.
2. Division 09 for general field painting.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Review other Sections in which primers or other coatings are provided to ensure compatibility of total systems for various substrates. Furnish information on characteristics of specified finish materials to ensure compatible primers.

B. If a potential incompatibility of primers applied by other trades exists, obtain the following from the primer applicator before proceeding further:

1. Confirmation of primer's suitability for expected service conditions.
2. Confirmation of primer's ability to be top coated with materials specified.

C. Notify Architect about anticipated problems before using the coatings specified over substrates primed under other Sections.

1.3 DEFINITIONS

A. Standard coating terms defined in ASTM D 16 apply to this Section.

B. Gloss ranges used in this Section include the following:

1. Semi-gloss refers to medium-sheen finish with a gloss range between 30 and 65 when measured at a 60-degree meter.
2. High gloss refers to high-sheen finish with a gloss range more than 65 when measured at a 60-degree meter.

C. Coating types:

1. Shop primer: Zinc.
2. Intermediate coat: Epoxy.
3. Finish coat: Hybrid Urethane/Modified Siloxane.

1.4 SUBMITTALS

A. Data: The manufacturer Product Data for each coating system indicated, including primers.

1. Material list: An inclusive list of required coating materials. Indicate each material and cross-reference the specific coating, finish system, and application. Identify each material by manufacturer's catalog number and general classification.
2. Manufacturer's information: Manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each material specified.

B. Manufacturer’s certification: Certifications that products supplied comply with requirements indicated that limit the amount of VOC in coating products.

C. Samples: Samples of each color and material to be applied, with texture to simulate actual conditions, on representative Samples of the actual substrate.

1. Provide stepped Samples defining each separate coat, including primers. Use representative colors when preparing Samples for review. Identify paint system on back of control Samples.
2. Resubmit until required sheen, color, and texture are achieved.
3. List of material and application for each coat of each sample. Label each sample for location and application.
4. Samples for each substrate for Architect review of color and texture: Provide two 12-inch square samples for each type of substrate with each type of finish.

D. Qualification data: For applicator to demonstrate its capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of Architect and owners, and other information specified.

E. Certification: Duplicate copies of manufacturer's affidavit with each shipment of materials delivered to the jobsite certifying that material furnished complies with specified requirements.

1.5 QUALITY ASSURANCE

A. Manufacturer qualifications: Firm that specializes in producing high quality industrial coatings with a minimum of 10 years experience demonstrated by case histories in the designated field of application.

B. Applicator qualifications: Firm who has completed high-performance coating systems similar in material and extent to those indicated for Project and whose work has a record of successful in-service performance.

C. Source limitations:

1. Obtain primers and undercoat materials for each coating system from the same manufacturer as the finish coats.
2. Only coatings that meet or exceed the performance of those identified herein may be submitted. No substitutions will be considered that change the generic chemistry of the coatings required by the Specifications.
3. Where manufacturer’s coating recommendations exceed those listed, the increased coating thickness shall be used. The coating thickness and coverage rate shall not be reduced from those scheduled.

D. SCAQMD Rule 1113: Submit paint manufacturer's certificate stating that provided coatings meet or exceed current SCAQMD Rule 1113 requirements.

E. Mockups: Provide a full-coat benchmark finish sample of each type of coating and substrate required.

1. Architect will select areas or surface to represent surfaces and conditions for application of each type of coating and substrate.
2. After permanent lighting and other environmental services have been activated in interior locations, apply coating systems to each surface as specified. Provide the required sheen, color, and texture of each surface.

    a. After finishes are accepted, Architect will use each surface to evaluate coating systems of a similar nature.

3. Final approval of colors will be from benchmark samples.

1.6 HANDLING

A. Deliver materials to Project site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label with the following information:

1. Name or title of material.
2. Product description (generic classification or binder type).

3. Manufacturer's stock number and date of manufacture.
4. Contents by volume, for pigment and vehicle constituents.
5. Thinning instructions.
6. Application instructions.
7. Color name and number.
8. Handling instructions and precautions.

B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45-degree F. Maintain containers used in storage in a clean condition, free of foreign materials and residue.

1. Protect materials from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily. Take necessary measures to ensure that workers and work areas are protected from fire and health hazards resulting from handling, mixing, and applying coatings.

1.7 PROJECT CONDITIONS

A. Apply coatings only when temperature of surfaces to be coated and surrounding air temperatures are between 45 and 95-degree F.
B. Do not apply coatings in snow**,** rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5-degree F above the dew point; or to damp or wet surfaces.

1. Allow wet surfaces to dry thoroughly and attain temperature and conditions specified before proceeding with or continuing coating operation.
2. Work may continue during inclement weather only if areas and surfaces to be coated are enclosed and temperature within the area can be maintained within limits specified by manufacturer during application and drying periods.

C. Protection:

1. Provide and maintain protection as required to protect finished work from damage until its acceptance.
2. Protect work of other trades, whether being coated or not, against damage from coating operation.
3. Provide "Wet Paint" signs to protect newly coated finishes. After completing coating operations, remove temporary protection.
4. Provide drop cloths, shields, barricades and other protection necessary to safeguard adjacent surfaces not to be painted. Post signs immediately after painting.

1.8 EXTRA MATERIALS

A. With closeout submittals, deliver one identified unopened gallon container of each color (if more than one color was used) of coating used on the Project. Identify with area and material for future identification.
B. Provide the Owner copy of instructions for touchup and maintenance recommendations.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Tnemec Co. Inc. (basis of design).
B. Carboline Co.
C. Sherwin Williams; Industrial and Marine Coatings (SW).
D. Or equal.

2.2 COATINGS MATERIALS, GENERAL

A. General: Provide paint systems meeting or exceeding current SCAQMD Rule 1113 requirements.
B. Material compatibility: Provide primers, undercoats, and finish-coat materials that are compatible with one another, and substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
C. Material quality:

1. Provide manufacturer's highest grade of the various high-performance coatings specified. Materials not displaying manufacturer's product identification are not acceptable.
2. Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers.
3. Furnish manufacturer's material data and certificates of performance for proposed substitutions.

2.3 COLORS

A. Colors: Match Architect’s control samples.

2.4 COATING SYSTEM EXTERIOR EXPOSED UNPRIMED AND NON-GALVANIZED STEEL SURFACES (MT-3 & 4)

A. Surface preparation: SSPC-SP6 Commercial Blast Cleaning.
B. Shop primer: Zinc-rich urethane primer/polyamidoamine epoxy/hybrid polyurethane, fast-cure, with 83 percent zinc content by weight in dried film.

1. Tnemec 90-97 Tneme-Zinc at 2.5 to 3.5 mils (65 to 90 microns) DFT.
2. Carboline: Carboline 621.
3. SW: Corothane 1 galvapac zinc primer.

C. Intermediate coat:

1. Tnemec Series 1075 Endura-Shield II, or equal at 2 to 3 mils (50 – 75 microns) DFT.
2. Carboline:.
3. SW:.

D. Finish coat:

1. Tnemec Series 1078V at 3 to 5 mils (75 to 125 microns) DFT.
2. Carboline:.
3. SW: .

E. Gloss range: Gloss.
F. Total DFT: No less than 9.5 mils (245 microns) DFT
G. Quality assurance standards:

1. ASTM B 117: System shall pass 30,000 hours salt fog corrosion resistance.
2. ASTM G53: Finish shall pass with 100 percent gloss retention and no more than 4 MacAdam Units color change after 3,000 hours exposure.
3. ASTM D 3363: Finish coat hardness shall be HB or better.
4. ASTM D 4060: Finish coat shall pass no more than 50 mg loss after 1,000 hours with 1,000 g load.
5. AAMA 24604-98: Meet exterior weathering requirements of this document.

H. Finish shall be graffiti resistant.

2.5 COATING SYSTEM FOR INTERIOR UNPRIMED METAL SURFACES EXPOSED TO PUBLIC CONTACT

A. Applies to handrails and guardrails, , steel doors and frames, metal surfaces in toilet rooms and in maintenance storage areas, and in areas of similar conditions indicated.
B. Does not apply to interior exposed structural and miscellaneous steel. These will be painted under Section 09 90 00.

C. Surface preparation: SSPC-SP6 Commercial Blast Cleaning.
D. Shop primer: Zinc-rich Urethane Primer/Polyamide Epoxy Finish, Satin Finish.

1. Tnemec Series 69 Epoxoline at 4 to 6 mils (100-150 microns) DFT.
2. Carboline: Carboline 890.
3. SW: Tile Clad Plus B-62.

E. Finish coat:

1. Tnemec Series 69 Epoxoline at 4 to 6 mils (100 – 150 microns) DFT.
2. Carboline: Carboline 890.
3. SW: Tile Clad Plus B-62.
4. Precision Coatings, Inc: PC3v100 Acrylic Polyurethane Topcoat.

F. Gloss range: To be determined.
G. Total DFT: No less than 8 mils (200 microns) DFT
H. Quality assurance standards:

1. ASTM D 4541: Primer and complete coating system shall have adhesion strength of not less than 1000 psi.
2. ASTM D 3359: Primer and complete coating system shall have a rating of not less than 5.
3. ASTM D 3363: Finish coat hardness shall be 3H.
4. ASTM D 4060: Finish coat shall pass no more than 115 mg loss after 1,000 cycles with 1,000 g load.

2.6 COATING SYSTEM FOR GALVANIZED STEEL

A. Surface preparation:

1. SSPC-SP1 preparation to remove soluble contamination.
2. Thoroughly roughen the entire surface to be coated using compressed air nozzle brush-off blast cleaning with a fine abrasive to achieve a uniform anchor profile (1.5 to 2 mils) (38 to 50 microns).
3. Pressure wash with 140 to 150-degree F alkaline cleaner followed by tap water rinse is the preferred method to remove both water soluble and organic solvent soluble contaminants.

B. Touchup: Where the galvanized surface is damaged, repair shall consist of mechanical surface cleaning to bare metal, followed by touchup application of organic zinc-rich moisture cured urethane primer at 2.5 mils DFT minimum.
C. Spot primer: Surface tolerant epoxy primer/aliphatic acrylic polyurethane gloss finish.

1. Tnemec Series 90-97 Tnemec-zinc at 2.5 to 3.5 mils (65 – 90 microns) DFT
2. Carboline: Carboline 621.
3. Corathane 1 galvanized zinc primer.

D. Primer:

1. Tnemec: Series L69 Epoxoline.
2. Carboline: Carboline 890.
3. SW: Tile Clad Plus B-62.
4. Precision Coatings, Inc: PC3v100 Acrylic Polyurethane Topcoat.

E. Finish coat:

1. Tnemec Series 75UVX or Carboline “Carboxane 2000” at 2 to 3 mils (100-150 microns) DFT.
2. Precision Coatings, Inc: OC3v100 Acrylic Polyurethane Topcoat.
3. Gloss range: To be determined.

F. Total DFT: No less than 4 mils (200 microns) of field-applied coating.

G. Quality assurance standards:

1. ASTM D 3363: Finish coat hardness shall be HB or better.
2. ASTM D 4060: Finish coat shall pass no more than 95 mg loss after 1,000 hours with 1,000 g load.

2.7 COATING SYSTEM FOR ALUMINUM

A. Surface preparation:

1. Preparation: Thoroughly roughen the entire surface to be coated using compressed air nozzle brush-off blast cleaning with a fine, non-metallic abrasive to achieve a uniform anchor profile (1.5 to 2 mils) (38 to 50 microns).
2. System Type: Epoxy/Hybrid Urethane.

a. Prime Coat: Tnemec L69 Epoxoline @ 2.0 to 4.0 mils DFT.
b. Finish Coat: Tnemec 750 UVX @ 2.0 to 4.0 mils DFT.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions under which high-performance coatings will be applied, for compliance with coating application requirements.

B. Apply coatings only after unsatisfactory conditions are corrected and surfaces to receive coatings are thoroughly dry.

C. Correct unsatisfactory conditions before starting application.

3.2 PREPARATION

A. General:

1. Remove plates, machined surfaces, and similar items already in place that are not to be coated.
2. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and coating.
3. After completing coating operations, reinstall items that were removed; use workers skilled in the trades involved.

B. Cleaning:

1. Before applying high-performance coatings, clean substrates of substances that could impair bond of coatings.
2. Remove oil and grease before cleaning.
3. Schedule cleaning and coating application so dust and other contaminates from cleaning process will not fall on wet, newly coated surfaces.

C. Surface preparation: Clean and prepare surfaces to be coated according to manufacturer's instructions for each substrate condition, and as specified. Provide barrier coats over incompatible primers or remove primers and reprime substrate.

D. Material preparation: Carefully mix and prepare coating materials according to manufacturer's written instructions.

1. Maintain containers used in mixing and applying coatings in a clean condition, free of foreign materials and residue.
2. Stir materials before applying to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into the material. Remove film and, if necessary, strain coating material before using.
3. Use only the type of thinners approved by manufacturer and only within recommended limits.

E. Tinting: Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of the same material are to be applied. Tint undercoats to match color of finish coat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

3.3 APPLICATION

A. General: Apply coatings according to their manufacturer's instructions and the following.

1. Use applicators and techniques best suited for the material being applied.
2. Do not apply coatings over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to forming a durable coating film.
3. Coating colors, surface treatments, and finishes are indicated in the coating system descriptions.
4. Provide finish coats compatible with primers used.
5. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, convector covers, grilles, covers for finned-tube radiation, and similar components are in place. Extend coatings in these areas, as required, to maintain system integrity and provide desired protection.

    a. Coat surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before final installation, coat surfaces behind permanently fixed equipment or furniture with prime coat only.
    b. Coat back sides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.

B. Scheduling coating: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for coating as soon as practicable after preparation and before subsequent surface deterioration.

1. The number of coats and film thickness required is the same regardless of application method.

    a. Omit primer on metal surfaces that have been shop primed and touchup painted.
    b. Do not apply succeeding coats until previous coat has cured as recommended by manufacturer.
    c. Where manufacturer's written instructions require sanding, sand between applications to produce a smooth, even surface.
    d. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until coating has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure, and application of another coat does not cause undercoat to lift or lose adhesion.

2. If undercoats or other conditions show through final coat, apply additional coats until cured film has a uniform coating finish, color, and appearance. Give special attention to edges, corners, crevices, welds, exposed fasteners, and similar surfaces to ensure that they receive a dry film thickness equivalent to that of flat surfaces.

C. Application procedures:

1. Brush, roller, spray, or other applicators according to manufacturer's requirements.
2. Apply primers and first coats by brush unless manufacturer's written instructions permit using roller or mechanical applicators.

D. Minimum coating thickness: Apply each material no thinner than manufacturers recommended spreading rate. Provide total dry film thickness of the entire system as recommended by manufacturer.

E. Prime coats:

1. Before applying finish coats, apply a prime coat of material, as recommended by manufacturer, to material required to be coated or finished that has not been prime coated by others.
2. Recoat primed and sealed substrates if there is evidence of suction spots or unsealed areas in first coat, to ensure a finish coat with no burn-through or other defects caused by insufficient sealing.

F. Completed work:

1. Match approved samples for colors, sheens, textures, and coverage. Remove, refinish, or recoat work that does not comply with specified requirements.
2. No “orange peel” finish, cloudiness, spotting, holidays, laps, sags, ropiness, drips, runs, skips or other surface imperfections, such as scratches, scrapes, dents, spots, stain, streaks and lines will be accepted.” “Remove, refinish, or recoat work that does not comply with the specified requirements.”

3.4 FIELD QUALITY CONTROL

A. Owner reserves the right to invoke the following procedure at any time and as often as Owner deems necessary during the period when coatings are being applied:

1. Owner may engage the services of a qualified testing agency to sample coating material being used. Samples of material delivered to Project site will be taken, identified, sealed, and certified in presence of Contractor.
2. Testing agency may perform appropriate tests for the following characteristics as required by Owner:

    a. Quantitative materials analysis.
    b. Absorption.
    c. Accelerated weathering.
    d. Accelerated yellowness.
    e. Color retention.
    f. Alkali and mildew resistance.
    g. Abrasion resistance.
    h. Apparent reflectivity.
    i. Washability.
    j. Dry opacity.
    k. Recoating.
    l. Skinning.

3. Owner may direct Contractor to stop applying coatings if test results show materials being used do not comply with specified requirements.

    a. Contractor shall remove non-complying coating materials from Project site, pay for testing, and recoat surfaces coated with rejected materials.
    b. If necessary, Contractor may be required to remove rejected materials from previously coated surfaces if, on recoating with specified materials, the 2 coatings are not compatible.

3.5 CLEANING

A. After completing coating application, clean spattered surfaces.
B. Remove spattered coatings by washing, scraping, or other methods.
C. Do not scratch or damage adjacent finished surfaces.

3.6 PROTECTION

A. At completion of construction activities of other trades, touchup and restore damaged or defaced coated surfaces.

END OF SECTION

DIVISION 10
SPECIALTIES

SECTION 10 10 00 – FIXED MARKERBOARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes providing and the installation of the fixed markerboards.
   1. Fixed, Magnetic optically clear, ghost-free, dry –erase markerboards.

B. Related Items
   1. Miscellaneous carpentry, Section 06 10 53.
   2. Concealed blocking, Section 09 22 16.

1.2 SUBMITTALS

A. The College will supply the required information for this section.

B. Product Data Manufacturer’s specifications and technical data by the College
   1. Detailed specification of construction and fabrication.
   2. Manufacturer's installation instructions.

C. Shop Drawings (by the Contractor): Indicate dimensions, description of materials and finishes, general construction, specific modifications, component connections, anchorage or mounting methods, hardware, and installation procedures, plus the following specific requirements.
   1. Indicated type of adhesive, backing, trim, or accessories required.
   2. Warranty documentation.

1.3 DELIVERY, STORAGE, AND HANDLING

A. College will turn over the markerboards to the Contractor.

B. Storage and Protection Comply with manufacturer's recommendations.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers for Markerboards
   1. Vivid Glass.
   2. Comparable products of other manufacturers.

2.2 FIXED MARKERBOARDS

A. Mounting: Provide manufacturer’s satin aluminum stand-offs.

B. Glass thickness: 1/4-inch thick tempered safety glass.

C. Stand offs: 1-3/8-inches.

D. Include hidden acrylic marker holders.

E. Corners: Rounded corners.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify Conditions
   1. Examine areas and conditions under which Work is to be performed and identify conditions detrimental to proper or timely completion.

2. Do not proceed until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's recommendations.

B. Deliver factory pre-assembled units complete with frame and backer board.
1. If overall size prevents pre-assembly, prefit at factory and ship knocked down. Use concealed steel splines at all joints to maintain surface alignment.

C. Securely mount boards and trim in compliance with manufacturer's recommendations.
1. Provide grounds, clips, backing materials, adhesive brackets, anchors, trim, and accessories for complete installation.

D. Joints between adjacent boards shall be smooth, flush butt hairline seams.

3.3 CLEANING

A. Clean units in compliance with manufacturer's recommendations. Demonstrate proper maintenance and cleaning procedures to the Owner’s personnel. Provide at least one copy of the manufacturer’s published cleaning instructions and recommended schedule for each person trained.

END OF SECTION

SECTION 10 14 00 - SIGNAGE

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Exterior signs: Building-mounted cast steel letters.
B. Interior Signs:

1. Dimensional Letters.
2. Room and door signs.
3. Building identification signs.
4. Code-compliance signs at exits, stairs and toilet rooms.

1.02 SUBMITTALS

A. Product Data: Manufacturer's printed product literature for each type of sign, indicating sign styles, font, foreground and background colors, locations, overall dimensions of each sign.
B. Signage Schedule: Provide information sufficient to completely define each sign for fabrication, including room number, room name, other text to be applied, sign and letter sizes, fonts, and colors.
C. Samples: Submit two samples of each type of sign, of size similar to that required for project, illustrating sign style, font, and method of attachment. Include the letters “B’ and “H” in cast steel letters with paint.
D. Selection Samples: Where colors are not specified, submit two sets of color selection charts or chips.
E. Verification Samples: Submit samples showing colors specified.
F. Manufacturer's Installation Instructions: Include installation templates and attachment devices.

1.03 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.
B. Uniformity: For each sign form and graphic image process indicated furnish products of a single manufacturer.
C. Coordination: Before starting Shop Drawings, notify the Architect and arrange a meeting with the Owner's designated personnel to review in detail the work of this Section. Review and coordinate layouts for each sign, and obtain Architect's approval prior to manufacture.
D. All tactile room identification and exit signs shall include Grade 2 Braille translation with the tactile portion of the sign following the requirements of ADA.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Package signs as required to prevent damage before installation.
B. Package room and door signs in sequential order of installation, labeled by floor or building.
C. Store tape adhesive at normal room temperature.

1.05 FIELD CONDITIONS

A. Verify type of supporting construction; provide suitable attachments.
B. Do not install tape adhesive when ambient temperature is lower than recommended by manufacturer.

C. Maintain this minimum temperature during and after installation of signs.
D. Adhesive as the sole means of installation is only allowed where sign is to be on glazing.

PART 2 - PRODUCTS

2.01 DESIGN REQUIREMENTS

A. Signage shall conform to the CBC and specifically to the following CBC chapters:

1. Chapter 11B-201.1 for design and construction, 11B-603 and 11B-604.8 for passageways.
2. Chapter 11B-216.6 for scoping for signs where accessible routes diverge from the regular circulation path
3. Chapter 11B-703 for non-accessible existing entrances and general standards.
4. Chapter 11B-703.3 for braille requirements.
5. Chapter 11B-703.5.1, 6.2 and 7.3 for finish and contrast.
6. Chapter 11B-703.2.4 and 2.6 for proportions.
7. Chapter 11B-307.3 for pole-mounted objects, edges and corners.

B. Characters:

1. Comply with CBC 11B-703.5 for visual characters.
2. Character Type: Characters on signs shall be raised 1/32 inch minimum and shall be sans serif uppercase characters accompanied by contracted Grade 2 Braille (see Note 5 below).
3. Character Size: Raised characters shall be a minimum of 5/8 inch and a maximum of 2 inch high.
4. Finish and Contrast: Contrast between characters, symbols and their background must be 70% minimum and have a non-glare finish.
5. Proportions: Characters on signs shall have a width-to-height ratio of between 3:5 and 1:1 and a stroke width-to-height ratio of between 1:5 and 1:10.
6. Letters measured must be uppercase. After choosing a typestyle to test, begin by printing the letters I, X, and O at 1 inch height. Place the template's 1:1 square over the X or O, whichever is narrower. If the character is not wider that 1 inch, nor narrower than the 3:5 rectangle, the proportions are correct. Use the 1:5 rectangle to determine if the stroke of the I is too broad, and the 1:10 rectangle to see if it is to narrow. If all the tests are passed, the typestyle is complaint with proportion code.

C. Braille Symbols:

1. Comply with CBC Section 11B-703.3.
2. Contracted Grade 2 Braille shall be used whenever Braille is required in other portions of these standards. Dots shall be spaced 1/10 inch on center in each cell, with 2/10 inch space between cells, measured from the second column of dots in the first cell to the first column of dots in the second cell. Dots shall be raised a minimum of 1/40 inch above background
3. Provide rounded or domed Contracted Grade 2 Braille dots, each distinct and separate. Dots with straight sides and flat tops are not acceptable.

D. Type Imagery:

1. Type style: Sans Serif upper case.
    a. Letter Size: See signage drawings.

b. Number Size: See signage drawings.
c. Raised Letters: Letters shall be raised a minimum of 1/32 inch above background.
d. Other Sizes: As specifically indicated.

2. Arrangement: Use standard spacing between letters, words, numbers and lines; center text.
3. Symbol Style: Recognized standard International Symbols of Accessibility, such as those developed by the American Institute of Graphics, for the U. S. Department of Transportation.

a. Accessible Restrooms shall include a 6 inch high wheelchair logo. Logo shall be raised a minimum of 1/32 inch above the background.
b. On visual signs, characters and symbols shall be sized according – to view distance. Signs mounted 80 inch or more AFF shall have minimum 3 inch high characters.
c. Pictographs and ISA's (International Symbol of Accessibility) on interior signs at eye level, shall be minimum 3 inch high or twice as high as the height of text on the sign; whichever is greater. On signs where bottom is 72 inch or more AFF, minimum height shall be 6 inch or twice as high as the largest text on the signs; whichever is greater.

4. Colors:

a. Background Colors: As selected by the Architect from manufacturer's standard color range (12 colors maximum); one color maximum, typically.
b. Type Imagery: White or black, as selected by Architect to contrast with background colors; one color maximum, each, for interiors and exteriors.
c. Code Required Colors for Symbols and Signs: Where colors are mandated by Codes or Regulations conform to their requirements including 11B-703; colors from the CBC.
d. Other colors: Certain colors are specifically noted.

2.02 MANUFACTURERS

A. Acceptable Manufacturers:

1. Advance Corporation; Braille-Tac Division.
2. ASI.
3. Architectural Graphics, Inc.
4. Architectural Signs and Directories.
5. Vomar Products, Inc.
6. Or equal.

2.03 SIGNAGE APPLICATIONS

A. Accessibility Compliance: All signs are required to comply with ADAAG and CBC Chapter 11B and applicable building codes, unless otherwise indicated; in the event of conflicting requirements, comply with the most comprehensive and specific requirements.
B. All Signage Types: Unless otherwise indicated:

1. Character Font: Helvetica, or other sans serif font acceptable to the Architect.
2. Character Case: Upper case only.
3. Background Color: Clear.
4. Character Color: Contrasting color.

C. Room and Door Signs: Provide a sign for every doorway, whether it has a door or not, not including corridors, lobbies, and similar open areas.

1. Sign Type: Flat signs with engraved panel media as specified.
2. Provide “tactile" signage, see above.
3. Braille shall be rounded or contracted domed top.
4. Character Height: 1 inch.
5. Sign Height: 2 inches, unless otherwise indicated.
6. Office Doors: Identify with room numbers to be determined later, not the numbers shown on the drawings.
7. Conference and Meeting Rooms: Identify with room numbers to be determined later, not the numbers shown on the drawings.
8. Service Rooms: Identify with the room names and numbers shown on the drawings.

2.04 DIMENSIONAL CHARACTERS

A. Fabricated characters located on canopy: Characters with uniform faces, sharp corners, and precisely formed lines and profiles, and as follows:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ASI Sign Systems, Inc.
b. Century Sign Builders
c. Gemini Incorporated.
d. Metallic Arts.
e. Or equal.

2. Character Material: Fabricated as indicated on Drawings.
3. Character Height: As indicated on Drawings.
4. Thickness: As indicated on Drawings.
5. Finishes: Powder coat.
6. Mounting: As indicated on Drawings.
7. Typeface: As selected by Architect.

2.05 PLASTIC SIGN MATERIAL

A. Material:

1. Type: Phenolic Resin Core with a three-ply melamine resin surface.
2. Thickness: 1/8 inch.

B. Adhesive: Pressure sensitive, hi-tack transfer tape with peel-back paper backing. Structural grade silicone adhesive for mounting on glazing.
C. Mounting Screws: Non-corrosive, tamperproof screws. Match finishes to the door hardware for the door where the signs are mounted.
D. Signs shall be non-static, fire retardant, and self-extinguishing.
E. No. SP125 Manufacturing Specifications per basis of design manufacturer:

1. Material thickness: 1/8 inch.
2. Standard sheet size: 48 inch x 96 inch.
3. Weight: 1/8 inch = 1 lb/ square foot.
4. Maximum continuous operating temperature: 225°F.
5. Flexural strength flat: 21,497 psi.

6. Tensile strength: 22,000 psi.
7. Shear strength: 22,729 psi.
8. NEMA rated "self-extinguishing"

2.06 SIGN TYPES

A. Graphic Process and Fabrication: All signs shall be manufactured using "Sand-Etched Process" or equivalent system, as per acceptable manufacturers stated methods, whereby characters are integral part of signage body.

1. Tactile characters shall be raised the required 1/32 inch from sign face. Glue-on letters, images and/or symbols are not acceptable.
2. Work to have sharp clean profiles.
3. Text shall be accompanied by Contracted Grade 2 Braille. Braille shall be separated 1/2 inch from corresponding raised characters or symbols.
4. Perimeter borders shall be 1/4 inch minimum.
5. Edges: Finish edges smooth and clean, without chips or burrs.
6. Corners: Provide radius corners; 1/8 inch diameter.
7. Cut-outs For Hardware: Factory made, accurately, to templates.
8. Mounting Holes: Factory drilled.
9. Adhesive Backing: Completely cover rear surface of each sign.

B. Room Identification Signs:

1. Refer to Drawings for names, numbers, identification symbols, sizes, configurations, and locations.
2. Colors for Type Imagery:
    a. Room Name Signs:
        1) Type: Black or white, to be selected by Architect.
        2) Background: One color to be selected by the Architect from manufacturer's standard color range (12 colors, minimum) for interior signs, unless otherwise noted. Refer to signage schedule.
    b. Room Number Signs:
        1) Type: Black or white, to be selected by Architect.
        2) Background: One color to be selected by the Architect from manufacturer's standard color range (12 colors, minimum) for interior signs, unless otherwise noted. Refer to signage schedule.
        3) Architect shall select a second color for signs located on exterior.

C. Accessibility Symbol Signs:

1. Refer to Drawings for identification symbols, sizes, configuration, and locations.
2. Figure Symbols for Building Entrance Signs:
    a. Size: 6 inch x 6 inch, typically.
    b. Refer to Drawings.
3. Geometric Symbols for Toilet Rooms:
    a. For Men/Boys: An equilateral triangle, 10 inches on a side; 1/4 inch thick.
    b. For Women/Girls: A 12-inch diameter circle; 1/4 inch thick.

c. For Both Sexes: An equilateral triangle, 10 inches on a side, inlayed in 12 inch diameter circle; 1/4 inch thickness for the triangle and the circle.

4. Directional Signs.
5. International Symbol for Access for the hearing impaired.
6. Colors for Symbols:

a. International Accessibility Symbols:

1) Symbols: White.
2) Background: Blue, Color No. 15090 per Federal Standard 595C.

b. Male and Female Symbols:

1) Symbols: Blue.
2) Background: White.

D. Room Capacity Signs:

1. Wording for sign at Assembly Room at Multi-Purpose Building: See Plans and Signage drawings. Number to be on Drawings or provided by Architect.
2. Refer to Drawings for identification.

2.07 ACCESSORIES

A. Interior:

1. Concealed Screws: Stainless steel, galvanized steel, chrome plated, or other non-corroding metal.

a. Exterior: Stainless steel, galvanized steel.
b. Interior: Bright finish.

2. Tape Adhesive: Double sided tape, permanent adhesive.

a. Completely cover the plate with adhesive.

3. Where flat signs are mounted on glass walls:

a. Provide an additional blank plate with same background color.
b. Mount this plate on the inside of glass in alignment with sign plate.

B. Exterior:

1. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signs, noncorrosive and compatible with each material joined, and complying with the following:

a. Use concealed fasteners and anchors unless indicated to be exposed.
b. For exterior exposure, furnish stainless steel devices unless otherwise indicated.
c. Sign Mounting Fasteners:

1) Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of sign material, screwed into back of sign assembly, or screwed into tapped lugs cast integrally into back of cast sign material, unless otherwise indicated.

2) Projecting Studs: Threaded studs with sleeve spacer, welded or brazed to back of sign material, screwed into back of sign assembly, or screwed into tapped lugs cast integrally into back of cast sign material, unless otherwise indicated.
3) Through Fasteners: Exposed metal fasteners matching sign finish, with type of head indicated, installed in predrilled holes.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that substrate surfaces are ready to receive work.

3.02 PREPARATION

A. Layout: Accurately lay out work to maintain proper lines, levels and spacing.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions and CBC Chapter 11B.
B. Install neatly, with horizontal edges level.
C. Mounting location shall be determined so that a person may approach within 3 inches of signage without encountering protruding objects or standing within the swing of the door. CBC Section 11B-703.4.2.
D. Mounting:

1. See drawings for locations.
2. Press tape firmly to mounting surface, and secure each plaque or sign with minimum four tamper-proof screws for square or rectangular signs; minimum three tamper-proof screws for triangle, or round signs.
3. Signs shall have pre-drilled holes when delivered, and mounted with non-corroding anchors and tamper-proof screws.
4. When mounting on glazing, press silicone adhesive firmly to glazing. Clean excess adhesive from glazing.

E. Protect from damage until Substantial Completion; repair or replace damage items.

3.04 ADJUSTING AND CLEANING

A. Remove and replace damaged or deformed signs and signs that do not comply with specified requirements. Replace signs with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.
B. Remove temporary protective coverings and strippable films as signs are installed.
C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by District.

END OF SECTION

SECTION 10 21 13 - TOILET COMPARTMENTS & SCREENS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Floor-mounted, overhead-braced painted metal toilet compartments.
2. Wall-mounted painted metal urinal screens.

B. Related requirements: Division 10 for toilet room accessories.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate installation of toilet partitions and screens with their supports. Supply Shop or setting drawings, templates and directions for installing backing plates, brackets, anchors, suspension system, and other accessories.
2. Coordinate fabrication of toilet partitions for installation of surface-mounted and recessed toilet room accessories supported by the partitions. Obtain Shop or setting drawings, templates and directions required for reinforcement to be built-in the partitions.
3. Verify dimensions by field measurements before fabrication and indicate measurements on Shop Drawings.

B. Scheduling and sequencing:
C. Pre-installation meeting:

1.3 SUBMITTALS

A. Data: Manufacturer Product Data for compartments and screens.
B. Shop drawings:

1. Show layout of compartments and screens in each space to receive them.
2. Show elevations.
3. Show fabrication and erection of compartment assemblies, to extent not fully described by manufacturer’s data sheets.
4. Show anchorage, accessory items and finishes.
5. Provide location drawings for bolt hole locations in supporting members for attachment of compartments.

C. Samples: 6-inch square by 22-gage steel samples with the selected finish.

1.4 MAINTENANCE

A. With closeout submittal, provide instructions for proper care of compartments and screens such as required lubrications, adjustments, and cleaning.

PART 2 - PRODUCTS

2.1 MANUFACTURE/TYPE

A. DuraLine Series by Bobrick, basis of design (Tag 11 on Drawings).
B. Or equal.

2.2 COMPACT LAMINATE (SOLID PHENOLIC), MOISTURE RESISTANT SUBSTRATE

A. Compact Laminate (Solid Phenolic) Toilet Partitions: Bobrick DuraLineSeries.

1. Design Type::

a. Standard Height.

1) Door/Panel Height: 58 inches (147 cm).
2) Floor Clearance: 12 inches (30 cm).

2. Privacy Style Partitions: No sightlines with gap-free interlocking doors and stiles routed 0.300 inches (7.6 mm) from the edge to allow for 0.175 inch (4.4 mm) overlap to prevent line-of-sight into the toilet compartment. Privacy strips fastened or adhered onto the partition material are not acceptable.
3. Mounting Configuration:

a. Floor-mounted, overhead-braced with anodized aluminum headrails, 0.065 inch (1.65 mm) thick with anti-grip profile.

1) Stile Maximum Height: 83 inches (211 cm); Extended Height: 97 ¾ inches (248 cm).

B. Compact Laminate (Solid Phenolic) Urinal Screens: Bobrick DuraLineSeries.

1. Mounting Configuration:

a. Wall-hung.

1) Screen Height: 48 inches (122 cm) with 12 inches (30 cm) floor clearance.

C. Materials: Solidly fused plastic laminate with matte-finish melamine surfaces; integrally bonded colored face sheets and black phenolic-resin core.
D. Edges: Black; brown edges not acceptable.
E. Color: Color: 515-58 Graphite Grafix.
F. Fire Resistance:

1. National Fire Protection Association/International Building Code Interior Wall and Ceiling Finish: Class A / Uniform Building Code: Class I.

a. Flame Spread Index (ASTM E 84): 15-25 for panels, stiles and doors.
b. Smoke Developed Index (ASTM E 84): 25 - 105 for panels, 20-90 for stiles.

G. Finished Thickness:

1. Stiles and Doors: 3/4 inch (19 mm).
2. Panels and Screens: 1/2 inch (13 mm).

H. Stiles: Floor-anchored stiles furnished with expansion shields and threaded rods.

1. Leveling Devices: 7 gauge, 3/16 inches (5 mm) thick, corrosion-resistant, chromate-treated, double zinc-plated steel angle leveling bar bolted to stile; furnished with 3/8 inch (10 mm) diameter threaded rods, hex nuts, lock washers, flat washers, spacer sleeves, expansion anchors, and shoe retainers.
2. Stile Shoes: One-piece, 22 gauge (0.8 mm), 18-8, Type 304 stainless steel, 4 inch (102 mm) height; tops with 90 degree return to stile. One-piece shoe capable of adapting to 3/4 inch (19 mm) or 1 inch (25 mm) stile thickness and capable of being fastened (by clip) to stiles starting at wall line.

I. Wall Posts: Pre-drilled for door hardware, 18-8, Type 304, 16 gauge (1.6 mm) stainless steel with satin finish; 1 inch (25 mm) x 1-1/2 inches (38 mm) x 58 inches high (1473 mm).

J. Anchors: Expansion shields and threaded rods at floor connections as applicable. Threaded rods secured to supports above ceiling as applicable. Supports above ceiling furnished and installed as Work of Section 05 50 00 - Metal Fabrications.

K. Hardware:

1. Compliance: Operating force of less than 5 lb (2.25 kg).
2. Emergency Access: Hinges, latch allow door to be lifted over keeper from outside compartment on inswing doors.
3. Materials: 18-8, Type 304, heavy-gauge stainless steel with satin finish.
4. Doorstops: Prevents inswinging doors from swinging out beyond stile; on outswing doors, doorstop prevents door from swinging in beyond stile.
5. Fastening: Hardware is secured to door and stile with pin-in-head Torx stainless steel machine screws. Hinges, latch and optional door stops secured to door with pin-in-head Torx stainless steel machine screws into factory-installed, threaded brass inserts. Fasteners for hinges, latch and optional door stops secured directly into core not acceptable.

    a. Threaded Brass Inserts: Factory-installed; withstand direct pull force exceeding 1500 lb (680 kg) per insert.

6. Clothes Hooks: Projecting no more than 1-1/8 inch (29 mm) from face of door.
7. Door Latch: Track of door latch prevents inswing doors from swinging out beyond stile; on outswing doors, door keeper prevents door from swinging in beyond stile; 16 gauge (1.6 mm) sliding door latch, 14 gauge (2 mm) keeper.

    a. Locking: Door locked from inside by sliding door latch into keeper.

8. Pull: Provide door pulls on each side of accessible stall doors in accordance with CBC 11B-604.8.12,
9. Hinge Type: Balanced, with field-adjustable cam to permit door to be fully closed or partially open when compartment is unoccupied.
10. Mounting Brackets: Mounted inside compartment; exposed brackets on exterior of compartment not acceptable with the exception of outswing doors.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions and measurements affecting the work of this Section at site.
B. Correct detrimental conditions before proceeding with installation.

3.2 PREPARATION

A. Prepare substrates including but not limited to blocking and supports in walls and ceilings at points of attachment using methods recommended by the manufacturer for achieving the best result for the substrates under the project conditions.

1. Inspect areas scheduled to receive compartments for correct dimensions, plumbness of walls, and soundness of surfaces that would affect installation of mounting brackets.
2. Verify spacing of plumbing fixtures to assure compatibility with installation of compartments.

B. If preparation is the responsibility of another installer, notify Architect in writing of deviations from manufacturer's recommended installation tolerances and conditions.

C. Do not proceed with installation until substrates have been properly prepared with blocking and supports in walls and ceilings at points of attachment and deviations from manufacturer's recommended tolerances are corrected. Commencement of installation constitutes acceptance of conditions.

3.3 INSTALLATION

A. Set compartments and screens plumb, level, and space uniformly in compliance with their manufacturer's instructions and the following.

B. Set pilasters with anchorages having not less than 2-inch penetration into structural floor, unless otherwise recommended by partition manufacturer.

1. Level, plumb, and tighten installation with devices furnished.
2. Hang doors and adjust so that tops of doors are level with tops of pilasters when doors are in closed position.

C. Secure panels to walls with continuous brackets not less than 2 stirrup brackets attached near top and bottom of panel.

1. Locate wall brackets at the same height, so that holes for wall anchorages occur in tile joints.
2. Secure panels to pilasters with not less than 2 stirrup brackets located to align with stirrup brackets at wall.
3. Anchor panels to studs or backing plates; fastening components to walls with toggle bolts will not be allowed.

D. Install hardware as recommended by manufacturer. Conceal evidence of drilling in finished work.

E. Tolerances: Installed compartments and screens shall be within the following tolerances.

1. From true position: 1/4-inch.
2. From plumb, alignment, and level: 1/8-inch.

3.4 ADJUSTING/CLEANING

A. Adjust hardware for proper operation. Set hinges on in-swinging doors to hold open approximately 30-degree from closed position when unlatched, except set hinges on out-swinging doors and accessible compartments to return to fully closed position.

B. After completion of installation, clean and polish exposed surfaces and touchup minor scratches. Remove and replace components that cannot be satisfactorily touched-up in the field, in the Architect's opinion.

END OF SECTION

SECTION 10 22 39 - FOLDING PANEL PARTITIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes the following:
B. Classrooms: Manually operated, center stacking, top supported operable wall with panels hinged in groups of two or three.
C. Related requirements:

1. Section 05 50 00 for structural supports and braces.
2. Division 9 - for panel finishes not addressed in this section.

1.2 DEFINITIONS

A. NVLAP: National Voluntary Laboratory Accreditation Program
B. NIC: Noise Isolation Class
C. STC: Sound Transmission Class

1.3 SUBMITTALS

A. Product Data: Material descriptions, construction details, finishes, installation details, and operating instructions for each type of operable panel partition, component, and accessory specified. Included data on acoustical performance, surface-burning characteristics, and durability.
B. Shop Drawings: Show location and extent of operable panel partitions. Include plans, elevations, sections, details, attachments to other construction and accessories. Indicate dimensions; weights; conditions at openings and for storage; and required installation, storage, and operating clearances. Indicate location and installation requirements for hardware and track, and direction of travel. Show blocking to be provided by others.
C. Setting Drawings: For embedded items and cutouts required in other work, including support beam-punching template.
D. Samples for Selection:

1. Manufacturer's color charts showing the full range of colors available for units with factory-applied color finishes.
2. Minimum 12-inch-long samples of aluminum extrusions with the required finish.
3. Full size sample of hardware when so requested.
4. Minimum 24-inch square samples of each type of panel face finish.

E. Product Certificates: Submit letter signed by manufacturer certifying that operable walls to be furnished on this project comply with the requirements of the specification.
F. Product Test Reports: From an independent testing agency indicating that each operable panel partition complies with requirements. Submit the following:

1. Report for STC.
2. Proof load testing of track/trolley/bracket/hanger rod assembly. Other proof load tests as may be identified in the "PART 2" of this specification.

G. Maintenance Data: For the following to include in maintenance manuals specified in Division 1:

1. Panel finishes and finishes for exposed trim and accessories. Include precautions for materials and methods that could be detrimental to finishes and performance.
2. Seals, hardware, track, carriers, and other operating components.

H. Seismic qualification certificates: The following from the manufacturer.

1. Indicate whether certification is based on actual test of assembled components or on calculation.
2. Dimensioned outline drawings of equipment unit identifying center of gravity and locating and describing mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

1.4 QUALITY ASSURANCE

A. Installer qualifications: Experienced installer certified in writing by the operable partition manufacturer as qualified to install the manufacturer's partition system.
B. Testing Agency Qualifications: An independent NVLAP-accredited testing laboratory with experience and capability to conduct the testing indicated, as documented according to ASTM E-548.
C. Fire-Test-Response Characteristics: Provide operable wall partitions with the following fire-test-response characteristics

1. Surface-Burning Characteristics: As follows, per ASTM E-84:

a. Flame Spread: 25 or less

2. Fire Growth Contribution: Textile wall coverings comply with the acceptance criteria of UBC Standard 8-2.

1.5 HANDLING

A. Store partition components indoors at temperature and humidity approximating those to be expected when the partition is in service.

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify operable panel partition openings and storage arrangements by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the work.

1.7 WARRANTY

A. Provide warranty in accordance with Article 13 of the General Conditions and Section 01 74 00 Warranties, Guaranties and Bonds.
B. Tracks:

1. Provide 1-year all-inclusive warranty covering defects in material and workmanship.

2. Covered components shall include track, trolleys and (if appropriate) track curves, intersections, switches, and control devices exclusive of wiring.

C. Panels:

1. Provide 1-year all-inclusive warranty covering defects in material and workmanship.
2. Warranty shall cover structural members, panel faces, panel trim, hardware and operating components.

D. 5-Year Panel Limited Warranty: Provide 5-year limited warranty for welded steel panels located at Classrooms. Warranty shall cover structural members, panel faces, panel trim, hardware and operating components. In the event warranty covered items fail or have their performance materially reduced due to defects in workmanship or materials, the manufacturer shall repair or provide replacement parts FOB jobsite, not including unloading or installation. Warranty shall not exclude "normal wear and tear".

E. 2- Year Panel Limited Warranty: Provide 2-year limited warranty for tracks located at Classrooms. Warranty covered components shall include track and trolleys and, if utilized, steel curves, and "Y's" and track switches excluding electric, pneumatic components or drive system components. In the event warranty covered items fail or have their performance materially reduced due to defects in workmanship or materials, the manufacturer shall repair or provide replacement parts FOB jobsite, not including unloading or installation. Warranty shall not exclude "normal wear and tear".

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Advanced Equipment Corporation.
B. Or equal.

2.2 SYSTEM PERFORMANCE REQUIREMENTS

A. Acoustical Performance: Provide operable panel partitions tested by a qualified testing agency for the following acoustical properties according to test methods indicated:

1. Sound Transmission Requirements: Operable panel partition assembly in a full-size opening, 14 by 9 feet, for laboratory sound transmission loss performance according to ASTM E-90, determined by ASTM E-413, and rated for not less than STC indicated in product description below.

2.3 PANEL CONSTRUCTION

A. For purposes of establishing minimum performance standards, this specification is based on operable walls manufactured by Advanced Equipment Corporation, 2401 West Commonwealth Ave., Fullerton, CA 92833, ph. 714-635-5350.
B. Provide top reinforcement as required to support panel from suspension components and provide reinforcement for hardware attachment. Fabricate panels with tight hairline joints and concealed fasteners. Fabricate panels so finished in-place partition is rigid; plumb aligned, with tight joints and uniform appearance; and free of bow, warp, twist, deformation, and surface and finish irregularities.

C. Welded steel panel construction, 3-1/2 inch thick.

1. Panels with this construction occur at Classrooms.
2. Panels at Classrooms shall have minimum 18-gauge (1.22-mm) steel face sheets, robotically fusion welded to 16-gauge (1.52-mm) vertical frame members and 14-gauge (1.9-mm) top rail.
3. Panel weight not to exceed 7.4 psf.
4. Panels at Classrooms shall be rated minimum 52 STC. If field sound tested, wall/s shall achieve a minimum 40 NIC when tested in accordance with ASTM E336, providing that the surrounding building construction is compatible with this rating.
5. Submit test report showing that trolley plate anchorage in test specimen (minimum 4-ft. wide and same construction as proposed for this project) is capable of withstanding a tensile load of 8,000 pounds applied via pendant bolt without failure.
6. Submit test report (minimum 4-ft. wide by 20-ft. long test specimen of the same construction as proposed for this project) showing that panel is capable of resisting a uniform load of 20 pounds per square foot applied normal to the panel face without permanent damage when tested in accordance with ASTM E-72.

D. Panel Edge Trim

1. Panels at Classrooms to be furnished with protective vertical edge trim that overlaps the panel face and secures finish at the vertical edge.

E. Panel Trim Finish:

1. Panels located at Classrooms shall have silicon polyester panel trim.
2. Hardware: Manufacturer's standard as required to activate operable panel partition and accessories; with decorative, protective finish to match panel trim finish.

2.4 SEALS

A. General: Provide types of acoustical seals indicated that produce operable panel partitions with acoustical performance requirements and the following.

1. Seals made from materials and profiles that minimize sound leakage.
2. Seals fitting tight at contact surfaces and sealing continuously between adjacent panels and between operable panel partition perimeter and adjacent surfaces, when operable panel partition is extended, closed, and in place.

B. Vertical Seals: Deep-nesting, interlocking astragals mounted on each edge of panel, with continuous PVC acoustical seals.
C. Top Seals: Panel top seals shall be fixed, flexible multi-fin.
D. Horizontal Bottom Seals

1. Panels at Classrooms shall have tool-activated, mechanical, retractable bottom seals. Seal shall be operated by rotation of a removable crank inserted into a socket located approximately 8-inches from the floor and centered on one panel face. Bottom seal shall be spring loaded and internally guided. Bottom seal assembly shall be a cartridge, removable without cutting panel face.
2. Panels at Classrooms shall have minimum 2-inches travel bottom seal.

2.5 FINISH FACING

A. General: Provide finish facings that comply with indicated fire-test-response characteristics and that are factory applied to operable partitions with appropriate backing, using mildew-resistant non-staining adhesive.

1. Apply one-piece facings free from air bubbles, wrinkles, blisters, and other defects, with no gaps or overlaps. Tightly secure and conceal raw and selvage edges of facing for finished appearance.

B. Vinyl Fabric: Panels at Classrooms shall have manufacturer's standard Type-I vinyl fabric finish. Material shall be mildew-resistant, washable and comply with CFFA-W-101-B for Type indicated; Class A; weight not less than 18 oz. per lineal yard. Color and pattern shall be selected from operable wall manufacturer's standard offering.

2.6 SUSPENSION SYSTEM

A. Suspension Tracks: Steel and aluminum composite as noted below with adjustable steel hanger rods for overhead support, designed for type of operation, size and weight of operable panel partitions as indicated. Size track to support partition operation and storage without damage to suspension system, operable panel partitions, or adjacent construction. Limit track deflection to no more than 0.10-inch between bracket supports. Provide a continuous system of track sections and accessories to accommodate configuration and layout indicated for partition operation and storage.

1. Operable walls at Classrooms shall utilize AEC #2 composite track (aluminum case with steel running surface) or equal.

a. Panel guide shall have finish to match track soffit shall be furnished at operable walls configured as paired panels or continuously hinged.
b. Track soffit trim shall be integral to track.
c. Track brackets shall interlock with top flange of track and attach to structure with pairs of 1/2-inch diameter steel threaded rod. Track joints to be aligned by concealed, steel dowels.
d. Track shall have minimum 2.2-inch-to-the-fourth moment of inertia.
e. Trolleys shall have 4, ball-bearing, steel wheels. Individual trolley capacity shall be 600 pounds.
f. Pendant bolt to be 5/8-inch diameter and attach to panel through a steel plate mounted internally with panel frame.
g. Track at walls configured as individual panel operation shall utilize 12-inch radius turns. Trolleys shall be pre-programmed to select the appropriate stack track. Changes in direction of panel travel shall be by means of remotely controlled track switches.

B. Track Finish:

1. Track soffit trim at Classrooms shall have silicon polyester finish.

C. Proof Load Testing:

1. Classrooms- Submit test report from nationally recognized independent laboratory showing that assembly of track/trolley/bracket/hanger rod sustains a load of 3,000

pounds at mid-point of 42-inch simple span without damage. Load applied to trolley via pendant bolt.

PART 3 - EXECUTION

3.1 EXAMINATION/PREPARATION

A. Examine adjacent construction, supports and built-in components to ensure a coordinated installation.
B. Verify that openings and substrates are within allowable tolerances, plumb, level, clean, will provide a solid anchoring surface. Prepare opening to conform with ASTM E 557, operable partition manufacturer's installation instructions, and the approved shop drawings.
C. Verify that permanent building construction around the operable partition matches the required acoustical performance.
D. Level floors by grinding and filling to bring tolerances within limits acceptable to the partition manufacturer and the installer.
E. Correct other detrimental conditions before proceeding with installation.

3.2 INSTALLATION

A. Install assembly in compliance with manufacturer's instructions and ASTM E 557 after other finishing operations including painting are completed.
B. Install plumb and level, with sound-absorbing faces alternated with solid reflecting faces such that half of the sound absorption is exposed on each side of the partition.
C. Anchor track securely to overhead supports, and jambs to adjacent construction.
D. Match operable partition panels for color and pattern by installing partition from cartons in same sequence as manufactured and packaged, if so numbered. Broken, cracked, chipped, or deformed panels are not acceptable.
E. After completing installation, lubricate bearings and sliding parts; and adjust to ensure smooth, easy operation.

3.3 FIELD QUALITY CONTROL

A. Engage a factory-authorized service representative to adjust and operate the operable panel partitions.

    1. Test and adjust seals, hardware, carriers, tracks, pass doors, pocket doors, controls, safety devices and other operable wall components. Replace damaged or malfunctioning operable components.

B. In the College Representative's presence, conduct tests to ensure safe and efficient operation of the partition.
C. Review the maintenance data specified above with the College’s Representative.
D. Acoustical performance testing by an independent acoustical consultant in accordance with ASTM E336 with special conditions as follows:

    1. The source room levels shall have uniformity of plus or minus 2 dBC approximately 5 feet in front of the partition under test.
    2. The source and receiver room sound pressure levels will be measured across the width of the room and spatially averaged at approximately 10 feet from the partition.

E. Repair or replace operable partition components within areas where test results indicate partition does not comply with requirements and retest new partition at no cost to the University. After installation, restore marred or abraded surfaces to original condition as approved by the University Representative.

3.4 CLEANING AND PROTECTION

A. Clean soiled surfaces on completing installation of operable panel partitions, to remove dust, adhesives, and other foreign materials according to manufacturer's written instructions.
B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and installer, that ensure operable panel partitions are without damage or deterioration at time of Substantial Completion.
C. Replace panels that cannot be cleaned and/or repaired, in a manner approved by Architect, before time of Substantial Completion.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train owner's maintenance personnel to adjust, operate, and maintain operable panel partitions.

1. Train owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing and maintaining equipment and schedules.
2. Review data in maintenance manuals.

END OF SECTION

SECTION 10 28 00 – TOILET ROOM ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes toilet accessories, including framed mirrors.
B. Related requirements:

1. Section 08 86 00 for unframed mirrors.
2. Section 09 22 16 and 10 21 13 for toilet room accessories supports.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Scheduling and sequencing:
B. Pre-installation meeting:

1.3 SUBMITTALS

A. Data: Manufacturer Product Data, and illustrations, complete parts list, and installation requirements for each accessory specified.
B. Samples: Full size Samples of accessories, when requested. Samples will be returned to the Contractor.
C. Schedule: Schedule indicating types, quantities, sizes, and installation locations (by room) for each toilet accessory item to be provided for the Project.

1.4 QUALITY ASSURANCE

A. Basis of design is for accessories made by Bobrick Washroom Equipment, Inc. Other acceptable manufacturers include American Specialties, Inc. and Bradley Corp.
B. Compliance with CBC requirements for accessibility for accessories and their attachments is the Contractor's responsibility.

1.5 HANDLING

A. When possible, keep protective covers on accessories until their installation is complete, then remove at final cleanup.

1.6 SPECIAL WARRANTY

A. Provide the Owner the manufacturer warranty protecting mirrors against silver spoilage for 5 years after Substantial Completion.

1.7 MAINTENANCE

A. Furnish operating instructions and keys for equipment locks.

PART 2 - PRODUCTS

2.1 MANUFACTURERS & MODELS

A. Basis of Design - Bobrick as indicated in the schedule on the Drawings.
B. Or equal.

2.2 MATERIALS

A. Stainless steel: AAMA Type 302/304 complying with ASTM A 167.
B. Sheet steel:

1. Cold-rolled commercial quality, complying with ASTM A 336, 20 gage minimum.
2. Galvanized steel: ASTM A 653 LQ, G60 zinc coating, 20 gage minimum.

C. Mirror glass: 1/4-inch (6 mm) thick, "Silvering Quality" float glass with silver coating, copper protective coating and 2-mil thick protective paint; complying with CS 27.
D. Mounting devices: Galvanized steel.
E. Fasteners: Spanner head design stainless steel fasteners where exposed; may be galvanized steel where concealed.

2.3 AUTOMATIC HAND DRYERS

A. Recessed Automatic Hand Dryers (Tag 10 on Drawings):

1. Basis of Design: Bobrick TrimLine Series Model B-3725 208-240V.
2. Power: 208-240V AC, 4.0-4.4 amp, 1000 watts, 50/60 Hz, single phase, cULus Listed, CE Marked.
3. Compliance:
4. Comply with accessibility regulations, including requirement that unit shall not project more then 4 inches from wall.
5. Cover: 18-8, type-304, 18-gauge stainless steel with a projection of 2 inches from the wall. Corners shall be welded. Equipped with air inlets on sides.
6. Hand Drying Alcove: 9-7/8-inches H x 10-inches W x 6-inches D, curved back with a ceramic water absorbent surface to capture and evaporate excess water.
7. Automatic Function: Infrared sensor.
8. Turns off automatically if an inanimate object is placed over sensor.
9. After inanimate object is removed, electronic sensor resets itself and dryer automatically resumes normal operation.
10. LED light: Flashing Green, ready to use, Solid Green, in use, Solid Red, contact maintenance.

2.4 BABY CHANGING STATIONS:

A. Recessed-Mounted Horizontal Design Stainless Steel Changing Stations (Tag 14 on Drawings):

1. Basis of Design: Model KB110-SSRE as manufactured by Koala Kare Products, a Division of Bobrick.
2. Materials: Blow molded high-density polyethylene (HDPE) clad in 18 gauge Type 304 stainless steel, brushed finish. Includes flange in same material and finish.
3. Operation: Concealed pneumatic cylinder providing controlled, slow opening and closing of the changing station bed.
4. Stainless Steel Liquid Diversion Channel: Prevents liquids that may be present on the changing surface from draining into the wall.
5. Hinge Mechanism: Reinforced full-length steel-on-steel hinge with integrated steel hook plate.
6. Changing Surface: Contoured, concave and smooth, 442 sq. in.
7. Safety Straps: Replaceable, snap-lock, nylon protective holding straps.
8. Performance: Units exceed static load requirements called out by ASTM Standard F 2285, Standard Consumer Safety Performance Specification for Diaper Changing Stations for Commercial Use.
9. Mounting: Factory-drilled mounting holes and mounting hardware included.

10. Features: No hinge structure exposed on interior or exterior surfaces; two bag hooks; built-in liner dispenser with 25 liner capacity.
11. Instruction Graphics: Universal molded instruction graphics and safety messages in multiple languages.

2.5 DRESSING BENCH

A. Shower area ADA wall hung dressing benches (Tag 15 on Drawings):

1. Folding benches shall have a frame constructed of type-304, satin-finish stainless steel that consists of 1.6mm (16-gauge), 32mm square tubing and 1.2mm (18-gauge), 25mm diameter seamless tubing.
2. Benches shall be one-piece, 13mm thick, solid phenolic with matte-finish, ivory-colored, melamine surfaces and black phenolic-resin core; secured to frame with stainless steel carriage bolts and acorn nuts.
3. Benches shall be equipped with two 75mm diameter mounting flanges constructed of type-304, 5mm thick, satin-finish stainless steel; a guide bracket constructed of type-304, 1.6mm (16-gauge), satin-finish stainless steel; and a spring constructed of type-301, 0.6mm (24-gauge) stainless steel that is spot-welded to a baseplate of type 304, heavy-gauge stainless steel.
4. Benches shall be able to lock in upright position when not in use. Shower seat shall comply with Australia Standard AS1428.1-2009 for structural strength.

2.6 SHOWER SEAT

A. Reversible folding shower seat (Tag 19 on Drawings):

1. Frame constructed of Type-304, satin-finish stainless steel that consists of 16-gauge, 1-1/4-inch square tubing and 18-gauge, 1/2-inch diameter seamless tubing.
2. Seat shall be one-piece, 1/2-inch thick, solid phenolic with matte-finish, antique white-colored, melamine surfaces, and black phenolic-resin core; secured to frame with stainless steel carriage bolts and acorn nuts.
3. Seat shall be reversible for left- or right-hand installation in the field. Shower seat shall be equipped with two 3-inch diameter mounting flanges constructed of Type-304, 3/16-inch thick, satin-finish stainless steel; a guide bracket constructed of Type-304, 16-gauge, satin-finish stainless steel; and a spring constructed of Type-301, 24-gauge stainless steel that is spot-welded to a baseplate of Type-304, heavy- gauge stainless steel. Seat shall remain in upright position when not in use.
4. Shower seat shall comply with accessible design guidelines including ADAAG.

2.7 FABRICATION

A. Fabricate units with seamless one-piece flanges on exposed faces.

1. Miter corners, weld and grind smooth and flush with parent metal so that welds are invisible on exposed surfaces.
2. Open joints (not fully welded) on exposed surfaces are not acceptable.
3. Conceal anchoring devices.

B. Hang doors or panels on continuous stainless steel piano hinges.
C. Master-key locked dispensing units. Key coin boxes of coin-operated dispensing units separately from the lock on the unit.
D. Grind edges smooth, both inside and out.
E. Finish exposed surfaces with an AISI No. 4 finish running in the same direction (horizontal or vertical) for all accessories, except where a knurled surface is specified for grab bars.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine adjacent construction and supports.
B. Verify that attachment surfaces are within allowable tolerances, plumb, level, clean, will provide a solid anchoring surface.
C. Correct detrimental conditions before proceeding with installation.

3.2 INSTALLATION

A. Drill holes to correct size and location. Install accessories plumb, level and equally spaced (where applicable).

    1. Where accessories are attached to toilet compartments, do not “thru-bolt” but drill and tap partition reinforcement
    2. Provide templates of accessories for drilling and tapping required in Section 10 21 13.

B. When installed in ceramic tile surfaces, coordinate accessory location with the tilework so that the top and one side (closest to the door) of the accessory will align with a tile joint.
C. Attach accessories plumb, level, evenly spaced where applicable, securely anchored with screws or bolts to steel studs or backing plates. Do not use Molly or toggle bolts in gypsum board.
D. Install grab bars to withstand a downward load of at least 250 lbf when tested according to method in ASTM F 446.
E. Adjust accessories for proper operation. After completion of installation, clean and polish exposed surfaces after removal of protective coverings.

3.3 ACCESSORY SCHEDULE

A. See Sheet A411 on Drawings for schedule.

END OF SECTION

SECTION 10 41 16 - EMERGENCY ACCESS KEY BOXES

PART 1 - GENERAL

A. SUMMARY

1. Section Includes:

a. Fire department emergency access key boxes.

1.2 SYSTEM DESCRIPTION

A. Emergency Access Key Boxes: High security key-locked vaults approved by Fire Department, sized and configured to house entrance keys to designated spaces and rooms, and accessed by single master key controlled by Fire Department to provide rapid emergency access to those designated spaces and rooms.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Conference: Before starting emergency access key box installation, conduct conference at Project site.

1. Meet with Owner, Architect, and Fire Marshal.
2. Agenda: Review products, installation procedures and coordination with related work. Coordinate location of emergency access key box with Fire Marshal.

PART 2 - PRODUCTS

2.1 EMERGENCY ACCESS KEY BOXES

A. Emergency Access Key Boxes: Heavy duty steel case with hinged door for recessed mounting.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Knox-Box 3200 Series Hinged Door.

a. Prior approved equal.

2. Mounting: Recessed.
3. Case: 1/4-inch-thick welded steel plate; 30 cubic inch capacity capable of holding up to 10 keys and access cards.
4. Size: 7 inches wide by 7 inches high by 3 inches deep.
5. Recessed Mount Flange: Steel face flange secured to case; 7 inches wide x 7 inches high.
6. Door: 1/2-inch-thick solid plate steel with interior gasket seal and stainless-steel hinge; 1/8-inch-thick stainless steel lock cover with hole for tamper proof seal.
7. Lock: Double action rotating tumblers and hardened steel pins access by biased cut key; keyed to Fire Department master key.
8. Finish: Manufacturer's Knox-Coat proprietary finishing process; color to match adjacent wall finish.

2.2 ACCESSORIES

A. Recessed Mounting Kit: Provide manufacturer's standard shell housing and mounting hardware for casting into concrete or setting into masonry construction where required.

B. Fasteners: Grade 5 zinc plated steel carriage screws with nuts; fabricated from quenched and tempered steel with minimum 120,000 psi tensile strength; coarse thread; thread length at least 2 times screw diameter plus 1/4 inch; 3/8-inch diameter by lengths sufficient to secure emergency access key box to backing plates at recessed locations and through wall at surface mounted locations.

C. Sealant: As specified in Section 07 92 00 - Joint Sealants.

2.3 FABRICATION

A. Form emergency access key boxes to required shapes and sizes, with true lines and angles, square, rigid, and without warp, and with metal faces flat and free of dents or distortion. Make exposed metal edges and corners free of sharp edges and burrs and safe to touch. Fabricate doors of emergency access key boxes to preclude binding. warping. or misalignment.

B. Preassemble emergency access key boxes in shop to greatest extent possible to minimize field assembly.

C. Mill joints to a tight, hairline fit. Cope or miter corner joints. Form joints exposed to weather to exclude water penetration.

D. Drill or punch holes required for fasteners and remove burrs. Use security fasteners where fasteners are exposed. If used, seal external rivets before finishing.

E. Weld in concealed locations to greatest extent possible without distorting or discoloring exposed surfaces. Remove weld spatter and welding oxides from exposed surfaces.

F. Where dissimilar metals contact each other, protect against galvanic action by painting contact surfaces with bituminous coating or by applying other permanent separation as recommended by manufacturers of dissimilar metals.

2.4 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM/NOMMA's "Metal Finishes Manual for Architectural and Metal Products (AMP 500-06)" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer and fire marshal present, for compliance with requirements for roughing-in openings, clearances, and other conditions affecting performance of the Work.

B. Examine walls and other adjacent construction for suitable conditions before installation.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install emergency access key box in accordance with Fire Department requirements and with manufacturer’s instructions and recommendations.

B. Install emergency access key boxes level and plumb, according to manufacturer's written instructions.

1. Install recess mounted emergency access key boxes flush in non-rated framed construction. Install surface mounted emergency access key boxes in fire-rated framed construction, concrete construction, and masonry construction.
2. Where dissimilar metals contact each other, protect against galvanic action by painting contact surfaces with bituminous coating or by applying other permanent separation as recommended by manufacturer.
3. Where aluminum contacts grout, concrete, masonry, or wood, protect against corrosion by painting contact surfaces with bituminous coating.

C. Emergency Access Key Boxes: Install emergency access key boxes with centerline not more than 48 inches above finished floor.

3.3 FIELD QUALITY CONTROL

A. Examine and test emergency access key boxes.

3.4 ADJUSTING AND CLEANING

A. Remove temporary protective coverings and strippable films, if any, as emergency access key boxes are installed unless otherwise indicated in manufacturer's written installation instructions.

B. Adjust doors, hardware, and moving parts to function smoothly, and lubricate as recommended by manufacturer. Verify that integral locking devices operate properly.

C. Touch up marred finishes or replace emergency access key boxes that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by in-wall payment drop box manufacturer.

D. Replace emergency access key boxes that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

E. On completion of emergency access key boxes installation, clean interior and exterior surfaces as recommended by manufacturer.

END OF SECTION

SECTION 10 44 00 - FIRE PROTECTION SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Fire extinguishers.
2. Fire extinguisher cabinets.
3. Mounting brackets.
4. Fire extinguisher locators.

B. Related requirements: Division 21 for fixed fire protection systems.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Pre-installation meeting:

1. Coordinate size of fire extinguisher cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.
2. Coordinate sizes and locations of fire extinguisher cabinets with wall depths. Final location of fire extinguisher cabinets is subject to the Fire Department’s approval.
    a. Verify cabinet locations with both the Fire Department and the Architect and Owner’s Authorized Representative during the framing stage of the Project.
    b. Positioning of cabinets at locations other than indicated shall be done at no additional cost to the Owner.
    c. Where extinguisher Locations are not indicated, assume cabinet and extinguishers will be located within 75 feet of any point in the building, or at a rate of one for each 3,000 square feet of building area, or portion thereof, whichever yields the greater number of extinguishers.

1.3 SUBMITTALS

A. Data: Manufacturer Product Data and installation instructions for the work of this Section.

1. For fire extinguishers, submit Drawings indicating locations and type of extinguishers after approval by Fire Marshall.
2. For extinguisher cabinets, include roughing-in dimensions and details showing mounting methods, door hardware, cabinet type and materials, trim style and door construction, and materials.
3. Include color charts showing full range of manufacturer standard colors and designs available.

B. Closeout: 2 keys for each cabinet, all keyed alike, and properly tagged.

1.4 QUALITY ASSURANCE

A. Uniformity: Provide all fire extinguishers, cabinets and accessories made by one manufacturer.
B. UL listing: Provide UL listed fire extinguishers bearing the UL "Listing Mark" for type, rating, and classification specified. Provide cabinets with the same fire-rating as walls in which they are installed.

C. NFPA compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."

1.5 SPECIAL WARRANTY

A. Fire extinguisher warranty:

1. Warranty stating that manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship for 5 years from Substantial Completion.
2. Failures include:

a. Failure of hydrostatic test according to NFPA 10.
b. Faulty operation of valves or release levers.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis of design: Products by Larsen's Manufacturing Co.
B. Other acceptable manufacturers:

1. JL Industries, Inc./Division of Activar Construction Products Group.
2. Potter Roemer LLC.
3. Or equal.

2.2 FIRE EXTINGUISHERS

A. Multi-purpose dry chemical: 3A:40B:C UL rated, 6 lb. capacity, aluminum valve.

1. Markings:
2. Include pictorial marking system complying with NFPA 10, Appendix B and bar coding for documenting fire extinguisher location, inspections, maintenance, and recharging.
3. Label with standard warnings concerning breathing, eyes, skin and ingestion. Provide emergency and first aid procedures.

2.3 FIRE EXTINGUISHER CABINETS

A. Manufacturer:

1. Basis-of-design-product: "Architectural Series" Steel "Tub" box, "Larsen Loc", recessed and semi-recessed, with lockable door.

a. Recessed:

1) Non-fire-rated 2409-R2.
2) Fire-rated: FS 2409-R2.

b. Semi-Recessed:

1) Non-fire-rated: 2409-R4 with a 3-1/2-inch projection.
2) Fire-rated: FS 2409-R4 with a 3-1/2-inch projection.

2. Or equal.

B. Construction: Manufacturer standard enameled steel box. Miter and weld perimeter door and frames and grind smooth.
C. Doors: Full panel clear tempered glass with Larson-Loc.
D. Trim: One-piece combination trim and perimeter door frame overlapping surrounding wall surface, with exposed trim face and wall return at outer edge (backbend). Miter and weld all joints.
E. Door hardware: Manufacturer standard door operating hardware and keyed lock. Provide concealed or continuous type hinge permitting door to open 180 degrees.
F. Factory-finishing:

1. After cleaning and pretreatment, apply manufacturer's baked enamel coating of the color selected by the Architect from manufacturer's palette.
2. Identify fire extinguisher in cabinet with lettering spelling "FIRE EXTINGUISHER" painted on door by silk-screen process.
3. Provide vertical lettering on door as selected by Architect from manufacturer's standard letter sizes, styles and layouts.

2.4 ACCESSORIES

A. Fire extinguisher locators: White plastic. Red edge in white vinyl with a fire extinguisher symbol and “Fire Extinguisher” lettering by Flynn, or equal.
B. Mounting brackets (wall hooks):

1. Basis-of-design-products: Larsen’s Model B4, standard brackets of sizes required for extinguisher specified, in manufacturer standard plated finish.
2. Provide brackets for extinguishers, other than those in cabinets.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine adjacent construction and supports.
B. Verify that openings are within allowable tolerances, plumb, level, clean, will provide a solid anchoring surface.
C. Correct detrimental conditions before proceeding with installation.

3.2 INSTALLATION

A. Verify with Fire Marshal and Architect each fire extinguisher cabinet location during the framing stage of the Project; location of fire extinguisher cabinets is subject to the Fire Marshal's approval.

1. Position cabinets at locations other than indicated at no cost to the Owner.
2. Where not indicated locate, cabinets and extinguishers with the Architect's approval, so that they can be reached within 75 feet travel distance from any point, or one for each 3,000 square feet, whichever is more restrictive.

B. Install cabinets so that the fire and/or acoustical rating of the walls are not compromised.
C. Attach mounting brackets and fire extinguisher cabinets securely to studs or backing plates, square, plumb and level, in compliance with their manufacturer's instructions; do not attach them to gypsum board with Molly or toggle bolts.
D. Install fire extinguisher locators where indicated. Secure to supports with double-sided foam tape.

3.3 FIELD QUALITY CONTROL

A. Verify that installed extinguishers are fully charged and tagged in accordance with requirements of authorities having jurisdiction.
B. Touchup damaged finish, when the results are acceptable to the Architect, otherwise replace damaged components.

END OF SECTION

SECTION 10 51 13 - STEEL LOCKERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes

1. Heavy duty knocked down two tier lockers, including hardware, flat tops, skirts, fillers, and related accessories required for complete installation as indicated.
2. Locker benches.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Conference: Conduct conference at Project site.
B. Coordination:

1. Coordinate sizes and locations of concrete bases for metal lockers.
2. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of work specified in other Sections to ensure that metal lockers can be supported and installed as indicated.

1.3 SUBMITTALS

A. Data: Manufacturer product data giving sizes, standard fabrication details, materials, finishes, roughing-in diagrams and installation instructions, including those for anchors and fasteners.
B. Shop drawings:

1. Include plans, elevations, sections, and attachment details.
2. Show locker trim and accessories.
3. Include locker identification system and numbering sequence.
4. Show attachment and anchoring details with size of anchors to be used.

C. Samples:

1. Locker manufacturer samples shall be at least 80-sq-inches.
2. Trim samples shall be at least 8-linear-inches.

1.4 QUALITY ASSURANCE

A. Provide all lockers for the Project made by the same manufacturer.

1.5 HANDLING

A. Do not deliver lockers until the building is enclosed and ready for their installation.

1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of metal lockers that fail in materials or workmanship, excluding finish, within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures.

b. Faulty operation of latches and other door hardware.

2. Damage from deliberate destruction and vandalism is excluded.
3. Warranty Period for Knocked-Down Metal Lockers: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. One of the following:

1. Basis of design: Penco Products Inc.
2. Lyon Workspace Products.
3. Republic Storage Systems.
4. Or equal.

2.2 HEAVY DUTY LOCKERS

A. Heavy Duty Lockers: All locker body components made of cold rolled steel specially formed for added strength and rigidity and to ensure tight joints at fastening points.

1. Lockers with Doors: Penco Invincible II, knock-down lockers, with no legs.

B. Locker Body Construction: Steel specially formed for added strength and rigidity and to ensure tight joints at fastening points.

1. Sides, Bottoms, Tops, and Shelves:

a. 16-gauge steel.
b. Ventilation: 3/4 inch wide by 1-1/2-inch-high diamond-shaped perforations.
c. Solid sides.

2. Backs: Solid 18-gauge steel.
3. Doors:

a. 14-gauge steel.
b. Ventilation: 3/4 inch wide by 1-1/2-inch-high diamond-shaped perforations.
c. Solid doors.

4. Tops and bottoms with three sides formed 90 degrees, the front offset formed to be flush with horizontal frame member.
5. Shelves with four sides formed to 90 degrees, front edge having a second bend.
6. Hole spacing in locker body construction: Not exceeding 9 inches.
7. Two- tier lockers: Intermediate channel-shaped horizontal frame members attached to side frames with mortise and tenon construction, securely welded.
8. Optional factory assembly of locker bodies using rivets.

C. Components for two tier lockers

1. Body. Locker body components shall be minimum 24-gage steel sheet formed to ensure tight joints at fastening points.

    a. Tops and bottoms shall have 3 sides hemmed and bent 90 degrees and the front offset and formed to be flush with the horizontal frame member.
    b. Shelves shall have 3 sides hemmed and bent 90-degrees, the front edge shall be hemmed and bent twice to form a channel.
    c. Exposed Locker Sides: shall be minimum 16 gage steel sheet without any extra holes.

2. Door Frame: minimum 16 gage steel sheet formed to a channel shape. Vertical members shall have an additional flange to provide a continuous door strike. Inter-membering parts shall be mortised and tenoned and electrically welded. Cross frame members, including intermediate cross frames, on multiple-tier lockers, shall be channel shapes of minimum 16 gage steel and be securely welded to vertical framing members.
3. Door face, top and bottom rails and edge stiles: formed from one piece of 16 gage steel sheet.
4. Forming shall provide

    a. A fully enclosed channel shape on the lock side of adequate width and enough depth to fully conceal the lock bar.
    b. Channel formation on the hinge side.
    c. Right angle formations across the top and bottom.

5. Ventilation

    a. Doors 36- to 72-inches high shall have 2 sets of louvers, one set near the top of the door and one set near the bottom.
    b. Shorter doors shall have one set of louvers.

6. Interior Equipment Internal reinforcing may be manufactured of hot rolled pickled and oiled steel per ASTM A569, unless indicated otherwise.

    a. Double tier lockers shall have the following.

        1) 3 single-prong wall hooks mounted below the ceiling
        2) One double-prong hook mounted to the underside of the ceiling.

7. Internal reinforcing may be manufactured of hot rolled pickled and oiled steel per ASTM A569, unless indicated otherwise.

D. Locker Doors: One piece sheet steel.

1. Multi-Point Latch Doors: Full channel formation of adequate depth to fully conceal lock bar on lock side, channel formation on hinge side, right angle formations across top and bottom, with holes for attaching number plates.
2. Single Point Latch Doors: 14-gauge door reinforced by a full height 3-1/2 inch wide, 18-gauge vertical pan welded to the top, bottom and hinge side flanges and rear of door skin on 12-inch, 15 inch and 18-inch-wide doors. Provide a horizontal pan for doors wider than 18 inches.

3. Single Point Latch Doors: 14-gauge door reinforced by a full 18-gauge inner pan welded to outer door skin on all four sides.

    a. Solid outer door, solid inner pan
    b. Diamond perforated outer, offset diamond perforated inner pan.
    c. 3 inch or 6-inch louvered outer door, mini louvered inner pan.
    d. Mini louvered outer, mini louvered inner pan.

4. Doors over 15 inches wide and 30 inches high: Provided with 3-inch wide 20 gauge full height reinforcing pan welded to inside face of door at 6 inch centers.
5. Box Lockers (2 Tiers): Channel formations on lock and hinge sides; right angle flanges on top and bottom with friction catch door pull.
6. Provide holes for attaching number plates.
7. Ventilation:

    a. Doors 20 inches or higher: 3/4-inch wide by 1-1/2-inch-high diamond-shaped perforations.
    b. All other doors: 7/16-inch wide by 15/16-inch-high diamond-shaped perforations.

8. Ventilation: Provide louvered doors in manufacturer's standard louver pattern.
9. Ventilation: Provide louvered doors in manufacturer's standard mini-louver pattern, louvers 5/8 inch wide and 1/4 inch high.
10. Ventilation: Provide fully louvered doors in manufacturer's standard full louver pattern.
11. No Ventilation: Provide with solid doors.

E. Hinges:

1. Hinge: 0.074-inch-thick sheet steel, double spun, full loop, tight pin, projection welded to door frame and securely fastened to the door.

    a. Doors 24 inches wide by 60 inches or 72 inches high: Four 2 inch high five-knuckle hinges.
    b. All other doors: Two 2 inch high five-knuckle hinges.

2. Continuous Hinges: Continuous piano hinge for the full height of the door.

2.3 DOOR HANDLES AND LATCHING

A. 2 Tier Lockers:

1. Two, equal height locker compartments vertically stacked; furnish with 4-inch legs, skirted base, and sloped tops

    a. Size: As shown on Drawings.

        1) 18-inches wide by 24-inches deep by 36-inches high.
        2) 24-inches wide by 24-inches deep by 36-inches high.

    b. Locking, padlock, not key controlled.

2. Multi-point latching with recessed handles:

    a. Recess finger-lift control handle in door.
    b. Pocket: 22 gauge brushed stainless steel securely fastened to door with two tabs and a positive tamper-resistant decorative fastener; of depth sufficient to prevent a

combination padlock, built-in combination lock, or key lock from protruding beyond door face.

c. Provide lock hole cover plate for use with padlocks.
d. Attach 14 gauge formed steel lifting piece to latching channel with one concealed retaining lug and one rivet, assuring a positive two-point connection.
e. Handle Finger Lift: Molded, sound-deadening, attached with rivet; padlock eye for use with 9/32 inch (7.1 mm) diameter padlock shackle.
f. Latch Clip: Glass-filled nylon engaging the door frame and holding the door shut.

1) Doors 60 inches and 72 inches high: Three points.
2) Doors 20 inches to 48 inches high: Two points.

g. Locking Device: Positive, automatic type, whereby locker may be locked when open, then closed without unlocking.
h. Firmly secure one rubber silencer in frame at each latch hook.

2.4 INTERIOR EQUIPMENT

A. ADA-Compliant Lockers (Recessed Handles with Multi-Point Latch):

1. Locker Compartment Bottom: Minimum of 15 inches off the floor, or an extra shelf placed 15 inches off the floor for unobstructed forward and side reach.
2. Handicapped symbol attached to door.
3. Hooks and rods as specified for other lockers.

B. Non-ADA Lockers (Invincible II):

1. Openings up to 18 inches deep: Three single-prong wall hooks and one double-prong ceiling hook.
2. Openings 30 inch and 36 inch high: Three single-prong wall hooks and one double prong ceiling hook.

2.5 ACCESSORIES

A. Number Plates: Provide each locker with a polished aluminum number plate, 2-1/4 inches wide by 1 inch high, with black numerals not less than 3/8 inches high; attach to face of door with two aluminum rivets.
B. Closed Bases: 18 gauge closed metal front and end bases, finished to match lockers.
C. Padlocks: Control-keyed, three-number dialing combination type padlocks; not key controlled.
D. Finished End Panels: Minimum 16-gauge steel formed to match locker depth and height, 1 inch edge dimension; finish to match lockers; install with concealed fasteners.
E. Front Fillers: 20-gauge steel formed in an angle shape, with 20 gauge slip joint angles formed in an angle shape with double bend on one leg forming a pocket to provide adjustable mating with angle filler.

1. Attachment by means of concealed fasteners.
2. Finish to match lockers.

F. Zee Bases for Knock-Down Lockers without legs: 14-gauge, steel flanged outward at top for support of lockers, flanged inward at bottom for anchoring to floor.

1. Height: 6 inches.

G. Recess Trim: 18-gauge steel, 3-inch face dimension.

1. Vertical and/or horizontal as required.

2. Standard lengths as long as practical.
3. Attach to lockers with concealed clips.
4. Provide necessary finish caps and splices.
5. Finish to match lockers.

H. Benches: Laminated selected hardwood, 1-1/4-inch full finished thickness, corners rounded and sanded, surfaces finished with two coats of clear lacquer.

1. Depth: 24 inches deep.
2. Lengths: 48-inches long

I. Stainless Steel Free-Standing Bench Pedestals:

1. 2-inches diameter brushed 16-auge stainless steel formed into a trapezoid, 14-inch-wide bottom with two 5/16-inch diameter holes, top flange with four 5/16-inch diameter holes for fastening to bench (Cat # 60827H).
2. Provide non-skid kit for stainless pedestal (Cat # 68420).

2.6 FABRICATION

A. Fabricate components straight, clean cut and free from dents, scratches, oil canning, or other defects.
B. Knock-Down Lockers: Fabricate lockers on the unit principle, each locker with individual door and frame, individual top, bottom, back, and shelves, with common intermediate divisions separating compartments. Verify dimensions and arrangement before fabrication.
C. Use only smooth materials, free of blemishes such as pitting, seam marks, roller marks, trade names and roughness for surfaces exposed to view.
D. Remove blemishes by grinding before cleaning, treating and applying specified finishes.
E. Provide necessary cutouts and reinforcement for hardware.

2.7 FINISH

A. Finish: Enamel powder coat paint finish electrostatically applied and properly cured to manufacturer's specifications for optimum performance. Finishes containing volatile organic compounds and subject to out-gassing are not acceptable. Locker exterior and interior shall be painted the same color.

1. Powder Coat - Dry Thickness: 1 to 1.2 mils (0.025 to 0.03 mm).
2. Powder Coat Plus - Dry Thickness: 2 to 2.2 mils (0.05 to 0.055 mm).
3. Color: 736 Burgundy.
4. Hardware: Heavy chrome-plating with a mirror finish (US 26), and polished aluminum for number plates.
5. All other ferrous surfaces: Thoroughly clean, phosphatize and seal. Then electrostatically apply enamel finish coat and bake under controlled conditions. Colors shall have a 55 to 60 sheen.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions and measurements affecting the work of this Section at site.
B. Correct detrimental conditions before proceeding with installation.

3.2 INSTALLATION

A. Install lockers plumb, level and securely anchored, in accordance with their manufacturer's recommendations and Code seismic regulations, with hairline, flush joints between units.
B. Use concealed (when lockers are closed) fasteners only, appropriate to load and anchoring substrate; do not use toggle bolts in gypsum board. Install reinforcing plates to distribute the load where fasteners would distort the metal.
C. Install trim to provide flush, hairline joints against adjacent construction. Adjust doors and hardware to operate freely without binding.

3.3 FIELD QUALITY CONTROL

A. Verify operations of all the lockers, door swing and locking mechanism. Lubricate moving parts as required.
B. Touchup minor damage or replace damaged parts. Replace lockers damaged beyond satisfactory field repair as directed by the Architect.

END OF SECTION

SECTION 10 82 00 - EXTERIOR ROOF-MOUNTED SCREEN WALL

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes design/build prefinished exterior aluminum wall louvers.

1. Furnish and install screenwall/vision barrier, structural supports and attachment brackets as shown on the drawings, as specified, and as needed for a complete and proper installation.
2. The screenwall/vision barrier to be furnished include the following:

a. Fixed extruded screenwall/vision barrier.

B. Related requirements: Division 23 for interior louvers connected to ductwork.

1.2 SUBMITTALS

A. Data: Manufacturer Product Data and specifications, air performance and water penetration graphs (AMCA Certified Ratings), anchorage details and installation instructions, including specifications for finishing materials.
B. Shop Drawings:

1. Detail the fabrication and erection of louvers not shown in the manufacturer data.
2. Include details of sections and connections.
3. Show interface with adjacent materials, anchorage and accessories.

C. Samples: 6-inch-long finished Samples of each profile of aluminum extrusions with the specified finish.

1.3 QUALITY ASSURANCE

A. Single subcontract responsibility: Subcontract the work to a single firm that has had not less than six years' experience in the design and manufacturing of work similar to that shown and required.
B. Welding:

1. Qualify procedures and personnel according to AWS D1.1, Structural Welding Code-Steel, and AWS D1.3, "Structural Welding Code-Sheet Steel".
2. Welders shall have satisfactorily passed AWS qualification tests.
3. If recertification of welders is required, retesting will be Contractor's responsibility.

1.4 HANDLING

A. Delivery: At the time of delivery all materials shall be visually inspected for damage. Any damaged boxes, crates, louver sections, etc. shall be noted on the receiving ticket and immediately reported to the shipping company and the material manufacturer.

B. Handling:

1. Material shall be handled in accordance with sound material handling practices and in such a way as to minimize racking

C. Storage:

1. Material may be stored flat, on end or on its side.
2. Material may be stored either indoors or outdoors.
3. If stored outdoors the material must be raised sufficiently off the ground to prevent it being flooded.
4. If stored outdoors the material must be covered with a weather proof flame resistant sheeting or tarpaulin.

1.5 SPECIAL WARRANTIES

A. Warrant finish against fading, chalking, peeling, cracking, checking, chipping, or erosion to base metal of the exterior panel finish for 20 years after Substantial completion.
B. The warranty, the enforcement or lack of enforcement thereof, shall not deprive the Owner of other actions, rights or remedies available to him. Warranty shall be in form approved by Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. The screenwall/vision barrier and related materials herein specified and indicated on the drawings shall be as manufactured by:

1. Construction Specialties, Inc., basis of design.
2. Or equal.

2.2 PERFORMANCE REQUIREMENTS

A. Structural performance: Provide assemblies capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by louver blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act on vertical projection of louvers.

1. Wind loads: As indicated on the Structural Drawings.
2. Maximum allowable deflection for the louver structural members to be l/180 or 0.75 inch, whichever is less.
3. Maximum allowable deflection for the louver blades to be l/120 or 0.50 inch across the weak axis, whichever is less.

B. Seismic performance: The building is in Seismic Design Category (SDC) indicated on the Structural Drawings as defined by the CBC. Engineer, fabricate and Install assemblies requiring special bracing or mounting to meet the Seismic Design Category without failure or damage.
C. Thermal movements:

1. Provide louvers that allow for thermal movements resulting from the following change (range) in ambient and surface temperatures without buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
2. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
3. Temperature change (range) of 120-degree F, ambiant, 180-degree F, material surfaces.

2.3 SCREENWALL/VISION BARRIER MODEL

A. ALUMINUM SCREEN, VERT-A-CADE 301-- Blades to be fabricated from extruded aluminum sections in 6063-T5 alloy, minimum .081-inches thick and spaced approximately 6 3/4-inches on center. Blades to be nominal 4” deep, supported and lined up with heavy gauge extruded aluminum blade braces positively interlocked to each blade and mechanically secured to extruded aluminum supports. Aluminum channel supports fixed directly to horizontal steel supports with extruded aluminum clip angles. Fasteners to be type 304 stainless steel.
B. Blade material ships knocked down for field assembly by the installer.

2.4 MATERIALS

A. Aluminum Extrusions: ASTM B211, Alloy 6063-T5, 6063-T6 or 6061-T6.
B. Aluminum Sheet: ASTM B3209, Alloy 1100, 3003 or 5005.
C. Blank-off panels: Sheet aluminum, ASTM B 209.
D. Steel reinforcement: ASTM A 36.
E. Fasteners: Stainless steel or aluminum for aluminum-to-aluminum, galvanized steel for anchorage to supporting structure. Use Phillips flat-head machine screws for exposed fasteners.
F. Anchors and inserts:

1. Non-ferrous metal or hot-dip galvanized anchors and inserts.
2. Use steel or lead expansion bolt devices for drilled-in-place anchors.
3. Furnish inserts, as required, to be set into concrete and masonry.

G. Paint:

1. For concealed ferrous metal surfaces: Tneme-Zinc 90-93 by Tnemec, Zinc-Lock 308 by Porter International, or MZ-4 Epoxy Zinc-Rich Primer by Valspar Corp.
2. Bituminous paint: Cold-applied asphalt mastic paint complying with SSPC-Paint 12, except containing no asbestos, and formulated for 30-mil thickness per coat.

H. Sealants: As specified in Section 07 92 00.

2.5 FABRICATION

A. Provide CS screenwall models, structural supports and accessories as specified and/or shown on the drawings. Materials, sizes, depths, arrangements and material thickness to be as indicated or as required for optimal performance with respect to strength; durability; and uniform appearance.
B. Screenwall to be mechanically assembled using stainless steel or aluminum fasteners.
C. Include supports, anchorage, and accessories required for complete assembly.
D. Frame louvers with mitered or coped and continuously welded or riveted and soldered joints.

1. Weld or rivet and solder blades to frames at each end, so that all joints will be watertight.

2. Reinforce frames and blades as required for stiffness and to comply with the design criteria.

E. Blank-off panels:

1. Provide blank-off where indicated.
2. Fabricate from 0.064-inch aluminum sheet.
3. Locate on inside face of louver.
4. Install on continuous foam tape, specified in Section 07 92 00, to provide an airtight seal.
5. Attach to louver frames with machine screws at each corner and spaced at 12-inches o.c. maximum between.

2.6 FINISHES

A. General: Comply with NAAMM "Metal Finishes Manual" for finish designations and application recommendations, except as otherwise indicated. Apply finishes in factory. Protect finishes on exposed surfaces prior to shipment. Remove scratches and blemishes from exposed surfaces that will be visible after completing finishing process. Provide color as indicated or, if not otherwise indicated, as selected by architect.

B. 100% Fluoropolymer Resin Powder Coat System complying with AAMA-2605-5 standards for gloss and color retention. Finish thickness to be 1.5 to 3.0 mils.

1. Finish to allow zero VOCs to be emitted into facility of application or at job site.
2. Finish to adhere to a 4H Hardness rating.
3. Furnish manufacturer's twenty (20) year warranty for finish for gloss and color retention.

C. Three Coat Fluorocarbon Coating:

1. Sunshades to be finished with a minimum 1.4 mil (0.035mm) thick full strength 70% resin, 3 coat Fluoropolymer system.
2. Aluminum shall be thoroughly cleaned, etched and given a chromated conversion pre-treatment before application of the Kynar/Hylar coating. The coating shall consist of a primer, a high Metallic color coat and a clear PVF2 topcoat. It shall receive a bake cycle of 17 minutes at 450°F. All finishing procedures shall be one continuous operation in the plant of the manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine adjacent construction and supports.
B. Verify that openings are within allowable tolerances, plumb, level, clean, will provide a solid anchoring surface.
C. When areas behind louvers will be difficult to access after installation, clean free of debris and dust.
D. Correct detrimental conditions before proceeding with installation.

3.2 INSTALLATION

A. Comply with manufacturer's instructions and recommendations for installation of the work.
B. Place louvers plumb, level and in proper alignment with adjacent work.

C. Anchor securely to adjacent construction as indicated on the approved Shop Drawings. Use concealed anchorages wherever possible.
D. Form tight, flush joints with exposed connections accurately fitted together.
E. Protect unpainted aluminum surfaces that will be in contact with cementitious and dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint or by separating surfaces with waterproof gaskets or nonmetallic flashing.
F. Install blank-off panels on continuous ribbons of tape sealant to affect a weathertight seal.
G. Repair finish damaged by cutting, welding, soldering and grinding operations required for fitting and jointing. Restore finish so that there is no evidence of corrective work or return damaged parts to the shop for refinishing.
H. Seal joints between louvers and adjacent construction as specified in Section 07 92 00.
I. Erection Tolerances:

1. Maximum variation from plane or location shown on the approved shop drawings: 1/8" per 12 feet of length, but not exceeding 1/2" in any total building length or portion thereof (non-cumulative).
2. Maximum offset from true alignment between two members abutting end to end, edge-to-edge in line or separated by less than 3": 1/16" (shop or field joints). This limiting condition shall prevail under both load and no load conditions.

3.3 ADJUSTING AND CLEANING

A. Immediately clean exposed surfaces of the louvers to remove fingerprints and dirt accumulation during the installation process. Do not let soiling remain until the final cleaning.
B. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to the material finishes. Thoroughly rinse surfaces and dry.
C. Restore louvers and accessory components damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by the Architect, remove damaged materials and replace with new materials.

1. Touch up minor abrasions in finishes with a compatible air-dried coating that matches the color and gloss of the factory applied coating.

END OF SECTION

DIVISION 11
EQUIPMENT

SECTION 11 66 00 – ATHLETIC EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following basketball equipment:
   1. Portable basketball backstops.
   2. Protective Floor Cover/Storage Rack.
   3. Wall-mounted safety pads.
   4. Volleyball Standards.
   5. Divider Curtain.

B. Related Sections include the following:
   1. Construction Waste Management and Disposal- Section 01 7419
   2. Division 5 Section "Structural Steel" for structural supports not provided by basketball equipment manufacturer for supporting basketball equipment to building structure.
   3. Division 9 Section “Athletic Wood Flooring” regarding location of blocking under portable backstops.
   4. Division 26 Sections for electrical service and connections for shot clocks, scoreboards, controls, and other powered devices.

1.2 DEFINITIONS

A. NCAA: National Collegiate Athletic Association.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, features, and finishes. Include details of anchors, hardware, and fastenings. If applicable, include assembly, disassembly, and storage instructions.
   1. Basketball Equipment Operators: Include operating instructions.
   2. Motors: Show nameplate data, ratings, characteristics, and mounting arrangements.

B. Shop Drawings: Show location and extent of fully assembled basketball equipment. Show location and extent of disassembled equipment and components and transport and storage accessories. Include elevations, sections, and details not shown in Product Data. Show method of field assembly, connections, installation details, mountings, floor inserts, attachments to other Work, operational clearances, and relationship to adjoining work.
   1. Blocking and Reinforcement: Show locations of blocking and reinforcement required for support of basketball equipment.
   2. Basketball Equipment Operators: Show locations and details for installing operator components, switches, and controls. Indicate motor size, electrical characteristics, drive arrangement, mounting, and grounding provisions.
   3. Wiring Diagrams: Power, signal, and control wiring.

C. Coordination Drawings: Court layout plans and elevations drawn to scale and coordinating game lines and markers applied to finished flooring.

D. Samples for Verification: For the following products:
   1. Pad Fabric: Not less than 3 inches square, with specified treatments applied. Mark face of material.

E. Product Certificates: For each type of basketball equipment, signed by product manufacturer.

F. Submit certification that wall pad foam complies with Building Code requirement for maximum heat release, when tested in accordance with UL Test Standard 1975.

G. Manufacturer Certificates: Signed by manufacturers certifying that they comply with requirements. Include evidence of manufacturing experience.

H. Qualification Data: For installer.

I. Maintenance Data: For basketball equipment and basketball equipment operator to include in maintenance manuals.

J. Warranty certifications.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of basketball equipment through one source from a single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Standards: Provide basketball equipment complying with or exceeding requirements of NCAA.

1.5 PROJECT CONDITIONS

A. Environmental Limitations: Do not install basketball equipment until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

B. Field Measurements: Verify position and elevation of floor inserts and layout for basketball equipment. Verify dimensions by field measurements.

1.6 COORDINATION

A. Coordinate installation of floor inserts with structural floors and finish flooring installation and with court layout and game lines and markers on finish flooring.

B. Coordinate layout and installation of overhead-supported equipment and suspension system components with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Basketball Equipment: Portable Goals. (Arena = 3)
      a. Spalding: Model# 401-990 with jack lift system.
         1) NCAA approved backboard and rim.
      b. Porter: Model# 1835108
         1) NCAA approved backboard and rim.
   2. Basketball Equipment: Portable Goals: (Practice = 2)
      a. Spalding Model# 401971.
         1) NCAA approved backboard and rim.
      b. Porter: Model# 735050.
         1) NCAA approved backboard and rim.

3. Protective Floor Cover

    a. Covermaster.
    b. M Putterman
    c. Cover Sports USA

4. Wall-Mounted Safety Pads: Color and Graphics as determined by Architect.

    a. Sportsgraphics, Inc.
    b. Draper Shade & Screen Co., Inc.
    c. Jaypro Sports, Inc.
    d. Porter Athletic Equipment Co.

5. Volleyball Standards: Complete with floor anchors and Scorer's platform.

    a. Porter Athletic Equipment Co.- 01999-000 Composite Powr-Line Volleyball Standards.
    b. Comparable Products by other manufacturers.

6. Divider Curtains:

    a. Draper
    b. Spalding
    c. Covermaster

2.2 MATERIALS, GENERAL

A. Portable Basketball Backstop

1. Portable Basketball Backstop-Complete system meeting NCAA requirements, including regulation glass backboard, rim, backboard and frame padding. (Comparable to Spalding – Model # 401-990.)

B. Protective Floor Cover System / Storage Rack

1. Flooring Covering: basis of design is Covermaster model no. Ultima 5000

    a. Supplier shall provide adequate coverage of the entire athletic wood flooring in the Practice
    b. Court ensuring proper material overlaps
    c. PVC Coated polyester on both sides.
    d. Total cover weight to be between 27 oz. and 32 oz. per square yard.
    e. Provide a minimum ten (10) year manufacturers warranty
    f. Material to be provided in ten (10) feet wide sections
    g. All seems to be thermally welded with a minimum 1" lap weld.
    h. Provide fire resistance testing results indicating compliance with one of the following standards;
    i. Underwriter Laboratory test UL-214; NFPA 701; Fed Std 191 method #5903.

2. Storage Rack

    a. The storage rack shall provide an appropriate level of storage (number of rolls) to accommodate the required area of floor covering for the Practice Court.
    b. Non-marking casters shall have ball bearing swivel base, lubrication fittings and foot brakes.
    c. Brackets shall be adjustable rubber mounted and fitted with roller bearings that allow rollers to rotate. Locking safety clips shall be provided.
    d. Rollers shall easily rotate in the bearing housing supports allowing individual rollers to remain on the rack during installation and removal of the protective cover.
    e. Two (2) hand cranks shall be provided for loading of the cover onto the rollers.
    f. Provide a minimum ten (10) year warranty.

3. Practice Court Wall Padding

a. Safety pads shall have foam filler that produces a maximum heat release rate of 100kW when tested in accordance with UL Test Standard 1975.
b. Pad Covers: Provide safety pad fabric covers fabricated from puncture- and tear-resistant, not less than 14-oz. PVC-coated polyester or nylon-reinforced PVC fabric treated with fungicide for mildew resistance, with the fire-test-response characteristics indicated.

1) Flame-Resistance Ratings: Passes NFPA 701 Standard Methods of Fire Tests for Flame Propagation of Textiles and Films.

c. Wall Safety Pads: Padded wall wainscot panels designed to be attached in a continuous row; each panel section consisting of fill laminated to backer board with visible surfaces fully covered by seamless fabric cover, free from sag and wrinkles and firmly attached to back of backer board.

1) Backer Board: Not less than 7/16-inch- thick plywood or composite panel.

a) Where wall pads span between supports, the thickness of the backer board shall be increased as necessary to withstand the same impact that the pad material is capable of withstanding, but not less than 3/4-inch thick.

b) Finished face of wall-mounted pads and pads across window openings shall be flush.

2) Fill: Multiple-impact-resistant foam not less than 2-1/2 inch thick polyethylene, 3.5 pounds per cubic foot density.
3) Indentation Force Deflection value: not less than 90 pounds or more than 100 pounds, per ASTM D5672-95.
4) Size: Each panel section, as indicated on Drawings.
5) Number of Panel Sections: As indicated on Drawings.
6) Installation Method: Concealed mounting Z-clips at the top, bottom, and intermediate supports where indicated at windows.
7) Fabric Cover Color: Color / Graphics as selected by Architect.
8) Where pads are visible through windows, wrap back of wall pads with pad fabric so that all visible surfaces are fabric-covered.
9) Padding to be manufactured to accommodate openings required for electrical outlets.

d. Corner Wall Safety Pads shall be constructed of the same materials as the wall pads. Fabric shall wrap around the corner and cover all exposed sides and edges.

C. Divider Curtain: Specification is based on proprietary information provided by Draper, Inc. Other manufacturers should submit comparable products.

1. Electrically operated, top-roll gymnasium divider including motor, controls, clamps for attachment to building structure, threaded rod supports, and other components required for complete functional installation; top-Roll Gym Divider as manufactured by Draper, Inc.
2. Operation: Curtain moves by rolling directly onto drive tube without the use of belts or cables.
3. Configuration: Rectangular shape with straight bottom and extending across room as indicated on Drawings.

a. Maximum dimension of stored divider: from bottom or structural support to bottom of rolled curtain: 6 inches.
b. Minimum required clearance between vertical curtain edges and adjacent fixed objects: 6 inches.

c. Provide at least 36 inches space between curtain ends and walls or fixed objects to allow passage space around divider.

4. Operating mechanism: Drive pipe winch powered with 1 HP, 110VAC, 60-cycle, single phase, reversible capacitor, C-Face motor with thermal overload protection. Entire winch assembly to be UL listed and shall carry a five-year warranty. Provide with load holding worm gear reduction and integral limit switches to control curtain travel. Drive pipe shall rotate in pipe support assemblies spaced at approximately 10 feet.
5. Attachment: Attach to structural support with beam clamps, hanger brackets, and ½ inch diameter threaded rods. Attachment clamps designed to be capable of supporting a minimum of 5,000 lbs. Each and provided in sufficient number to provide a combined minimum 45:1 attachment point safety factor.
6. Drive pipe: 5 inch diameter steel pipe. Drive pipe shall roll in precision laser cut and formed support assemblies. Assemblies spaced at a maximum of 10 feet on center.
7. Divider bottom: 1-5/8 inches diameter steel pipe batten in 6 inches wide curtain pocket.
8. Curtain Fabric:

   a. Bottom 8 feet of curtain to be solid vinyl coated polyester.

      1) Weight 22 ounces.
      2) Resistant to rot, mildew, and ultraviolet light.
      3) Flammability; Rated self extinguishing in accordance with California State Fire Code F-31.5 and F-140.
      4) Color to be selected by Architect.

   b. Top portion of curtain to be to be vinyl coated polyester mesh.

      1) Weight: 9 ounces.
      2) Resistant to rot, mildew, and ultraviolet light.
      3) Flammability: Rated self-extinguishing in accordance with California State Fire Code F-230.
      4) Color to be selected by Architect.

   c. VOC Emission; Divider Curtain Vinyl and Mesh to be low emitting and certified to meet all of the requirements of the GREENGUARD Children and Schools and GREENGUARD certification program. GREENGUARD Children and Schools requires emissions of total volatile compounds 0.22 mg/m cubed, formaldehyde 0.0135 ppm, total aldehydes 0.043 ppm, individual volatile organic compounds 1/1000 TLV and ½ chronic REL and total phthalates 0.01 mg/m cubed. Vinyl and mesh must be evaluated to indoor air quality evaluation (IAQ) using a GREENGUARD product evaluation protocol following the requirements of the GREENGUARD Environmental Institutes (GEI) Product Certification Program.
   d. ASTM Stanard D5116 and the US Environmental Protection Agency and modeled based on GEI requirements for a standard gymnasium loading and modeled based on GEI requirements for a standard gymnasium loading and ASHRAE 62.1-2004 ventilation conditions. Manufacturer to provide certificate and or test results upon requests.
   e. Top Edge: Solid fabric , cut square for attachment to roller tube and of sufficient length to allow at least two complete wraps on roller tube at all times.
   f. Bottom edge : Pocket to house bottom pipe batten.
9. Curtain Safety Device:

   a. Provide Draper Model 504301 Curtain Lok safety device. Curtain Lok to be directly speed sensitive to automatically lock divider curtain in position at any time during storage or operation. In the event of an over-speed situation (greater than 1.5 feet per second)caused by malfunction of the hoisting apparatus, whether sudden or gradual, device will immediately activate. Curtain Lok work regardless of direction of rotation and automatically resets when load is reversed or removed.

10. Controls: Provide key lock, 3-position, momentary contact wall control switch to lower, raise, and stop gymnasium divider. Provide with switch box and plastic cover plate. 11. Coordinate electrical requirements.

2.3 COMPETITION RULES

A. General: Provide equipment and installation that complies with requirements in the "NCAA Basketball Rule Book."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for play court layout, alignment of mounting substrates, installation tolerances, operational clearances, accurate locations of connections to building electrical system, and other conditions affecting performance.
   1. Verify critical dimensions.
   2. Examine wall assemblies, where reinforced to receive anchors and fasteners, to verify that locations of concealed reinforcements have been clearly marked for installers. Locate reinforcements and mark locations if not already done.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. General: Comply with manufacturer's written installation instructions and competition rules indicated for each type of basketball equipment. Complete equipment field assembly, where required.

B. Unless otherwise indicated, install basketball equipment after other finishing operations, including painting, have been completed.

C. Permanently Placed Basketball Equipment and Components: Rigid, level, plumb, square, and true; anchored securely to supporting structure; positioned at locations and elevations indicated on Shop Drawings; in proper relation to adjacent construction; and aligned with court layout.
   1. Floor Insert Location: Coordinate location with application of game lines and markers.
   2. Floor Insert Elevation: Coordinate installed heights of floor insert with installation and field finishing of finish flooring and type of floor plate.
   3. Operating Basketball Equipment: Verify clearances for movable components of basketball equipment throughout entire range of operation and for access to operating components.

D. Anchoring to In-Place Construction: Use anchors and fasteners where necessary for securing built-in and permanently placed basketball equipment to structural support and for properly transferring load to in-place construction.

E. Wall Safety Pads: Mount with bottom edge at dimension indicated on Drawings above finished floor.

F. Connections: Connect automatic operators to building electrical system.

G. Portable Basketball Equipment and Components: Assemble in place to verify that equipment and components are complete and in proper working order. Instruct Owner's designated personnel in properly handling, assembling, adjusting, disassembling, transporting, storing, and maintaining units. Disassemble portable basketball equipment after assembled configuration has been approved by Architect, and store units in location indicated on Drawings.

H. Blocking support: Provide additional blocking support within wood flooring system at final locations of all portable goal base supports in the upright position. Re: plans for locations.

3.3 ADJUSTING

A. Adjust movable components of basketball equipment to operate safely, smoothly, easily, and quietly, free from binding, warp, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Lubricate hardware and moving parts.

3.4 CLEANING AND PROTECTION

A. After completing basketball equipment installation, inspect components. Remove spots, dirt, and debris and touch up damaged shop-applied finishes according to manufacturer's written instructions.

B. Provide final protection and maintain conditions acceptable to manufacturer and Installer that ensure basketball equipment is without damage or deterioration at time of Substantial Completion.

C. Replace basketball equipment and finishes that cannot be cleaned and repaired, in a manner approved by Architect, before time of Substantial Completion.

END OF SECTION

DIVISION 12
FURNISHINGS

SECTION 12 24 16 - ROLLER SHADES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes motorized (MS-2) and manually operated (MS-1) roller shades and operators.
B. Shade Fabric.
C. Work furnished, but installed in other Sections:

1. Metal shade pockets or housings recessed into ceiling systems, and extruded aluminum ceiling pocket trim (closure) assemblies.
2. Electrical control components including switches and relays necessary for control characteristics specified.

D. Related requirements: Division 26 for electrical service and connections for motor operators, controls, limit switches, and other powered devices and for system disconnect switches for motorized shade operation.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Where motorized shades are to be controlled by control systems provided under other sections, coordinate the work with other trades to provide compatible products.
2. Coordinate the work with other trades to provide rough-in of electrical wiring as required for installation of hardwired motorized shades.

B. Preinstallation Meeting: One week prior to commencing work related to this section. Require attendance of all affected installers.
C. Sequencing:

1. Do not fabricate shades until field dimensions for each opening have been taken with finished conditions in place. "Hold to" dimensions are not acceptable.
2. Do not install shades until final surface finishes and painting are complete.

1.3 SUBMITTALS

A. Data: Manufacturer Product Data for each type of product indicated. Include styles, material descriptions, construction details, dimensions of individual components and profiles, features, finishes, and operating instructions.

1. Motorized shade operators: Include operating instructions.
2. Motors: Show nameplate data, ratings, characteristics, and mounting arrangements.

B. Shop drawings: Large scale, dimensioned drawings showing location and extent of roller shades, including the following:

1. Elevations, sections, details, and dimensions not shown in Product Data. Show locations and size of backing required for installation of shades.
2. Installation details, mountings, attachments to other work, operational clearances, and relationship to adjoining work.
3. Head, jamb and sill details as necessary to coordinate work with surrounding conditions and construction.
4. Shade schedule coordinating room number, window type, opening size(s), quantities and key to details.

5. Locations and details for backing, installing operator components, switches, and controls. Indicate motor sizes, electrical characteristics, drive arrangement, mounting, and grounding provisions.
6. Complete wiring diagrams including connection details for components furnished under this Section.
7. Provide location plan showing all switch and control zones as per the performance requirements of the specifications. All switches, sensors and other control accessories must clearly be shown and called out in a bill of materials.
8. Provide location plan showing all manual shade control locations. Cross-reference furniture plans for optimal positioning of chains.
9. Provide elevation drawings showing shade band layout. Indicate any necessary seam or batten locations.

C. Coordination drawings: Show the following.

1. Overall arrangement of shades and control locations.
2. Shade mounting assembly and attachment.
3. Size and location of access to shade operator, motor, and adjustable components.

D. Selection Samples:

1. 3-inch by 5-inch shade cloth fabric swatches for initial fabric color selection from manufacturer's full range of available fabrics.
2. Standard aluminum finish color Samples from manufacturer's range of standard colors.

E. Verification Samples:

1. One fully operational window shade assembly of each type required, 30-inch square complete with selected shade cloth including sample of seam/batten when applicable. Disassemble sample to demonstrate compliance with the requirements of this Section.
2. One complete set of all shade components, unassembled, demonstrating compliance with the specified requirements.

F. Design Data, Test Reports, and Certificates: Current reports from independent testing laboratories demonstrating specified requirements.
G. Manufacturers' instructions: Manufacturer standard installation instructions.
H. Window treatment schedule: Include roller shades in schedule using same room designations indicated on Drawings.
I. Qualification data: For Installer.
J. Maintenance data: Furnish maintenance manuals with the following information:

1. Methods for maintaining roller shades and finishes.
2. Precautions about cleaning materials and methods that could be detrimental to fabrics, finishes, and performance.
3. Operating hardware.
4. Motorized shade operator.

1.4 QUALITY ASSURANCE

A. Manufacturer qualifications: Firm with minimum 5 years' experience manufacturing products comparable to those specified.
B. Installer qualifications: Firm with minimum 5 years' experience, having completed installation of roller shades similar in material, design, and extent to that indicated for the Project and whose work has resulted in a record of successful in-service performance.
C. Source limitations and material standards: Obtain roller shades through one source from a single manufacturer and provide products with the following characteristics.

1. Shade band materials with flame-resistance ratings that pass NFPA 701, as determined by testing identical products by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.

2. Shade fabrics tested in accordance with University of Pittsburgh Toxicity Protocol including LC50 analysis and toxicity characteristics.
3. Shade cloth shall be 100 percentage polyester core yarn. Fiberglass content in shade cloth is unacceptable.
4. ASTM G 22 results for ATCC6538 (Staphylococcus aureus) and ATCC13388 (Pseudomonas aeruginosa) indicating minimum 5mm 'No Growth Contact Area'.
5. ASTM G 285 results for ATCC9642, ATCC9644, ATCC9348 and ATCC9645 indicating "No Growth."
6. Electrical components, devices, and accessories as a system: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Mockup: Build a full size motorized shade mockup to verify selections made under sample submittals and to demonstrate aesthetic effects and qualities of materials and execution.

1. Build mockup in the location and of the size indicated or, if not indicated, as directed by the Architect.
2. Approved mockup may become part of the completed Work if undisturbed at time of Substantial Completion.

E. Fire-Test-Response Characteristics: Passes NFPA 701 small and large-scale vertical burn. Materials tested shall be identical to products proposed for use.

F. ShadeCloth Anti-Microbial Characteristics: 'No Growth' per ASTM G 21 results for fungi ATCC9642, ATCC9644 and ATCC9645, and E2180.

1.5 HANDLING

A. Storage and protection:

1. Do not deliver items to the Project until all wet work has been completed and is dry.
2. Deliver shades to Project site in labeled protective packaging, uniquely labeled to identify each shade for each opening, using same room designations indicated and scheduled.
3. Schedule delivery to prevent delays to completion of work but to minimize on site storage time.
4. Store materials in a dry secure place. Protect from weather, surface contaminants, corrosion, construction traffic and all other potential damage.

1.6 PROJECT CONDITIONS

A. Environmental limitations: Do not install roller shades until construction and wet and dirty finish work in spaces, including painting, is complete and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

B. Field measurements:

1. Where roller shades are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings.
2. Allow clearances for operable glazed units' operation hardware throughout the entire operating range. Notify Architect of discrepancies.

1.7 MAINTENANCE

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

B. Before installation begins, deliver full-size units equal to 5 percent of quantity installed for each size, color, texture, and pattern indicated.

1.8 WARRANTIES

A. Roller Shade Hardware and Chain Warranty: Manufacturer's standard non-depreciating warranty for interior shading.

1. Shade Hardware:

a. Mecho/5 with ThermoVeil, EuroVeil, EuroTwill, Soho, Equinox, Midnite, Chelsea, or Classic Blackout shade fabric: 25-years.

2. Standard Shadecloth: Manufacturer's standard 25-year warranty.
3. Roller Shade Installation: One year from date of Substantial Completion, not including scaffolding, lifts or other means to reach inaccessible areas, which are deemed owners responsibility.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. MechoShade Systems, Inc.; as represented by ARCHITYPE, Tel: (213) 631-5001. Fax: (213) 884-4790, Contact: Jean-Guy Poitras. Email: jean-guy.poitras@mechoshade.com ; jeanguy@architype.net.
B. Draper Shade & Screen Co., Inc.
C. Hunter Douglas Window Fashions.
D. Levolor Contract; a Newell Company.
E. Or equal.

2.2 APPLICTION/SCOPE

A. Roller Shade Schedule:

1. Manual operating, chain drive, Urban sunscreen roller shades and related mounting systems and accessories as indicated on drawings.

a. Shade pockets.
b. Fascias.

2. Motorized interior sunscreen roller shades in all exterior / interior windows of rooms and spaces as shown on referenced Drawings, and related EDU control requirements systems. Include the following as scheduled and as indicated on the Drawings:

a. Shade pockets.
b. Fascias.

3. Motorized operating, chain drive, Urban room darkening opaque roller shades and related mounting systems and accessories on all door windows as indicated on drawings.

2.3 ROLLER SHADES, MANUAL OPERATION AND ACCESSORIES

A. Shade System; General:

1. Components capable of being removed or adjusted without removing mounted shade brackets, or cassette support channel.
2. Smoothly operation raising or lowering shades.

B. Basis of Design: See Interior Finish Materials Schedule on Drawings. Fabric window shade system complete with mounting brackets, roller tubes, hembars, hardware, and accessories.

1. Shade Type: Single Roller. Manual.
2. Shade Type: Double Roller. Manual.
3. Drop Position: Regular. Fabric falls off roller tube, close to glass
4. Mounting: As indicated on drawings.
5. Size: As indicated on drawings.

6. Fabric: As indicated under Shade Fabric article and Window Treatment Schedule.
7. Brackets and Mounting Hardware: Stamped steel. As recommended by manufacturer for mounting indicated accommodating shade fabric roll-up size and weight.
    a. Double Roller Brackets: Configured for light-filtering and room-darkening shades in one opening.
        1) Light-Filtering Fabric: Room-side of opening.
        2) Room-Darkening Fabric: Glass-side of opening.
8. Roller Tubes: Extruded aluminum. Capable of being removed and reinstalled without affecting roller shade limit adjustments.
    a. Size: As recommended by manufacturer; for installation conditions, span, and weight of shades.
    b. Fabric Attachment: Extruded channel in tube accepts vinyl spline welded to fabric edge.
        1) Shade Band: Removable and replaceable without removing roller tube from brackets or inserting spline from the side of the roller tube.
9. Hembars: Maintains bottom of shade straight and flat.
    a. Style: Full wrap fabric covered bottom bar, flat profile with heat sealed closed ends.
10. Manual Operation:
    a. Clutch Operator: Manufacturer's standard material and design integrated with bracket/brake assembly.
        1) Brake Assembly: Mounted on a low-friction plastic hub with wrapped spring clutch.
            a) Brake must withstand minimum pull force of 25 lbs (12 kg) in stopped position.
        2) Clutch/Brake Mounting: On support brackets, independent of roller tube components.
    b. Drive Chain: Continuous loop beaded ball chain. Upper and lower limit stops.
        1) Breaking Force: 95 pound (43 kg) minimum.
        2) Chain Retainer: Chain tensioning device complying with WCMA A100.1.
    c. Lift Assist Mechanism: Provide manufacturer's standard device, contained in the idler end of roller tube, when hanging weights exceed roller tube weight limits.
11. Accessories:
    a. Fascia: Removable extruded aluminum. Size as required to conceal shade mounting. Attachable to brackets without exposed fasteners.
        1) Profile: Square.
        2) Configuration: Captured and continuous, as indicated on drawings.
    b. Ceiling Pockets: Pre-manufactured metal shade pocket with removable closure panel, for recess mounting in acoustical tile or drywall ceilings; size and configuration as indicated on drawings.

2.4 ROLLER SHADE FABRICATION

A. Field measure finished openings prior to ordering or fabrication.
B. Dimensional Tolerances: Fabricate shades to fit openings within specified tolerances.

1. Vertical Dimensions: Fill openings from head to sill with 1/2 inch space between bottom bar and window stool.
2. Horizontal Dimensions: Inside Mounting.
    a. Fill openings from jamb to jamb.
3. Horizontal Dimensions: Outside mounting.
    a. Cover window frames, trim, and casings completely.

C. Openings Requiring Continuous Multiple Shade Units with Separate Rollers: Locate roller joints at window mullion centers; butt rollers end-to-end.

2.5 SHADE FABRIC

A. See Drawings.

2.6 SHADE MOTORS AND MOTOR CONTROL SYSTEMS (IQ/MLC SYSTEM)

A. Motors:

1. Tubular, asynchronous motors with built-in reversible capacitor operating at 110V AC (60hz), single phase, temperature Class A, thermally-protected, totally enclosed, maintenance free with line voltage power supply equipped with locking disconnect plug assembly furnished with each motor.
2. Conceal shade motors inside shade roller tube.
3. Each shade motor shall draw a maximum current of 2.3 amps.
4. Use motors rated at the same nominal speed for all shades in the same room.

B. Hanging weight: Total hanging weight of shade band shall not exceed 80 percentage of the rated lifting capacity of the shade motor and tube assembly.

C. Wall switches:

1. Three-button flush-mounted switches with metal cover plates and no exposed fasteners.
2. Connect local wall switches to control system components via low voltage (12V DC) 4 conductor modular cable equipped with RJ-11 type connectors specified in Division 16.
3. Connect master wall switches to control system components via low voltage (12V DC) 6-conductor modular cable equipped with RJ-12 type connectors specified in Division 26.

D. Motor control system:

1. Provide power to each shade motor via individual 3 conductor line voltage circuits connecting each motor to the relay-based controllers (IQ/MLC).
2. For control system components provide appropriate (spike and brown out) over-current protection (plus or minus 10 percent of line voltage) for each of the 4 individual motor circuits and shall be rated by UL or ETL as a component of this system.
3. Motor control system allows each group of 4 shade motors to be controlled by each of 4 local switch ports, with up to 14 possible “sub-group” combinations via local 3 button wall switches and all at once via a master 3-button switch. System shall allow for overlapping switch combinations from 2 or more switches.
4. Multiple “sub-groups” from different IQ/MLC control components may be combined to form “groups” operated by a single 3-button wall switch.
5. Each shade motor shall be accessible (for control purposes) from up to four local switches and one master switch.
6. Control system shall allow for automatic alignment of shade hembars at 25 percent, 50 percent and 75 percent of opening heights, or up to 3 user defined intermediate stopping positions in addition to all up/all down positions regardless of shade height. Control system shall allow shades to be stopped at any point in the opening height.
7. Control system shall have 2 standard operating modes: “Normal Mode” allowing the shades to be stopped anywhere in the opening height and “Uniform Mode” allowing the

shades to only be stopped at the predefined intermediate stop positions. Both modes shall allow for all up/all down positioning.

8. Control system components shall allow for interface with low voltage Audio Visual system components via a dry contact terminal block.
9. Control system components shall allow for interface with external analog input control devices such as solar activated controllers, wind activated controllers, 24-hour timers, etc. via a dry contact terminal block.
10. Reconfiguration of switchable groups, as specified above, shall not require rewiring of the hardwired line voltage motor power supply wiring or the low voltage control wiring.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions for installation tolerances, operational clearances, accurate locations of connections to building electrical system, and other conditions affecting performance.
B. Correct detrimental conditions before proceeding with installation.

3.2 SHADE INSTALLATION

A. Install shades level, plumb, square, and true per manufacturer's instructions and approved shop drawings. Locate so shade band is at least 2 inches from interior face of glass. Allow proper clearances for window operation hardware. Use mounting devices as indicated.
B. Replace shades exceeding specified tolerances at no extra cost to Owner.
C. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range. Adjust level, projection, and shade centering from mounting bracket. Verify there is no telescoping of shade fabric.
D. Clean roller shade surfaces after installation, per manufacturer's written instructions.
E. Demonstrate operation and maintenance of window shade system to Owner's personnel.
F. Manufacturer's authorized personnel are to train Owner's personnel on operation and maintenance of system.

1. Use operation and maintenance manual as a reference, supplemented with additional training materials as required.

G. Install units within the following tolerances:

1. Maximum variation of gap at window opening perimeter: 1/4-inch, per 8 feet (plus or minus 1/8-inch) of shade height.
2. Maximum offset from level: 1/16-inch per 5 feet of shade width.

H. Allow clearances for window operation hardware.
I. Connect motorized operators to building electrical system.

3.3 ADJUSTING

A. Adjust and balance shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

3.4 SYSTEM STARTUP

A. Motorized Shade System: Provide services of a manufacturer's authorized representative to perform system startup.
B. Turn-Key Single-Source Responsibility for Motorized Interior Roller Shades: Design, engineering, and installation of motorized roller shade systems, motors, controls, and low voltage electrical control wiring specified is to be performed by a single manufacturer and their authorized installer/dealer.

1. The Architect will not provide a set of electrical drawings for installation of control wiring for motors, or motor controllers of motorized roller shades.
2. Power wiring (line voltage), to be provided by roller shade installer/dealer, per requirements provided by manufacturer. Coordinate following with roller shade installer/dealer:
3. Contractor To Provide the Following:

    a. Power Panels and Circuits: Size to accommodate roller shade manufacturer's requirements, as indicated on mechanical and electrical drawings.
    b. Coordinate with requirements of roller shade installer/dealer, before inaccessible areas are constructed.
    c. Line voltage as dedicated home runs, of sufficient quantity, and capacity as required. Terminate in junction boxes at locations designated by roller shade installer/dealer.
    d. Run line voltage from terminating points to motor controllers. Wire roller shade motors to motor controllers. Run low voltage control wiring from motor controllers to switch/control locations designated by Architect.

        1) Above-ceiling and concealed wiring to be plenum-rated, or in conduit, as required by the electrical code having jurisdiction.
        2) Use conduit with pull wire in areas, not accessible to roller shade contractor due to building design, equipment location or schedule.

3.5 FIELD QUALITY CONTROL

A. Upon completion of installation, conduct tests to ensure the proper operation of the shades.
B. Adjust and lubricate as required for safe and efficient operation.
C. Review the maintenance data specified in PART 1 above with the Owner's representative.
D. Restore marred or abraded surfaces to original condition using same primer used for shop painting.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain the assemblies. CLEANING AND PROTECTING
B. Clean shade surfaces after installation in compliance with their manufacturer's instructions.
C. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and installer that ensure that shades are without damage or deterioration at Substantial Completion.
D. Replace damaged shades that cannot be repaired, in a manner approved by Architect, before Substantial Completion.

END OF SECTION

SECTION 12 36 61 - QUARTZ SURFACING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes quartz surfacing for countertops, and backsplashes. (SLS-1)
B. Related requirements:

1. Division 07 for perimeter sealant to adjacent construction.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Scheduling and sequencing:
B. Preinstallation meeting:

1.3 REFERENCES

A. Architectural Woodwork Institute “North American Architectural Woodwork Standard Section 11, “Premium Grade.”

1.4 SUBMITTALS

A. Data: Manufacturer Product Data, sample warranty form, fabrication and installation instructions.
B. Shop Drawings:

1. Indicate materials, show fabrication details, field jointing, adjacent construction and methods of support and anchorages, and integration of plumbing components.
2. Dimension position of openings required, with rough-in sizes. Provide templates for cast-in or placed frames or anchors; tolerances for item placement and temporary bracing of components.

C. Samples:

1. Three-inch square samples representative of color, texture and finish to be expected for final product. Finish all exposed edges same as for exposed face.
2. Variation in distribution of aggregates in quartz surfacing in stock that will be used for the Project must be approved by the Architect prior to fabrication.

D. Manufacturer's certificate: Certification that product meets or exceeds specified requirements for stain resistance.
E. Fabricator qualifications: Evidence of fabricator qualifications.
F. Closeout:

1. List of approved cleaning materials and procedure required and provide list of substances that are harmful to product.
2. Include instructions for stain removal, surface and gloss restoration and scratch removal.

1.5 QUALITY ASSURANCE

A. Regulatory requirements: Conform to Code for flame/smoke rating in accordance with ASTM E 84.
B. Fabricator qualifications: Firm specializing in fabrication of products specified with minimum 3 years documented successful experience.
C. Color match: Materials for the Project shall be from the same batch and shall bear labels with same batch number. Visually inspect materials to be used for adjacent pieces to assure acceptable color match. Inspect in lighting conditions similar to those on Project.

1.6 HANDLING

A. Packaging, shipping, handling, and unloading:

1. Observe manufacturer's recommendations and handle in manner to prevent breakage or damage.
2. Brace parts if necessary.
3. Transport in the near-vertical position with finished face to finished face.
4. Do not allow finished surfaces to rub during shipping or handling.

B. Storage and protection:

1. Store in racks in near-vertical position. Prevent warpage and breakage.
2. Store inside away from direct exposure to sun between 25- and 130-degree F.
3. Store with finished face toward finished face.

1.7 WARRANTY

A. Ten-year warranty against cracking, softening and discoloration of the countertops.

PART 2 - PRODUCTS

2.1 MANUFACTURERS/MATERIALS

A. Quartz surfacing:

1. US Quartz Products Inc. "CaesarStone Quartz Surfacing" (basis of design).
2. DuPont "Zodiac Quartz Surfacing."
3. Consentino "Silestone."
4. Samsung "Staron."

2.2 PERFORMANCE REQUIREMENTS:

A. Performance:

1. Flexural strength: 7,420 psi, ASTM C880.
2. Compressive strength: ASTM C-170.

a. Dry: 10,430 psi average.
b. Wet: 11,265 psi average.

3. Izod impact strength: 0.361-foot lbs./inch of notch average; ASTM D256.

4. Bond Strength: 205 psi; ASTM C482 modified.
5. Modulus of rupture: 2,110 average, ASTM C99.
6. Mohs hardness: 6.5-7.5; scratch test.
7. Absorption: 0.022 percent; ASTM C97.
8. Stain and Acid Resistance: Not affected; ASTM D2299.
9. Surface burning characteristics:

    a. Flame spread: 10.
    b. Smoke density: 195; ASTM E84.

10. Wear resistance: 36.12 gram average; ASTM C501, tested with 1 kg. load, 1000 cycles at 70 rpm.]

2.3 QUARTZ SURFACING

A. Composition: 93 percent crushed quartz aggregate combined with resins and pigments and fabricated into slabs using a vacuum vibro-compaction process.
B. Identification: Material shall be labeled with batch number and imprinted on back with manufacturer's identifying mark.
C. Color and finish: As selected by the Architect from manufacturer's palette.

2.4 MISCELLANEOUS MATERIALS

A. Adhesive: Type recommended by the quartz surfacing manufacturer.
B. Sealant: As specified in Section 07 92 00.
C. Cleaning agents: Non-abrasive, soft-scrub type kitchen cleansers.

2.5 FABRICATION

A. Color match materials throughout Project shall be from the same batch with labels with same batch number. Visually inspect materials to be used for adjacent pieces to assure acceptable color match. Inspect under lighting conditions similar to those on Project.
B. Fabricate countertops to profiles and dimensions shown in compliance with WI Manual of Millwork Section 16, Premium Grade. Minimize joints.

    1. Finish exposed surfaces smooth and polish to a low sheen.
    2. Radius corners and edges unless otherwise indicated.

C. Cut and drill sinkages and holes for anchors, supports, and attachments.
D. Provide openings, reveals, and similar features as needed to accommodate adjacent work.
E. Fabricate edges with edge profile to produce uniform shape throughout entire length of edge and with precisely formed arris slightly eased to prevent snipping, and matched at joints between units. Form corners slightly eased, unless otherwise indicated. Miter and glue corners to a hairline using adhesive colored to match stone.
F. Finish exposed faces to match approved Samples. Provide matching finish on the exposed edges of countertops.
G. Fabricate tops without joints, except that where length of exceeds available slab length, locate joints where indicated. Make joints hairline and flush.
H. Fabricate thresholds with a uniform honed (400 to 1,200 grit abrasive) finish on exposed surfaces for a tight fit against door jambs and a smooth transition between tile and adjoining floor surface. Bevel edges at 1:2 slope, aligning lower edge of bevel with adjacent floor finish. Limit height of bevel to 1/2-inch or less.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions and measurements affecting the work of this Section at site.
B. Correct detrimental conditions before proceeding with installation.

3.2 INSTALLATION

A. Install countertops in compliance with the approved shop drawings, WI Manual of Millwork for the grade specified, and the quartz surfacing manufacturer's instructions, plumb, level, with tight, flush joints.
B. Anchor with adhesive securely to supports with a maximum variation from true dimension and position of 1/8-inch.

3.3 CLEANING/PROTECTING

A. Clean and polish in compliance with quartz surfacing manufacturer's instructions.
B. Protect finished work from damage by covering with heavy Kraft paper until final cleaning.

END OF SECTION

SECTION 12 76 50 - TELESCOPIC SEATING

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Manufacture, deliver and install Telescopic Seating Systems in accordance with applicable codes, the following specifications, and approved drawings.

1.2 RELATED WORK BY OTHERS

A. Adequate floor levelness and strength for operation of telescopic seating.
B. Adequate wall strength for attachment and operation of wall attached telescopic seating.
C. Electrical wiring within the building as required for power operated telescopic seating.

1.3 SYSTEM DESCRIPTION

A. Telescopic seating system shall be multiple tiered seating rows comprised of seat and deck components, risers, and supportive understructure.
B. Telescopic seating shall be operable on the telescopic principle, stacking vertically in minimum floor area when not in use.
C. The first moving row, on manual sections, shall be secured with release lever. All other rows shall be mechanically locked, operable only upon unlocking and cycling of first row. Power sections shall be secured with mechanical locks as well as the power system, operable upon activating the pendant control.

1.4 SUBMITTALS

A. Product Data: Manufacturer's specifications and technical data including the following.

1. Detailed specification of construction and fabrication.
2. Manufacturer's installation instructions.
3. Certified test reports indicating compliance with performance requirements specified herein.
4. Description of operations, including step by step set-up and take-down tasks.
5. Complete list of all deviations from specifications. To include any changes in heights or runs as depicted in the Drawings.

B. Shop Drawings: Indicate dimensions, description of materials and finishes, general construction, specific modifications, component connections, anchorage methods, hardware, and installation procedures, plus the following specific requirements.

1. Floor plans of each level indicating seating section numbers, row numbers, seat numbers and seat count.
2. Seat sizes and aisle widths.
3. Railing locations and attachment details.
4. Closure panel locations and details.
5. Anchorage details for retractable sections, horizontal and vertical structure allowing safe lifting and transport of removable sections.
6. Provide storage plan indicating width, depth and height at all seating sections, including all storage carts for platforms and rails.
7. Shop Drawings: Prepared, sealed and signed by a Professional Engineer registered in the State of California.

C. Samples: Submit 2 sets of samples for color selection or verification of the following:

1. Seats and backs, complete with outer shell, padding and upholstery.
2. Color samples for upholstery and plastic outer shells and armrests.

3. Color samples for understructure.
4. Color samples for drapes 6 inch by 6 inch from standard color palette.

D. Mock-up: A working mock-up shall be submitted with the bids if requested by Owner. Mock-up shall be a complete and fully functional manual portable retractable unit not less than 3 tiers high by 8 feet wide and shall include items listed below:

1. Provide a two-chair sample mounted to a deck section complete with fully operable fold down mechanism. One bleacher shall be mounted on first level and second bleacher on second level directly behind first bleacher.
2. Provide a complete understructure assembly, including framing, brace, and finish.
3. Platform decks and aisles including finish and safety strip.
4. Aisle front step.
5. Removable rails and guardrails.
6. End standard with removable or folding arm to comply with ADA requirements.
7. Mock-up shall remain property of bidder.

E. Quality Control Submittals:

1. Test reports.
2. Statement of qualifications.

F. Contract Closeout Submittals: Comply with Section 01 77 00.

1. Project record documents.
2. Operating and maintenance manuals.
    a. Include required lubrication and adjustments, complete parts list, and name of nearest parts supply and service company for retractable platforms.
    b. Setup configuration layout and details to permit verification of correct use are safety design requirements.
3. Seating Manifest: Provide electronic media seating manifest for ticketing by section and seat type.
    a. Manifest shall be provided in media and format compatible with fixed seating manufacturers manifest who shall incorporate the information into a single comprehensive seating manifest. Provide initial manifest, an updated manifest and final manifest.

1.5 QUALITY ASSURANCE

A. Products and materials to be provided are to be from manufacturers regularly engaged full-time in the manufacture or production of this and similar items, with a history of successful manufacture or production acceptable to the Owner. Additional documentation shall include:
B. In addition to complying with pertinent codes and regulations, comply with industry and trade standards normally associated with this product or material, except where product or material is superior in quality to industry trade standards.
C. It will be the responsibility of the bidder or manufacturer of any proposed substitute product to furnish a complete list and clarification of deviations from this specification. Suppliers not complying with this paragraph and Div. 01 requirement for proposed substitutions will be subject to rejection.
D. Installation: Shall be handled directly by the manufacturer or by a factory certified installation subcontractor.
E. Product Liability: Certification of insurance coverage of not less than $5,000,000.
F. Welding Processes: To be performed by certified professional welding operators in accordance with American Welding Society – Certified Welding Fabricator, (AWS-CWF), D1,1 "Structural Welding Code-Steel."

G. Product Improvements: Equipment provided shall incorporate manufacturer's design improvements and materials current at time of shipment, provided that such improvements and materials are consistent with the intent of these specifications.

1.6 DSA APPROVAL

A. Telescopic bleachers specified herein and indicated on the drawings, including detailed plans, specifications and engineering calculations have been accepted and signed by the Architect or Engineer in charge of design and the Architect who has been designated responsible to cover the work shown on a particular plan or specification, and approved by the Division of State Architect. Products of other manufacturers may be submitted for approval as equivalent provided, they meet or exceed the requirements of this specification.
B. Acceptable substitutions shall be submitted to the Division of the State Architect as a Field Change Directive and must be processed on a deferred approval basis. All associated design review engineering and submittal costs shall be borne by the contractor. No time extensions shall be allowed for FCD/Deferred Approval of this item.
C. Submittal shall include complete shop drawings and structural calculations (signed and stamped by the manufacturer's California licensed Structural Engineer in charge of design) for architectural/ engineering review, and processing through DSA.
D. Installation of acceptable substitute telescopic bleachers shall not be started until detailed plans, specifications and engineering calculations have been accepted by the Architect in charge of design and the signature of the Architect who has been designated responsible to cover the work shown on a particular plan or specification and approved by the Division of the State Architect.
E. All costs associated with review and submittal of acceptable substitute products to DSA as an FCD/Deferred Approval item shall be borne by the by the product manufacturer or contractor.

1.7 SUBSTITUTIONS

A. Products of other manufacturer's may be considered equivalent provided they meet or exceed requirements of this specification including retractable/recoverable first row modules for ADA and other event seating in locations shown on the plans, all skirting, closure, and finish panels. Substitutions shall be in accordance with Division 01 of the contract documents. The District or District's representative shall be the sole judge of the equivalency of any proposed substitution. Where manufacturer's offer more than one model, provide the premium model.

1.8 DESIGN CRITERIA

A. Comply with DSA IR 16-5, Deign Fabrication and Inspection of Bleachers, Folding and Telescopic Seating, and Grandstands.
B. Telescopic seating shall be designed to support, in addition to its own weight, and the weight of added accessories, a uniformly distributed live load of not less than 100 lbs. per sq. ft. (4.8 kN per sq. m.) of gross horizontal projection. Seat boards and footrest shall be designed for a live load of not less than 120 lbs. per linear foot (1.751 kN per linear m).
C. Sway force applied to seats shall be 24 lbs. per linear ft. (350 N per linear m.) parallel to the seats and 10 lbs. per linear ft. (146 N per linear m.) perpendicular to the seats. Sway forces shall not be considered simultaneously applied.
D. Railings, posts, and sockets designed to withstand the following forces applied separately.
E. Handrails shall be designed and constructed for:

1. A concentrated load of 200 lbs. (890 N) applied at any point and in any direction.

2. A uniform load of 50 lbs. per ft. (730 N/m) applied in any direction.

    a. The concentrated and uniform loading conditions shall not be required to be applied simultaneously.

F. Guards shall be designed and constructed for:

1. A concentrated load of 200 lbs. (890 N/m) applied at any point and in any direction along the top railing member and a uniform load of 50 lbs. per ft. (730 N/m) applied horizontally at the required guardrail height and simultaneous uniform load of 100 lbs. per ft. (1460 N/m) applied vertically downward at the top of the guardrail. The concentrated and uniform loading conditions shall not be required to be applied simultaneously.

G. American Institute of Steel Construction (AISC), American Iron and Steel Institute (AISI) and Aluminum Association (AA) design criteria shall be the basis for calculation of member sizes and connections.

H. Wood members shall be designed in accordance with National Forest Products Association, (NFOPA), and National Design Specification for Wood Construction.

1.9 WARRANTY

A. The manufacturer shall warrant all work performed under these specifications to be free of defects for a period of one year.

B. All understructure components shall be warranted for a period of ten years.

C. Any materials found to be defective within this period will be replaced at no cost to the owner. This warranty shall not include replacements required by Acts of God, war, vandalism, flood, fire, calamity or deliberate abuse or misuse of the equipment.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Seating shall be VersaTract Telescopic Seating System as manufactured by Irwin Seating Company - Telescopic Division, Altamont, IL 62411 or equal, subject to prior approval and strict compliance with these specifications.

2.2 MATERIALS

A. Seating area as shown on architectural drawings:

1. Sideline seating areas with tapered end sections.
2. End zone seating area with tapered end sections.
3. Corner seating area to include custom design telescopic section with adjacent passthrough tunnel section.
4. Ten seating rows – Nine telescopic with last row mounted to concrete behind.
5. All seating areas to be Recessed.

B. Dimensions:

1. Overall height: 11 feet 4 inches.
2. Open depth: 25 feet 8 5/8 inches.
3. Closed depth: 5 feet 10 5/8 inches.
4. Row Spacing: 34 inches.
5. Rise per row: 16 inches.
6. All seats to have a 19-inch seating area.

2.3 FABRICATION

A. Understructure System:

1. Steel supports and rolling frames shall be constructed from formed steel of the size and shape necessary to support the design loads. All support bracing shall begin at Row 2 and be of diagonal or "knee" type for rigidity. Diagonal bracing to be minimum 1 1/2-inch x 1 1/2-inches 14-gauge square tubing. Bracing fabricated from open-sided channel, angle iron or flat strap "X" type bracing is unacceptable.
2. Wheels shall not be less than 5-inches diameter x 1 3/8-inches non-marring soft rubber face to protect wood or synthetic floor surfaces. Each operating row shall have a minimum of 6 wheels.
3. Each fully skirted wheel channel shall be formed 12-gauge steel and continuously in contact with adjacent channels by means of an Integral Alignment System (IAS) and include nylon glides to eliminate any metal-to-metal contact. The IAS maintains proper alignment between adjacent wheel channels for smooth and consistent operation while eliminating the potential for accidental row separation. Wheel channel alignment systems with metal-to-metal contact requiring periodic lubrication or that utilizes a guide rod system that can be bent or damaged will not be acceptable.
4. Each cantilever arm shall be triple-formed 10-gauge steel, securely welded to the post assembly and include a nylon cantilever pad to ensure smooth operation. The cantilever pad shall also provide a firm base when in the occupied position and provide a solid feel when walked on.
5. Vertical columns shall be high tensile steel structural tube to meet design criteria. Minimum column size to be 2-inches x 3-inches 14-gauge structural tube, welded to a 2-foot-wide wheel channel using 360 degrees of weldment.
6. Deck support members shall be double formed 14-gauge steel and connect the front nosing and rear riser members. Each deck support shall include a unique dual-purpose roller that provides smooth support during operation. The deck support roller shall also include a 3/4-inch-wide shoulder that’s encapsulated by the deck support on the row above in order to maintain proper upper alignment while delivering consistent, repeatable operation.

B. Seat Systems:

1. Infinity Seat: Supply plastic modular seats with a minimum 19-inch seating area using an 18-inch module and a 1-inch seat spacer. Seat depth to be 10-inches. Narrower seats or seats that are cut down to form a 19-inches seat will not be acceptable. Seating to be scuff resistant injection molded high density polyethylene plastic.

    a. Seat modules supplied shall be of a high aesthetic design using multiple textures, style lines and a waterfall front. The rear of the seat shall be slightly curved to eliminate the straight-line appearance and include a moderate seat contour and texture to enhance spectator comfort.
    b. Seating design shall be molded to achieve a finished end appearance without the use of end caps. The rear of the seat shall include a smooth wall allowing for the deck to be easily swept clean without obstruction.
    c. Seat heights shall be maintained at a minimum of 16 3/4-inches. Lower seat heights which detour from spectator comfort will not be accepted.
    d. Each seat to be designed with the capability of using seat numbers and row letters at the aisle locations. Seat numbers to be stylishly designed using a radius corner to enhance the aesthetic value of the seat. Seat numbers and row letters shall be recessed into the seat to protect against any vandalism.
    e. Seat colors to be an exact match to Irwin Maroon (MRN). Color variations measuring more than 2 Deltas will not be acceptable.
    f. Securely fasten each seat to the nose beam using a 10-gauge formed steel bracket and locking hardware. Adjacent seating shall be interlocked together

along the full perimeter eliminating any fore or aft movement or the potential of any pinching hazard.

g. Seat modules shall be designed to support a uniform load of 600 lbs per seat and a concentrated load of 150 lbs over 4 square inches.

C. Panelam decking shall have a 0.030 (30 thousandths) high density polyethylene overlay, permanently bonded over 5-ply structural plywood in strict compliance with U.S. Product Standard PS 1 requirements. Plywood shall be supported along the front and back edge for maximum rigidity and designed in a manner that allows 3 plies to run front to back for increased deck strength. Each plywood panel shall be connected using a tongue and groove splice leaving the deck clean and free of any tripping or cleaning obstructions. Decking shall be secured in place by the encapsulation of the rear riser and mechanical fasteners along the front edge. Panelam color to match Irwin Light Grey.

1. 3/4-inches Panelam to be supplied. Due to the tread depth thinner deck panels will not be acceptable.

D. Nosing shall be one piece, formed, 14-gauge steel with a minimum G-60 pre-galvanized finish.

E. Rear riser shall be one piece, formed, 14-gauge steel with a minimum G-60 pre-galvanized finish.

F. Finish: For rust resistance in standard conditions all painted surfaces shall be finished in textured Epoxy Powder Coated Semi-Gloss Black.

2.4 ACCESSORIES

A. Aisles shall be footrest level and supplied as shown on the architectural plans. Aisles at the footrest level shall include non-slip treads on the top front edge.

B. Intermediate aisle steps shall be provided. Steps are permanently attached closed design. Steps shall be constructed from 14 ga. steel, finished in a custom silver powder coated epoxy as designated by the architect, and designed to eliminate any possible toe catch between the top of the intermediate step and the bottom of the nose beam per ADA or other applicable codes. Intermediate steps will be required in both rectangular and tapered designs. Front step shall be removable and interlock to the front row eliminating any possibility of accidental disengagement, and store on the front row when not in use.

C. Aisle handrails.

1. Smart Rail EX aisle handrails shall be provided for all aisles that are 90 degrees to the seating rows. Aisle railings shall quickly and easily rotate 90 degrees to the locked position and store parallel to the front of the aisle. Railings that require removal from the pocket or the use of tools for storage will not be acceptable. Aisle railings shall be an individual rail design, located on every other row starting at row two (2). Railing to be constructed of 1 1/2-inches 11 ga. round steel tubing, finished in a textured custom silver powder coated epoxy. For safety, railings designed without a full return of the handrail will not be acceptable.
2. Removable aisle handrails shall be provided for all tapered aisles. Aisle railings shall be an individual rail design, located on every other row starting at row two (2). Railing to be constructed of 1 1/2-inch 11ga. round steel tubing, finished in a textured custom silver powder coated epoxy. Aisle rails spanning several rows, or rails made from square tubing will not be acceptable. For safety, rail pockets that protrude beyond the face of the bleacher while in the closed position or railings with blunt, non-turned ends will not be allowed.

D. Recoverable wheelchair spaces shall be provided at the section joint location or section length as shown on architectural plans. An integral support on row two shall be provided to eliminate structural damage to the understructure during the operation and use of the system. Front rails to be supplied at each recoverable area.

E. End rails of the vertical, removable type, finished with textured custom silver epoxy powder-coated enamel, shall be provided at the open ends of the seating areas. Each area the rails are

intended to be used shall be equipped with permanent slide-out pockets allowing the rails to be securely attached. End rails shall start at row two and be constructed from 1-inch square tubing to meet all national building codes. Railings with flexible uprights that can be expanded beyond the 4-inch sphere are not acceptable.

F. Vinyl end curtains to be removable, individual strip design to limit unauthorized access to the underside of the telescopic system. Curtain strips shall be equal to the depth of each seating row, complete with a 2-inch overlap with sewn in Velcro for securing adjacent curtain. Each row end shall have heavy-duty Velcro securely attached to the end cap using minimum 1/8-inch steel rivets for attaching curtains. End curtains to be constructed of a sturdy vinyl material. Color to be selected from manufacturer's standard selection.

G. Seat numbers and row letters shall be supplied in a contrasting, but complementary color for easy seat identification. Layout of numbering to be coordinated with the architect/owner.

H. Molded contoured backrests and seat module shall be supplied on the last seating row and permanently mounted to the concrete tread. Backrest to be injection molded and styled in a manner to complement the appearance of the seat module. The contoured backrest shall be designed with proper ergonomic shapes and promote spectator comfort from multiple seating positions. Individual backrests shall attach to a clear anodized aluminum rail for improved aesthetics, including the use of hidden fasteners. All backrest support brackets shall be finished in a texture powder coated epoxy.

I. Infinity seat spacers shall be supplied as indicated on architectural drawings and create a 19-inch seating area. Seat spacers to be 1-inch wide with a contoured shape matching that of the adjacent seat modules and supplied in a matching color. Seat spacers to be constructed using the same material, design, durability and attachment method as the Infinity seat module.

J. Front closure panels of plywood and supports shall be provided to enclose the opening from the bottom of the recess to the top of the telescopic stands. Front panels to be constructed from Panelam and match the deck surface.

2.5 PROPULSION SYSTEM

A. MANUAL: For manually operated bleachers, individual sections containing a series of tiered rows shall be manually opened and closed. Each tiered row shall have mechanical locks to keep rows fully extended when in the open position. Row locks shall automatically release upon operation of release lever in the front skirt panel. Hinging of the lower skirt board is not acceptable.

B. FRICTION POWER: Integra Drive System (IDS) shall be furnished on each seating group to open and close the telescopic units. Each individual section shall include 2 IDS friction drive systems integrated into the first moving row of understructure to achieve smooth and efficient operation. Operation of the seating shall be accomplished with the use of a walk along pendant control.

1. Each IDS power system shall include large 6 1/2-inch diameter friction rollers to develop tractive force adequate to open and close the system. Each roller to include non-marring 1/2-inch-thick rubber covering.
2. Electrical motors for each section shall be heavy-duty and high efficiency gear reduction motors. The shaft diameter for the gear motor and rollers shall be a minimum of 1-inch and be connected by a 1-inch schedule 40 drive shaft.
3. All roller chain and sprockets used throughout the drive system shall be a minimum of #40 in size. Each drive unit shall be designed to include a safety shroud around the chain and sprocket for overall safety.
4. The power units shall develop tractive forces adequate to operate the seating units under normal conditions but inadequate to operate should significant obstacles be encountered.

C. Operation of the seating shall be accomplished with the use of a walk along steerable pendant control. Steering feature to be by a motor selection switch operation allowing the operator to make subtle adjustments during the opening/closing and ensuring proper alignment. Power operated systems without a steerable feature will not be acceptable.

D. Manufacturer shall provide all wiring from power source within bleacher seating including pendant control. Removable pendant control shall be handheld with forward and reverse button, plugging into a single receptacle. Electrical contractor shall provide a 60 HZ power source (as specified below) behind each group of seating. Amperage to be as specified by seating manufacturer depending on the number of power units required. For wall-attached installations, power source to terminate in a surface mounted junction box above floor. For reverse units, power source to terminate in a junction box, flush mounted under first seating row in center of group. Electrical contractor shall perform the connections to the seating equipment at the junction box. All electrical parts and wiring shall be installed in complete accord with the National Electric Code. U.L. Listing FHJU.E479554.

1. Supply power system with 208/230V, 5 wire 3-phase system.

PART 3 - EXECUTION

3.1 REVIEWS AND APPROVALS

A. Shop drawings shall be approved, and job site field measurements taken prior to installation and telescopic gym seating shall be installed in conformance therewith.

3.2 INSTALLATION

A. The installation of the telescopic gym seating will be handled directly by the manufacturer or by a factory authorized installation subcontractor qualified to perform the installation function.

3.3 PROTECTION

A. The manufacturer’s representative shall transmit instructions in both operation and maintenance to the owner.

B. Maintenance and operation of the telescopic gym seating shall be the responsibility of the owner or his duly authorized representative, and shall include the following:

1. During operation of the telescopic gym seating, the opening and closing shall be supervised by responsible personnel who will assure that the operation is in accordance with the manufacturer's instructions.
2. Only attachments specifically approved by the manufacturer for the specific installation shall be attached to the telescopic gym seating.
3. An annual inspection and required maintenance of all telescopic gym seating shall be performed to assure safe conditions. At least bi-annually, the inspection shall be performed by a Professional Engineer or factory service personnel.

C. Irwin Telescopic Seating Company constantly strives to improve its product and manufacturing methods; therefore, it reserves the right to make changes without notice which, in the opinion of Irwin Seating Company, shall improve the product.

END OF SECTION

DIVISION 13
SPECIAL CONSTRUCTION

SECTION 13 11 00 - SWIMMING POOL GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The scope of the work included under this Section of the Specifications shall include swimming pool(s) as illustrated on the Drawings and specified herein. The General and Supplementary Conditions of the Specifications shall form a part and be included under this Section of the Specifications. The Swimming Pool Subcontractor shall provide all supervision, labor, material, equipment, machinery, plant and any and all other items necessary to complete the work. ALL OF THE WORK IN SECTIONS 13 11 00 - 13 11 08 IS TO BE THE RESPONSIBILITY OF ONE EXPERIENCED SWIMMING POOL CONTRACTOR PRIMARILY ENGAGED IN THE CONSTRUCTION OF COMMERCIAL PUBLIC-USE SWIMMING POOLS. A SWIMMING POOL SUBCONTRACTOR SHALL BE CONSIDERED PRIMARILY ENGAGED AS REQUIRED HEREIN IF THE CONTRACTOR DERIVED 50% OF ITS ANNUAL REVENUE FROM PUBLIC-USE SWIMMING POOL CONSTRUCTION FOR EACH OF THE LAST FIVE YEARS. THE CONTRACTOR MUST HAVE ALSO, IN THE LAST FIVE YEARS CONSTRUCTED AT LEAST FIVE (5) COMMERCIALLY DESIGNED MUNICIPAL AND PUBLIC-USE SWIMMING POOLS, EACH OF WHICH SHALL HAVE INCORPORATED A MINIMUM SIZE OF 6,000 SQUARE FEET OF WATER SURFACE AREA WITH A CONCRETE AND CERAMIC TILE PERIMETER OVERFLOW GUTTER AND SELF-MODULATING BALANCE TANK. The Swimming Pool Contractor shall furnish and install the swimming pool structures, finishes, cantilever forming, swimming pool mechanical and electrical systems, and all accessories necessary for a complete, functional swimming pool system, as herein described. Work shall include start-up, instruction of Owner’s personnel, as-built plans, and warranties as required.

1.2 CODES, RULES, PERMITS, FEES

A. The swimming pools shall be constructed in strict accordance with the applicable provisions set forth by authorities having jurisdiction over swimming pool construction and operation in the State of California.

B. The Swimming Pool Contractor shall include in the work any labor, materials, services, apparatus, or drawings in order to comply with all applicable laws, ordinances, rules and regulations, whether or not shown on Drawings and/or specified.

1.3 DESCRIPTION OF WORK

A. Furnish and perform supervision, coordination, all layout, formwork, excavation, hand trim, disposing off-site of all unused material or debris to complete the swimming pool excavation to the dimensions shown on the plans.

B. Furnish and install complete swimming pool structures, including reinforcing steel and cast-in-place or pneumatically placed concrete walls and floors.

C. Furnish and install swimming pool finishes, including ceramic tile and marble plaster or other waterproof finishes.

D. Furnish and install complete swimming pool mechanical system(s), including, but not limited to, circulation systems, filtration systems, pool water heating systems, water chemistry control systems, domestic water fill line systems, booster pump and special effects systems, and all pumps, piping, valves, and connections between system(s) and swimming pool(s).

E. Furnish and install complete swimming pool electrical system(s) from P.O.C. in Mechanical Room, including, but not limited to, underwater lighting systems, water level control systems, timing systems, scoreboards, special effects systems, control circuitry, motor starters, time

clocks, bonding, and all conduits, conductors, contactors, and switches between the system(s) and swimming pool(s).

F. Furnish and install all swimming pool cantilever forming, deck equipment and required anchors and inserts for the specified equipment as required by code, shown on the Drawings and specified herein.

G. After the initial filling of the swimming pool system(s), should any repairs, continuing work, or other Subcontractor responsibility require drainage or partial drainage of the swimming pool systems, the Swimming Pool Contractor shall be responsible for any subsequent refilling and shall complete the project with the swimming pool system(s) full of water, water in chemical balance, complete in every way, and in full operation.

1.4 ASSIGNED RESPONSIBILITIES AND RELATED WORK

A. It is the intent of this section of the Specifications to clarify Work responsibilities of the trades directly and indirectly involved in construction of the pool systems. All labor, equipment, materials and supplies furnished by the Swimming Pool Subcontractor and other Subcontractors per the contractual agreement with the General Contractor and Owner and shall be as directed by the Owner through their Designated Representative.

B. THE SWIMMING POOL CONTRACTOR SHALL NOT SUBCONTRACT ANY PORTION OF THE SWIMMING POOL CONSTRUCTION OR SWIMMING POOL EQUIPMENT INSTALLATION TO ANYONE OTHER THAN A SUBCONTRACTOR THAT SATISFIES THE REQUIREMENTS OF SECTION 13 11 00.

C. References to “swimming pool systems” shall include the swimming pools, equipment, and accessories.

D. The Owner will provide one complete water filling of the swimming pool(s) but will not assume any responsibility for the swimming pool system(s) until they have been proved fully operational, complete in every way and accepted by the Designated Representative.

1.5 RESPONSIBILITIES OF THE GENERAL CONTRACTOR/POOL CONTRACTOR

A. The General Contractor shall grade the swimming pool site(s), establish benchmarks, cut and fill as necessary to provide as level an area as possible at swimming pool deck elevation before swimming pool layout.

B. The General Contractor shall be responsible for horizontal dimensions and grade elevations accurately from established lines and benchmarks (as indicated on the Drawings) and be responsible for those grades.

C. The General Contractor shall provide adequate temporary light, electric power, heat and ventilation per Federal and State OSHA requirements to construct the swimming pool system(s).

D. The General Contractor shall not permit any heavy equipment activity over any area or within five (5) feet of any area under which swimming pool piping is buried. There shall be no exceptions to this requirement.

E. The Pool Contractor shall keep the swimming pool excavation(s) and swimming pool structure(s) free of construction residue and waste materials of their workmen or Subcontractors, removing said material from the swimming pools as required.

F. The Pool Contractor shall protect the swimming pool(s) from damage caused by their construction equipment and /or workmen and Subcontractors.

G. The General Contractor shall provide a representative at the time of swimming pool start-up to coordinate all trades related to swimming pool system(s).

1.6 RESPONSIBILITIES OF THE MECHANICAL AND PLUMBING CONTRACTORS

A. The Mechanical and Plumbing Contractor shall be licensed in the State of California and provide written notifications to Swimming Pool Subcontractor and contractor when necessary to excavate and backfill within the swimming pool construction site.

B. The Mechanical Subcontractor shall not utilize any swimming pool piping trench for installation of any sanitary sewer, storm sewer, domestic water, hot water, chilled water or natural gas line.

C. The Plumbing Contractor shall furnish and install all sanitary sewer piping, including vent stacks (if necessary), for backwash pits, floor drains and floor sinks as required by code, shown on Drawings, and herein specified.

D. The Plumbing Contractor shall furnish and install all storm sewer piping and site drainage systems as required by code, shown on the Drawings, and herein specified.

E. The Plumbing Contractor shall provide a minimum 75 psi water supply for swimming pool construction work within fifty (50) feet of the swimming pool construction site(s).

F. The Plumbing Contractor shall furnish and install reduced pressure backflow protected domestic water lines to P.O.C. within swimming pool Mechanical Room as required by code, shown on the Drawings, and herein specified.

G. The Plumbing Contractor shall furnish and install natural gas piping, pressure regulation and valving to P.O.C. within swimming pool Mechanical Room as required by code, shown on the drawings, and herein specified.

H. The Mechanical Contractor shall furnish and install all ductwork, louvers, and all HVAC equipment within swimming pool Mechanical Room as required by code, shown on the Drawings, and herein specified.

I. The Mechanical Contractor shall provide a representative at time of swimming pool start-up to coordinate work related to swimming pool system(s).

1.7 RESPONSIBILITIES OF THE ELECTRICAL CONTRACTOR

A. The Electrical Contractor shall be licensed in the State of California and shall furnish and install electrical service to swimming pool Mechanical Room sized to accommodate all necessary swimming pool equipment as shown on the Drawings and herein specified.

B. The Electrical Contractor shall furnish any temporary power needed by the Swimming Pool Subcontractor within fifty (50) feet of the swimming pool construction site(s).

C. The Electrical Contractor shall furnish and install all conduits, conductors, starters/disconnects, panels, circuits, switches and equipment as required for lighting, ventilation and HVAC equipment within swimming pool Mechanical Room as required by code, shown on the Drawings, and herein specified.

D. The Electrical Contractor shall furnish and install all conduits, conductors, panels, circuits, switches and equipment for area lighting as required by code, shown on the Drawings, and herein specified.

E. All equipment, material and installation shall be as required under Division 16 of the Specifications and shall conform to NEC Article 680 (latest revision), State and Local Codes, and as may be required by all authorities having jurisdiction over swimming pool construction within the State of California.

F. The Electrical Contractor shall provide a representative at time of swimming pool start-up to coordinate work related to swimming pool system(s).

1.8 INTENT

A. It is the intention of these specifications and Drawings to call for finished work, tested and ready for operation. Wherever the work “provide” is used, it shall mean “furnish and install complete and ready for use.”

B. Minor details not usually shown or specified, but necessary for proper installation and operation, shall be included in the work, the same as if herein specified or shown.

1.9 SCHEDULE OF VALUES

A. Provide a Schedule of Values for all work specified in each of the technical specifications listed in the table below, regardless of whether the work is performed by the swimming pool contractor or others. Values listed shall be fully burdened, with contractor general conditions, overhead, profit and bonds included. Payments for swimming pool work completed shall not be approved until Schedule of Values has been submitted to and approved by Architect.

B.

SWIMMING POOL SCHEDULE OF VALUES			
No.	Section #	Description	Value
1.	13 11 01	Swimming Pool Excavation	
2.	13 11 02	Swimming Pool Concrete	
3.	13 11 03	Swimming Pool Shotcrete	
4.	13 11 04	Swimming Pool Ceramic Tile	
5.	13 11 05	Swimming Pool Plaster	
6.	13 11 06	Swimming Pool Equipment	
7.	13 11 07	Swimming Pool Mechanical	
8.	13 11 08	Swimming Pool Electrical	
Total			

1.10 SUBMITTAL PROCEDURES

A. General: Electronic copies of CAD Drawings of the Contract Drawings will not be provided by Architect for Subcontractor's use in preparing submittals.

B. Coordination: Coordinate preparation and processing submittals with performance construction activities.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.

a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

C. Submittals Schedule: Comply with requirements in Division 1 Section "Construction Progress Documentation" for list of submittals and time requirements for schedules performance of related construction activities.

D. Processing Time: Allow enough time for submittal review, including time for re-submittals as follows. Time for review shall commence on Architect's receipt of submittal.

1. Initial Review: Allow fifteen (15) days for initial review of each submittal. Allow additional time if processing must be delayed to permit coordination with subsequent submittals. Architect will advise Contract when a submittal being processed must be delayed for coordination.

2. Concurrent Review: Where concurrent review of submittals by Architect's consultants, Owner, or other parties is required, allow twenty-one (21) days for initial review of each submittal.
3. Direct Transmittal to Consultant: Where the Contract Documents indicate that submittals may be transmitted directly to Architect's consultants, provide duplicate copy of transmittal to Architect. Submittal will be returned to Architect before being returned to Subcontractor.
4. If intermediate submittal is necessary, process it in same manner as initial submittal.
5. Allow fifteen (15) days for processing each submittal.
6. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing.

E. Identification: Place a title block on each submittal for identification.

1. Indicate name of firm or entity that prepared each submittal on title block.
2. Provide a space on title block to record Subcontractor's review and approval markings and action take by Architect.
3. Include the following information on title block for processing and recording action taken: (See Attached Sample)

    a. Project name.
    b. Date.
    c. Name and address of Subcontractor.
    d. Name of Subcontractor.
    e. Name of Supplier.
    f. Name of Manufacturer.
    g. Unique identifier, including revision number.
    h. Number and title of appropriate Specification Section.
    i. Drawing number and detail references, as appropriate.
    j. Other necessary identification.

SUBMITTAL FOR:	SUBMITTAL TO:	SUBCONTRACTOR:

Item Number: _____
Section Number: _____
Section Description: _____
Subcontractor: _____
Supplier: _____
Manufacturer: _____
Product Code: _____
Quantity: _____

Subcontractor Certification:

It is hereby certified that the equipment or material designated in this submittal is proposed to be incorporated in the above named project and is in compliance with the contract drawings and / or specifications and is submitted for approval.

Certified by: _____
Date: _____
Job Superintendent: _____
Revisions: _____

Contractor's Submittal Stamp:

Architect's Review Stamp and Comments

F. Deviations: Highlight, encircle, or otherwise identify deviations from the Contract documents on submittal.

G. On all catalogue or cut sheets identify which model or type is being submitted.

H. Transmittal: Package each submittal individually and appropriately for transmittal and handling. Product data and shop drawings shall be packaged within a three-ring binder and colored samples shall be packaged on a heavy cardboard. Transmit each submittal using a transmittal form.

1. On an attached separate sheet, prepared on Subcontractor's letterhead, record relevant information, request for data, revisions other than those requested by Architect on previous submittals and deviations from requirements of the Contract documents, including minor variations and limitations. Include the same label information as the related submittal.
2. Include Subcontractor's certification stating that information submitted complies with requires of the Contract Documents.
3. Transmittal Form: Provide locations on form for the following information:

a. Project name.
b. Date.
c. Destination (To:).
d. Source (From:).
e. Names of Subcontractor, manufacturer, and supplier.
f. Category and type of submittal.
g. Submittal purpose and description.
h. Remarks.

I. Distribution: Furnish copies of final submittals to manufacturers, Subcontractors, suppliers, fabricators, installers, authorities having jurisdiction and others as necessary for performance of construction activities. Show distribution on transmittal forms.

J. Use for Construction: Use only final submittals with mark indicating action taken by Architect in connection with construction.

1.11 SUBSTITUTIONS

A. To obtain approval to use unspecified products, bidders shall submit requests for substitution at least ten (10) days prior to bid date. Requests shall only be considered if they clearly describe the product for which approval is asked, including all data necessary to demonstrate acceptability. All unspecified products and equipment will be considered on an “or equal” basis at the discretion of the Designated Representative. Requests for substitution received after the specified deadline will not be considered. Where a conflict exists between the requirements of the General Conditions / Special Conditions / Division 1 concerning substitutions and the requirements of this Article, this Article (Section 13 11 00, Article 1.11) shall govern.

B. Where the Swimming Pool Contractor proposes to use an item of equipment other than that specified or detailed on the Drawings which requires any redesign of the structure, partitions, foundations, piping, wiring, or any other part of the architectural, mechanical, or electrical layout, all such redesign and all new drawings (stamped by California Licensed Engineer) and detailing required shall be prepared by the Swimming Pool Contractor, at their own expense, submitted for review and approval by the Designated Representative prior to bid.

C. Where such approved deviation requires a different quantity and arrangement of piping, supports and anchors, wiring, conduit, and equipment from that specified or indicated on the Drawings, the Swimming Pool Contractor shall furnish and install any such piping, structural supports, controllers, motors, starters, electrical wiring and conduit, and any other additional equipment required by the system, at no additional cost to the Owner.

1.12 SURVEYS AND MEASUREMENTS

A. The Swimming Pool Contractor shall base all measurements, both horizontal and vertical, from benchmarks established by the Contractor. All work shall agree with these established lines and levels. The mechanical Drawings do not give exact details as to elevations of piping, exact locations, etc. and do not show all offsets, control lines, pilot lines and other installation details. Verify all measurements at site and check the correctness of same as related to the work.

1.13 DRAWINGS

A. Drawings are diagrammatic and indicate the general arrangement of the systems and work included in the Contractor. Drawings are not to be scaled. The architectural drawings and details shall be examined for exact dimensions. Where they are not definitely shown, this information shall be obtained from the Designated Representative.

1.14 SWIMMING POOL CONTRACTOR

A. The swimming pool construction work as herein described and specified in Division 13 of the Project Manual shall be the complete responsibility of a qualified and specifically licensed (C-53 license classification within the State of California) Swimming Pool Subcontractor with extensive experience in commercial public use swimming pool installations.

B. The Swimming Pool Contractor shall furnish performance and payment bonds in the amount of 100% of the Swimming Pool Contractor’s bid written by a surety Company properly registered in the State of California and listed by the U.S. Treasury. The expense of the bond(s) is to be borne by the Contractor. The Contractor shall clearly specify the amount and requirements of the bond(s) in the Contractor’s written or published request for subbids. The Contractor’s written or published request for subbids shall also specify that the bond(s) expense is to be borne by the Subcontractor.

C. Contractor certifies that it meets the qualifications and experience requirements established in Swimming Pool General Conditions, Section 13 11 00, as follows:

1. Contractor has derived 50% of its annual revenue from public-use swimming pool construction for each of the last five (5) years.
2. Contractor has, in the last five (5) years, constructed at least five (5) commercially designed municipal and public-use swimming pools, each of which have incorporated a minimum size of 6,000 square feet of water surface area with a concrete and ceramic tile perimeter overflow gutter and self-modulating balance tank.
3. The following list of projects meet the requirements of section (b) above and the contact as reference by the Contractor, the Awarding Authority of their agent or designee.

a. Owner: _____
Scope of Project: _____
Contact Person: _____
Phone Number: _____
Architect for Project: _____

b. Owner: _____
Scope of Project: _____
Contact Person: _____
Phone Number: _____
Architect for Project: _____

c. Owner: _____
Scope of Project: _____
Contact Person: _____
Phone Number: _____
Architect for Project: _____

d. Owner: _____
Scope of Project: _____
Contact Person: _____
Phone Number: _____
Architect for Project: _____

e. Owner: _____
Scope of Project: _____
Contact Person: _____
Phone Number: _____
Architect for Project: _____

D. Swimming Pool Deck Subcontractor other than the swimming pool Contractor certifies that it meets the qualifications and experience requirements established in Swimming Pool General Conditions, Section 13 11 00, as follows:

1. Subcontract has, in the last five (5) years, constructed at least five (5) commercially designed cantilevered pool decks over perimeter gutters, each of which have incorporated a minimum size of 6,000 square feet of water surface area of the swimming pool.
2. The following list of projects meet the requirements of section (b) above and the contact as reference by the Contractor, the Awarding Authority of their agent or designee.

SWIMMING POOL DECK SUBCONTRACTOR

a. Owner: _____
Scope of Project: _____
Contact Person: _____
Phone Number: _____
Architect for Project: _____

b. Owner: _____
Scope of Project: _____
Contact Person: _____
Phone Number: _____
Architect for Project: _____

c. Owner: _____
Scope of Project: _____
Contact Person: _____
Phone Number: _____
Architect for Project: _____

d. Owner: _____
Scope of Project: _____
Contact Person: _____
Phone Number: _____
Architect for Project: _____

e. Owner: _____
Scope of Project: _____
Contact Person: _____
Phone Number: _____
Architect for Project: _____

1.15 OPERATING INSTRUCTIONS

A. The Swimming Pool Contractor shall determine from actual samples of pool water supplied by the Owner, the proper water management program necessary for maximum operating efficiency and comfort. The Swimming Pool Contractor shall provide the services of experienced personnel familiar with this type of pool system operation, in conformance with Section 13 11 05 of the Specifications.

1.16 MAINTENANCE MANUALS

A. The Swimming Pool Contractor shall provide six (6) bound sets for delivery to the Designated Representative of instructions for operating and maintaining all systems and equipment included in this Contract. Manufacturer's advertising literature or catalog pictures will not be acceptable for operating and maintenance instructions.

B. Bound in ring binders shall be all parts lists, periodic maintenance instructions and troubleshooting guidelines for all pool equipment, including but not limited to filters, pumps, controllers, water chemistry control equipment, etc.

1.17 SECURE FROM THE OWNER

A. A complete Owner-furnished filling of the swimming pools.

B. The Owner's assistance, as specified herein, from the time of start-up until final written acceptance of the swimming pool system(s).

C. Chemicals as required for swimming pool operation after Swimming Pool Contractor completes initial water chemistry balance and water treatment during the maintenance period described in Section 13 11 05 of the Specifications.

1.18 WARRANTY

A. The Swimming Pool Contractor shall warrant all swimming pool structures, finishes and systems against defects in material and workmanship for a period of one year after the date of acceptance by the Owner. Any repair or replacement required due to defective material or workmanship will be promptly corrected by the Swimming Pool Contractor.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

NOT USED

END OF SECTION

SECTION 13 11 01 - SWIMMING POOL EXCAVATION

PART 1 - GENERAL

1.1 DESCRIPTION

A. Finish and fine grading to bring the surface of the ground to the required grades and elevations as indicated on the Drawings.

B. Subgrade improvements and placing of compacted fills.

C. Excavation and backfill for all swimming pool, pool deck and surge chamber structural, including footings, foundations, slabs and walls.

1.2 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies: Conform with requirements of the General Conditions, and more specifically the following:

1. Comply with California Building Code, latest edition.
2. Comply with applicable construction safety orders, latest edition, Federal and State OSHA.
3. Comply with applicable trench safety provisions, latest edition, Federal and State OSHA.

B. Qualifications of Workers:

1. The entity performing the work of this Section shall have been successfully engaged in the respective trade for at least five (5) years immediately prior to commencement of the Work.
2. For actual construction operations, use only trained and experienced workers with a minimum of three (3) years experience with the materials and methods specified.
3. Provide at least one person who shall be present at all times during execution of the work of this Section, with a minimum of five (5) years experience with the type of materials being installed, the referenced standards, and who shall direct all Work performed under this Section.

C. Project/Site Conditions:

1. Be familiar with site and subsurface conditions.
2. Excavation is unclassified and includes excavation to sub-grade elevations indicated or necessary, regardless of character of materials and obstructions encountered.
3. Provisions for mitigation of wet soils due to seepage or rain shall be made during excavation and throughout construction. If wet soils are encountered within the swimming pool excavations, de-watering shall be provided and the Geotechnical Engineer shall make recommendations for moist soil mitigation.
4. Where slope instability is encountered, all excavations within those areas shall be 1:1 or flatter. Forming of vertical walls may be necessary, and all soil conditions shall be field verified by the Geotechnical Engineer.
5. Contractor shall review the Geotechnical Investigation Report as furnished by the Owner’s Representative to determine the suitability of the soils.

D. Adverse Weather Conditions:

1. During the periods when site soil moisture content is substantially in excess of moisture content required for optimum compaction, do not perform fill compaction.
2. When unfavorable weather conditions necessitate interrupting filling and grading operations, prepare areas by compaction of surface and grading to avoid collection of water. Provide adequate temporary drainage to prevent erosion.

1.3 SUBMITTALS AND SUBSTITUTIONS

A. Provide submittals in conformance with requirements of Section 01 33 00.

B. Required submittals include:

1. Offsite fill material, if applicable.

C. Submit proof of qualifications as specified in Article 1.2.A of this Section

1.4 EXCAVATING & TRENCHING, GENERAL REQUIREMENTS

A. Refer to Section 01 55 00, Temporary Facilities and Controls.

B. All trenches, holes, etc. are to be completely protected using solid barricades, steel plates, and plywood both during construction and during off hours, including night time.

C. Flashing warning light barricades are required on sidewalks, roads, and any other critical areas that require night time protection.

D. Roads, paths and sidewalks shall not be blocked at any time or in any way. Trenching across roads, paths or sidewalks involves special instructions and review of the construction procedure by the Owner's Representative at least three (3) days prior to the Work actually being started.

E. Construction equipment, including all trucks, cars, etc. shall not be parked or driven on roads, paths or sidewalks. Items not allowed on roads, paths or sidewalks include hoses, power cords, ropes, construction materials, dirt and debris, etc.

F. All roads, paths and sidewalks must remain clear and the Contractor shall maintain temporary safe and effective pedestrian access at all times.

G. Drawings show existing major underground utilities using the best information available. The Contractor shall also fully check public works reference drawings prior to excavation. Call local Dig Alert to locate utilities to ensure safety.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Fill Material, General: All material shall be subject to the review of the Geotechnical Engineer to determine acceptability.

B. The onsite shallow clay soils encountered in the borings are considered to have a low to moderate expansion potential. In general, they shall not be re-used as backfill within the upper one foot of subgrade below concrete flatwork except for roadway. Unless indicated otherwise, the shallow clay soils are considered suitable for backfilling purpose at depths exceeding one foot below finished subgrade, where concrete flatwork is anticipated and at subgrade where no concrete flatwork is anticipated, provided they are free of deleterious and oversize materials and are properly processed and moisture conditioned. Import materials will also be needed for backfilling purpose. The imported materials being used for backfilling shall have a low expansion potential (EI less than 20), and shall comply with the specifications of the Soils Report.

C. Import materials, if needed shall contain sufficient fines (binder material) so as to be relatively impermeable and result in a stable subgrade when compacted. The imported materials shall have an expansion index (EI) less than 20 and shall be free of organic materials, debris, and cobbles larger than 2½ inches with no more than 35% passing the #200 sieve. A bulk sample of potential import material, weighing at least 35 pounds, shall be submitted to the Geotechnical Consultant at least 48 hours before fill operations. All proposed import materials shall be tested for corrosivity, shall be environmentally cleared from contamination and shall be approved by the Geotechnical Consultant prior to be placed onsite.

D. All fill soil shall be placed in thin, loose lifts moisture conditioned, as necessary, to near optimum moisture content, and compacted to a minimum 95 percent relative compaction as determined by ASTM Test Method D1557.

PART 3 - EXECUTION

3.1 INSPECTION

A. Verify drawing dimensions and elevations with actual field conditions. Inspect related Work and adjacent surfaces and report discrepancies and conditions which prevent proper execution of the Work to the Owner's Representative.

3.2 SUBGRADE IMPROVEMENTS

A. The proposed swimming pool and pool deck shall be supported entirely on engineered fill. The pool deck area shall be overexcavated by at least 2½ feet below existing grade or below the bottom of the hardscape surface, whichever is greater. The overexcavation below the pool bottom shall also be at least 2½ feet.

B. Following geotechnical approval, the bottom of the removal excavations shall be scarified to a depth of 8 inches, moisture conditioned within 2 ½ percent of optimum for clay and recompacted to at least 90% relative compaction as determined by ASTM D1557. All fill placed shall be compacted to at least 90% relative compaction at moisture contents within 2 ½ percent of optimum for sand soils and 125% of optimum for clay and silt soils. The upper 12 inches of backfill below the pool deck and pool shell shall consist on non-expansive soils (EI<20). The non-expansive soils shall be placed immediately following the placement of the clay soils to prevent drying of the clay soils.

C. To collect any water that may infiltrate from the ground surface or from the pool/pipe leakage, the pool shall have an underdrain blanket consisting of 6 inches of ¾-inch drain gravel (CalTrans Class 2 permeable or equivalent) extending over the entire footprint or the pool. A collector drain shall be installed at the low points of the pool and any water in the low shall be directed to a sounding tube which can be pumped as needed due to the relative imperviousness of the clay soils.

3.3 EXCAVATION

A. Checking Layout: Contractor shall, before commencing the excavation work, check all lines, stakes and levels for dimensions, angles, elevations and grades with the survey.

B. Except where extra excavation is directed by the Owner's Representative or Geotechnical Engineer, excavations made to a greater depth or size than indicated or required shall be filled with concrete or shotcrete as specified in Sections 13 11 02 / 13 11 03.

C. Dimensions: Excavate to proper dimensions as shown, cut square and smooth with firm level bottoms. Prepared excavations shall be approved by Geotechnical Engineer. Excavations shall be free of loose or disturbed materials.

D. Excess Water Control: Keep all excavations free from standing water by pumping, draining or providing proper protection against water intrusion. If soil becomes soft, soggy or saturated, perform additional excavation to firm soil not affected by water.

E. Form Removal: Make all excavations of sufficient size to permit installation and removal of forms and all other required work.

F. Alternate Forming: Sides of structures may be formed by neat excavations where banks will stand without caving. If banks cave, provide forming as required and widen excavation to permit forming, bracing and inspection. Provide forming in conformance with Section 13 1102 and all recognized safety standards.

3.4 BACKFILLING

A. Method: After concrete has been placed, forms removed and concrete work approved, backfill the excavations with earth to indicated or required grades. Carry on backfilling simultaneously on each side of walls or grade beams. Remove all rubbish and wood from the excavations before placing backfill.

B. Concrete Protection: Prior to placing any backfill, adequately cure all concrete and provide any bracing required to ensure the stability of the structure. Protect waterproofing and dampproofing against damage in a manner acceptable to the Owner's Representative. Remove bracing as backfill operations progress.

C. Material: Use the material from the excavations for backfilling, subject to approval by Soils Testing Agency. The earth shall be free from debris, large clods or stones.

D. Lifts: Place backfill in eight (8) inch loose layers, bring to optimum moisture content and compact to ninety percent (95%) of maximum density, sloping down and away from the structures being backfilled.

E. Moisture: Rigidly control the amount of water used to insure optimum moisture conditions for the type of fill material used. Excessive amounts of water causing saturation of earth will not be permitted. Compaction by flooding or jetting is prohibited.

3.5 GRADING

A. Slopes: Grade to finish grades indicated on Drawings, with uniform slopes between all points.

B. Subgrades: Blade to required grade and roll or tamp subgrades for exterior slabs, decks and paving.

3.6 CLEAN-UP

A. Disposal: Haul away rubbish, debris, and rocks from site promptly and dispose of legally. Burning rubbish on site is prohibited.

B. Dust and Noise Abatement: During entire period of construction keep area and material being loaded sprinkled to reduce dust in air and annoyance to premises and surrounding property.

END OF SECTION

SECTION 13 11 02 - SWIMMING POOL CONCRETE

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Forming for cast-in-place concrete and shotcrete associated with swimming pools and pool decks.

B. Reinforcement for cast-in-place concrete and shotcrete associated with swimming pools and pool decks.

C. Cast-in-place concrete for swimming pool structures. Do not use waterproofing admixture of any kind.

D. Cast-in-place concrete for swimming pool decks with Xypex C-500 crystalline waterproofing admixture. Waterproofing admixture for swimming pool decks only.

E. Provide labor, materials and equipment as required to install sealant for all pool deck expansion joints, or any other caulking, as indicated on the aquatic Drawings and herein specified.

1.2 QUALITY ASSURANCE

A. Qualifications of Workers:

1. The entity performing the work of this Section shall have been successfully engaged in the respective trade for at least five (5) years immediately prior to commencement of the Work.
2. For actual construction operations, use only trained and experienced workers with a minimum of three (3) years experience with the materials and methods specified.
3. Provide at least one person who shall be present at all times during execution of the work of this Section, with a minimum of five (5) years experience with the type of materials being installed, the referenced standards, and who shall direct all Work performed under this Section.

B. Standards:

1. In addition to complying with the California Building Code (latest edition), comply with all pertinent recommendations contained in "Guide to Formwork for Concrete," Publication ACI 347R-14 of the American Concrete Institute.
2. In addition to complying with California Building Code (latest edition), comply with all pertinent recommendations contained in “Guide to Presenting Reinforcing Steel Design Details,” Publication ACI 315R-18 of the American Concrete Institute.
3. In addition to comply with all local codes and regulations, comply with all pertinent recommendations contained in American Society for Testing and Materials (ASTM); ASTM C 920 “Standard Specification for Elastomeric Joint Sealants.”
4. Where provisions of applicable codes and standards conflict with the requirements of this Section, the more stringent provisions shall govern.

C. Tolerances: Construct all swimming pool concrete straight, true, plumb and square within a tolerance horizontally of one in 200 and vertically of one in 2000.

1.3 SUBMITTAL AND SUBSTITUTIONS

A. Provide submittals in conformance with the requirements of Section 01 33 00.

B. Samples and Certificates, Concrete Reinforcement:

1. Provide all data and access required for testing as described in Section 01 44 00 of the Specifications.

2. All material shall bear mill tags with heat number identification. Mill analysis and report shall be made available upon request.
3. Material not so labeled and identifiable may be required by the Owner's Representative to be tested by the testing laboratory selected by the Owner's Representative and at no additional cost to the Owner, in which case random samples will be taken for one series of tests from each 2-1/2 tons or fraction thereof of each size and kind of reinforcing steel.
4. Design mix from batch plant demonstrating previous use history and associated strengths at 28 days.
5. The Contractor shall submit a mix design stamped and signed by a licensed engineer for approval by the Owner's Representative prior to any placement of concrete.
6. The Contractor shall submit a mix design stamped and signed by a licensed engineer for the swimming pool decks which contains the specified Xypex C-500 crystalline waterproofing admixture for approval by the Owner's Representative prior to any placement of concrete.

C. Submit proof of qualifications as specified in Article 1.2.A of this Section.

D. Submit reinforcing drawings for pool walls, gutters, floors, dike walls and balance tanks, etc. as shown on the construction drawings.

1.4 PRODUCT HANDLING

A. Delivery: Deliver materials to the Project Site in the manufacturer's original unopened containers with all labels intact and legible.

B. Storage: Store materials under cover in a manner to prevent damage and contamination, and store only the specified materials at the Project Site.

C. Protection: Use all means necessary to protect the swimming pool concrete before, during, and after installation and to protect the installed Work specified in other Sections.

D. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the approval of the Owner's Representative.

PART 2 - PRODUCTS

2.1 CONCRETE FORMWORK

A. Form Materials:

1. Form Lumber: All form lumber in contact with exposed concrete shall be new except as allowed for reuse of forms in Part 3 of this Section, and all form lumber shall be one of the following, a combination thereof, or an equal approved in advance by the Owner's Representative.

   a. "Plyform," Class I or II, bearing the label of the Douglas Fir Plywood Association; "Inner-Seal" Form as manufactured by Louisiana-Pacific, or approved equal.
   b. Douglas Fir-Larch, number two grade, seasoned, surfaced four sides.

2. Form Release Agent: Colorless, non-staining, free from oils; chemically reactive agent that shall not impair bonding of paint or other coatings intended for use.

B. Ties and Spreaders:

1. Type: All form ties shall be a type which do not leave an open hole through the concrete and which permits neat and solid patching at every hole.
2. Design: When forms are removed, all metal reinforcement shall be not less than two (2) inches from the finished concrete surface.
3. Wire Ties and Wood Spreaders: Do not use wire ties or wood spreaders.

C. Alternate Forming Systems: Alternate forming systems may be used subject to the advance approval of the Owner's Representative.

2.2 CONCRETE REINFORCEMENT

A. Bars: Bars for reinforcement shall conform to "Specifications for Deformed Carbon-Steel Bars for Concrete Reinforcement," ASTM A-615, Grade 60.

B. Wire Fabric: Wire fabric shall conform to "Specifications for Carbon Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete," ASTM A-1064.

C. Tie Wire: Tie wire for reinforcement shall conform to "Specifications for Carbon Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete," ASTM A-1064 black annealed 16-gauge tie wire.

2.3 CAST-IN-PLACE CONCRETE

A. Concrete:

1. All concrete, unless otherwise specifically permitted by the Owner's Representative, shall be transit-mixed in accordance with ASTM C94. Concrete for water retaining structures that do not receive a waterproofing finish such as ceramic tile or swimming pool plaster shall receive a topical waterproofing finish.
2. The control of concrete production shall be under the supervision of a recognized testing agency, selected by the Owner in accordance with Section 01 44 00 of the Specifications.
3. Quality: All concrete shall have the following minimum compressive strengths at twenty-eight (28) days and shall be proportioned within the following limits:

    a. 4,000 psi minimum compressive strength for cast-in-place concrete swimming pool structures.
    b. 4,000 psi minimum compressive strength for cast-in-place swimming pool decks with Xypex C-500 waterproofing admixture.
    c. 1" maximum size aggregate.
    d. 6.0 minimum sacks of cement per cubic yard.*
    e. Maximum water to cement ratio of 0.40 – 0.45 maximum.
    f. 4" maximum slump.
    g. Xypex Admix C-500 2% - 2.5% by weight of cement content. Contact Xypex Technical Services to confirm dosage. (To be used for swimming pool decks only.)

    * For estimate only: to be determined by mix design.

4. Cement: All cement shall be Portland Cement conforming to ASTM C-150, Type II or V, and shall be the product of one manufacturer.
5. Aggregates:

    a. Shall conform to "Standard Specifications for Concrete Aggregates," ASTM C33, except as modified herein.
    b. Coarse Aggregate: Clean sound washed gravel or crushed rock. Crushing may constitute not more than 30% of the total coarse aggregate volume. Not more than 5% flat, thin, elongated or laminated material nor more than 1% deleterious material shall be present. 1" aggregate graded from 1/4" to 1", fineness modulus 6.90 to 7.40. 1-1/2" graded from ½" to 1-1/2", fineness modulus 7.80 to 8.20.
    c. Fine Aggregate: Washed natural sand of hard, strong particles and shall contain not more than 1% of deleterious material, fineness modulus 2.65 to 3.05.
    d. Aggregate must be certified, non-expansive from a "known" good source.

6. Water: ASTM C1602; Clean, fresh, free from acid, alkali, organic matter or other impurities liable to be detrimental to the concrete (potable).
7. Admixtures: Admixtures shall be used upon approval of the Owner's Representative.

    a. Air-entraining admixture: Conform to ASTM C260.

b. Water-reducing admixture: Conform to ASTM C494.
c. Waterproofing admixture for swimming pool decks only: Xypex Admix C-500, no solutions permitted. Conform to ASTM C494.

8. Xypex Admix C-500 Dosage: To be used for swimming pool decks only.

a. General: Xypex Admix must be added to concrete mix at time of batching. It is important to obtain a homogeneous mixture of Xypex Admix with the concrete. Do not add dry Admix powder directly to wet mixed concrete as this could cause clumping and thorough dispersion may not occur.
b. Dosage Rate: Under normal conditions, the crystalline waterproofing powder shall be added to the concrete mix at the following rates:

1) Xypex Admix C-500 2% – 2.5% by weight of cement content

c. Weather Conditions: For mixing, transporting and placing concrete under conditions of high temperature or low temperature, follow concrete practices such as those referred to in ACI 305R (Hot Weather Concreting) and ACI 306R (Cold Weather Concreting) or other applicable standards.
d. Concrete Batching & Mixing Procedures: Procedures for the addition of Xypex admixture will vary according to type of batch plant operation and equipment. Prior to the placement of any concrete, the concrete batch plant and the contractor shall be responsible to consult with the local Xypex representative concerning additional procedures for the addition, mixing and to confirm dosage.
Note: For enhanced chemical protection or for meeting specific project requirements or where the concrete mix design contains higher than 25% type F fly ash content or includes a portland cement/slag cement/type C fly ash blend, consult with manufacturer or its authorized representative to determine appropriate dosage rates.

B. Construction Joints: Use keyform for slab pour joints. Either preformed galvanized or PVC construction joint forms of a standard manufacturer may be used. Install per manufacturer's recommendations and tool edges of slabs.

C. Waterstops: PVC bulb-type for use between concrete pours / lifts, conforming with ASTM D 570, D 624, and D 638. Provide in configuration(s) as recommended by manufacturer for specific application. Greenstreak, W.R. Meadows, or approved equal.

D. Curing Materials:

1. Liquid Membrane (covered slab): Chlorinated rubber membrane forming, curing-sealing compound conforming to ASTM C309.
2. Liquid Membrane (exposed slab): Clear methyl and butyl methacrylate non-staining, membrane forming, curing-sealing compound conforming to ASTM C309.

E. Cement Grout and Drypack:

1. Cement Grout: Mix 1 part by volume of Portland Cement, 1/2 part by volume of water and fine aggregate enough to make mixture flow under its' own weight.
2. Drypack: Mix 1 part by volume of Portland Cement, 1/2 part by volume of water and fine aggregate enough to make a stiff mix that will mold into a ball. Mix no more than can be used in 30 minutes.

2.4 JOINT SEALANT MATERIALS

A. Caulking: Multipart, non-sag gun grade polyurethane-based sealant meeting the requirements of ASTM C920-02, Type S or M, Mamemco International, Pecora, Sika Corp., Sonneborn Building Products, Tremco or approved equal. Self-leveling caulking materials are not allowed.

B. Primer: Non-staining type, recommended by sealant manufacturer to suit application.

C. Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer; compatible with joint forming materials.

D. Sealant Backer Rod: Provide compressible polyethylene or polyurethane backer rod as recommended by the sealant manufacturer.

E. Bond Breaker Tape: Provide polyethylene tape or other plastic tape as recommended by sealant manufacturer, to be applied to sealant-contact surfaces where bond to substrate or joint filler must be avoided for proper performance of sealant.

F. Sand: Cover the surface of the caulking with #30 silica sand.

2.5 OTHER MATERIALS

A. All other materials not specifically described but required for proper completion of the work of this Section, shall be as selected by the Contractor subject to the advance review by the Owner's Representative.

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS

A. Inspection:

1. Prior to all Work of this Section, carefully inspect the installed Work of other trades and verify that all such Work is complete to the point where this installation may properly commence.
2. Verify that all Work may be constructed in accordance with all applicable codes and regulations, the referenced standards, the original design, and in accordance with site specific Geotechnical Report.

B. Discrepancies:

1. In the event of discrepancy, immediately notify the Owner's Representative.
2. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.
3. Failure to notify the Owner's Representative and give written notice of discrepancies shall constitute acceptance by the Contractor of existing conditions as fit and proper to receive work.

3.2 CONCRETE FORMWORK

A. Construction of Forms:

1. General: Construct all required forms to be substantial, sufficiently tight to prevent leakage of concrete paste, and able to withstand excessive deflection when filled with wet concrete.
2. Layout:

a. Form for all required cast-in-place concrete to the shapes, sizes, lines and dimensions indicated on the Drawings.
b. Exercise particular care in the layout of forms to avoid necessity for cutting concrete after placement.
c. Make proper provisions for all openings, offsets, recesses, anchorages, blocking and other features of the Work as shown or required.
d. Perform all forming required for Work of other trades and do all cutting and repairing of forms required to permit such installation.
e. Carefully examine the Drawings and Specifications and consult with other trades as required relative to providing for pipe and conduit penetrations, reglets, chases and other items in the forms.

3. Imbedded Items: Set all required steel frames, angles, bolts, inserts and other such items required to be anchored in the concrete prior to concrete being placed.
4. Bracings:
    a. Properly brace and tie the forms together so as to maintain position and shape and to ensure safety to workmen.
    b. Construct all bracing, supporting members and centering of ample size and strength to safely carry, without excessive deflection, all dead and live loads to which they may be subjected.
    c. Properly space the forms apart and securely tie them together, using metal spreader ties that give positive tying and accurate spreading.
5. Wetting: Keep forms sufficiently wetted to prevent joints from opening up before concrete is placed.

B. Plywood Forms:

1. Design: Nail the plywood panels directly to studs and apply in a manner to minimize the number of joints.
2. Joints: Make all panel joints tight butt joints with all edges true and square.

C. Footing Forms:

1. Wood Forms: All footing forms shall be wood unless otherwise specifically approved by the Owner's Representative, or as specified in paragraph 3.2(C)(2).
2. Earth Forms:
    a. Side walls for footings may be of earth provided the soil will stand without caving and the sides of the bank are made with a neat cut to the minimum dimensions indicated on the Drawings.
    b. For excavation and backfill of earth forms, conform with applicable provisions of Section 13 11 01.

D. Reuse of Forms:

1. Reuse of forms shall be subject to advance approval of the Owner's Representative.
2. Except as specifically approved in advance by the Owner's Representative, reuse of forms shall in no way delay or change the schedule for placement of concrete from the schedule obtainable if all forms were new.
3. Except as specifically approved in advance by the Owner's Representative, reuse of forms shall in no way impart less structural stability to the forms nor less acceptable appearance to finished concrete.

E. Removal of Forms:

1. General:
    a. In general, side forms of footings may be removed seven (7) days after placement of concrete, but time may be extended if deemed necessary by the Owner's Representative.
    b. Forms for footings, foundations, grade beams, slabs, walls, and other formed concrete may be removed fourteen (14) days after placement of concrete.
2. Removal:
    a. Use all means necessary to protect workers, passersby, the installed Work of other trades and the complete safety of the structure.
    b. Cut nails and tie wires or form ties off flush and leave all surfaces smooth and clean.
    c. Remove metal spreader ties on exposed concrete by removing or snapping off inside the wall surface and pointing up and rubbing the resulting pockets to match the surrounding areas.

d. Flush all holes resulting from the use of spreader ties and sleeve nuts using water, and then solidly pack throughout the wall thickness with cement grout applied under pressure by means of a grouting gun; grout shall be one part Portland Cement to 2-1/2 parts sand; apply grout immediately after removing forms.

3.3 CONCRETE REINFORCEMENT

A. Bending:

1. General:

a. Fabricate all reinforcement in strict accordance with the Drawings.
b. Do not use bars with kinks or bends not shown on the Drawings.
c. Do not bend or straighten steel in a manner that will injure the material. (When opposite end is already encased in concrete.)

2. Design:

a. Bend all bars cold.
b. Make bends for stirrups and ties around a pin having a diameter of not less than four (4) times the minimum thickness of the bar (#3-#5) per ACI.
c. Make bends for other bars, including hooks, around a pin having a diameter of not less than six (6) times the minimum thickness of the bar.

B. Placing:

1. General: Before the start of concrete placement, accurately place all concrete reinforcement, positively securing and supporting by concrete blocks, metal chairs or spacers, or by metal hangers.
2. Clearance:

a. Preserve clear space between bars of not less than one and one-half (1-1/2) times the nominal diameter of the round bars.
b. In no case let the clear space be less than one and one-half (1-1/2) inches nor less than one and one-third (1-1/3) times the maximum size of the aggregate.
c. Provide the following minimum concrete covering of reinforcement:

1) Concrete deposited against earth: three (3) inches minimum.
2) Concrete below grade deposited against forms: two (2) inches minimum.
3) Concrete elsewhere: As indicated on Drawings or otherwise approved by the Owner’s Representative.

3. Splicing:

a. Horizontal Bars:

1) Place bars in horizontal members with minimum lap at splices sufficient to develop the strength of the bars.
2) Bars may be wired together at laps except at points of support of the member, at which points preserve clear space described above.
3) Whenever possible, stagger the splices of adjacent bars.
4) Splice seventy-four (74) bar diameters minimum.
5) Provide non-contact lap slices for shotcrete.

b. Wire Fabric: Make all splices in wire fabric at least one and one-half (1-1/2) meshes wide.
c. Other Splices: Make only those other splices that are indicated on the Drawings or specifically approved by the Owner’s Representative.

4. Dowels: Place all required steel dowels and securely anchor them into position before concrete is placed.

5. Obstructions: In the event conduits, piping, inserts, sleeves and other items interfere with placing reinforcement as indicated on the Drawings or otherwise required, immediately consult with the Owner's Representative and obtain approval of a new procedure prior to placing concrete.

C. Cleaning Reinforcement: Steel reinforcement, at the time concrete is placed around it, shall be free from rust scale, loose mill scale, oil, paint and all other coatings which will destroy or reduce the bond between steel and concrete. Bend down all tie wire away from the top of the pool deck. Maintain a 2" clear from top of concrete to the tie wire.

3.4 SHOTCRETE REINFORCEMENT

A. The maximum size of reinforcement shall be No. 5 bars unless it can be demonstrated by preconstruction tests that adequate encasement of larger bars can be achieved. When No. 5 or smaller bars are used, there shall be a minimum clearance between parallel reinforcement bars of 2-1/2 inches (64 mm). When bars larger than No. 5 are permitted, there shall be a minimum clearance between parallel bars equal to six diameters of the bars uses. When two curtains of steel are provided, the curtain nearest the nozzle shall have a minimum spacing equal to 12 bar diameters and the remaining curtain shall have a minimum spacing of six bar diameters.

B. Lap splices in reinforcing bars shall be by the non-contact lap splice method with at least 2 inches clearance between bars. The enforcement agency may permit the use of contact lap splices when necessary for the support of the reinforcing provided it can be demonstrated by means of preconstruction testing, that adequate encasement of the bars at the splice can be achieved, and provided that the splices are placed so that a line through the center of the two spliced bars is perpendicular to the surface of the shotcrete work.

3.5 CAST-IN-PLACE CONCRETE

A. Conveying and Placing Concrete:

1. Before placing concrete, mixing and conveying equipment shall be well cleaned, and the forms and space to be occupied by concrete shall be thoroughly cleaned and wetted. Ground water shall be removed until the completion of the work.
2. No concrete shall be placed in any unit of work until all formwork has been completely constructed, all reinforcement has been secured in place, all items to be built into concrete are in place, and form ties at construction joints tightened.
3. Concrete shall be conveyed from mixer to place of final deposit in such a way to prevent the separation or loss of ingredients. It shall be placed as nearly as practicable in its' final position to avoid rehandling or flowing. Concrete shall not be dropped freely where reinforcing bars will cause segregation, nor shall it be dropped freely more than six (6) feet. Use tremies, spouts and dump boxes in deep sections. Vibrators are not acceptable for facilitating concrete transport.
4. Concrete shall be tamped and spaded to insure proper compaction into all parts of forms and around reinforcement. A mechanical vibrator shall be used to thoroughly compact the concrete. Vibration must be by direct action in the concrete and not against forms or reinforcement.
5. Mixing and transport time as indicated in ASTM C94 is required. If air temperature is between 85° and 90° F the delivery time is to be reduced to 75 minutes. When air temperatures are in excess of 90° F the delivery time should be reduced to 60 minutes.
6. Truck mixes without batch certificates will be rejected.

B. Construction Joints / Expansion Joints: Construction joints and expansion joints shall be provided at locations and in the manner shown on the Drawings. With exception of existing concrete / new shotcrete joints, use PVC bulb-type waterstops appropriate for design condition between all concrete pours / lifts to avoid cold joints. Waterstops shall be placed in such a way to protect reinforcing steel from rust and oxidation. All expansion joints must be the full depth of the concrete section in which they are located.

C. Slab Finishes: Concrete slabs shall be compacted and screeded uniformly to grades shown. Push large aggregates below the surface with a screen tamper, screed and bull float. As soon as the surface becomes workable, it shall be wood floated, then finished as indicated on the Drawings to a uniform smooth, true surface in a neat and workmanlike manner. Carefully coordinate slab finish requirements with other trades (ceramic tile, pool plaster) to insure concrete finish is appropriate substrate for final finish material.

1. Contractor shall provide three mock-up deck samples, minimum 3'x 3', with a wedge anchor installed in one sample. These (3) samples shall be constructed; one with a light broom finish, one (1) with a medium broom finish and one (1) with a heavy broom finish for determination and selection of an appropriate deck finish. Each sample shall be edged on all four sides to demonstrate a 3/4" radius edge. Anchor installation shall demonstrate acceptable interface between anchor and the top of deck. Deck samples shall remain on job site through final inspection for reference.
2. Pool Floor Slab: Heavy Wire Broom Finish.

D. Protection and Curing:

1. Concrete shall be protected from injurious action of the elements and defacement of any nature during construction.
2. All forms must be kept wet to prevent drying out of the concrete.
3. All concrete surfaces including footings must be kept wet for at least seven (7) days after concrete is placed.
4. Apply the appropriate curing materials, as specified in 2.3 of this Section, immediately after finishing slabs. Application shall be as specified by the manufacturer.

E. Form Removal:

1. Take care in removing forms so that surfaces are not marred or gouged and that corners are true, sharp and unbroken.
2. No steel spreaders, ties or other metal shall project from or be visible on any concrete surfaces.

F. Defective Work:

1. Should the strength of any concrete for any portion of the work indicated by tests of molded cylinders and core tests fall below minimum 28 days strength specified or indicated, concrete will be deemed defective work and shall be replaced.
2. Concrete work that is not formed as indicated, is not true to intended alignment, not plumb or level where so intended, not true to intended grades or elevations, not true to specified or selected finish, contains sawdust shavings, wood, or embedded debris, which exhibits cracks or contains fine or coarse sulfide particles, or expansive aggregates detrimental to performance or appearance of the concrete shall be deemed defective.
3. Promptly perform work required to replace and properly clean (by sandblasting if necessary) any defective concrete panels (control joint or expansion joint to control joint or expansion joint), at Contractor's expense, including all expense of additional inspection, tests, or supervision made necessary as a result of defective concrete.

3.6 EXPANSION JOINTS

A. Temperatures: Do not install sealants when air temperature is less than 40°F.

B. Tooling: Tool exposed joints to a slightly concave surface using slicking materials recommended by the manufacturer. The tooling procedure shall press sealant against the sides of the joint. No materials shall be left "feathered" out or smeared on the abutting materials. Completed joints shall have a uniform professional appearance.

C. Joint Construction: Sealant joint width, thickness and cross-sectional profile to be constructed in strict accordance with the sealant manufacturer's recommendations.

D. Sand: At the appropriate time cover the sealant with sand to provide a sanded finish.

3.7 CLEAN-UP

A. Upon completion of the Work of this Section, immediately remove all swimming pool concrete materials, debris and rubbish occasioned by this Work to the approval of the Owner's Representative.

END OF SECTION

SECTION 13 11 03 - SWIMMING POOL SHOTCRETE

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide labor, materials and equipment as required to install wet mix shotcrete for swimming pool structures as indicated on the Drawings and herein specified.

1.2 QUALITY ASSURANCE

A. Qualifications of Workers:

1. The entity performing the work of this Section shall have been successfully engaged in the respective trade for at least five (5) years immediately prior to commencement of the Work.
2. For actual construction operations, use only trained and experienced workers with a minimum of three (3) years experience with the materials and methods specified.
3. Provide at least one person who shall be present at all times during execution of the work of this Section, with a minimum of five (5) years experience with the type of materials being installed, the referenced standards, and who shall direct all Work performed under this Section.

B. Standards: Except as otherwise indicated, provide shotcrete per American Concrete Institute Standard ACI 506. In addition, conform to recommendations contained in “Shotcrete,” Brochure G-84 as published by the Gunite Contractors Association, Sylmar, California and the California Building Code (latest edition). Comply with CBC 2016 Section 1908A.

C. Mix Design: The Contractor shall submit a mix design stamped and signed by a licensed engineer for approval by the Owner’s Representative prior to any placement of shotcrete. Mix design shall indicate source of aggregate and brands of cement and admixtures used. All mix designs shall take character of locally available aggregate into consideration and make adjustments as necessary to conform with specified design criteria.

D. Testing and Inspection: A test panel shall be shot, cured, cored or sawn, examined and tested (representing the most congested and difficult project scenario) prior to commencement of the project in accordance with ASTM C1140. All project conditions and personnel shall be represented in the test panel. Additionally, one test panel shall be provided for each 50 yards (or portion thereof) of shotcrete placed for each day or each nozzleman, whichever is greater. The size of the strength test panel shall be per the direction of the Special Shotcrete Inspector. At least three (3) cores shall be taken from each test panel. (At least three (3) cores shall be taken from the completed work for each day of shotcrete operation.) Testing shall be performed by the Owner’s designated Testing Lab and comply with Section 1908A.10, California Building Code. Continuous inspection of the shotcrete operation by a deputy inspector provided by the Owner shall be required. Inspection of shotcrete work shall comply with Section 1908A of California Building Code, and coring, sampling, soaking and testing per 1908A.5 and 1908A.10 of California Building Code. Contractor shall provide test panels for all required tests. The Contractor shall provide the Owner and Testing Lab 48 hours’ notice before the start of shotcrete operations.

E. Tolerances: Construct all swimming pool shotcrete straight, true, plumb and square within a tolerance horizontally of one in 200 and a tolerance vertically of one in 2000.

1.3 SUBMITTALS AND SUBSTITUTIONS

A. Provide submittals in conformance with the requirements of Section 01 33 00 and ACI 506.2.

B. Materials List: Within thirty (30) days after issuance of Notice to Proceed, and before shotcrete materials are delivered to the project site, submit to the Owner’s Representative a complete list

of materials proposed to be used in this portion of the Work, showing manufacturer's name and catalog number of all items such as admixtures and curing membranes, and the name and address of the supplier of cement and aggregate to be used.

C. Submit proof of qualifications as specified in Article 1.2.A of this Section.

1.4 PRODUCT HANDLING

A. Protection: Use all means necessary to protect shotcrete materials before, during and after installation and to protect the installed Work specified in other Sections.

B. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the approval of the Owner’s Representative and at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cement: Cement shall be Type II Portland Cement conforming to ASTM C150. Cement type shall be the same for all shotcrete work.

B. Aggregate: ASTM C33, washed hard dense durable clean sharp sand from approved pit, free of organic matter and opaline, feldspar, or silicous magnesium substances and containing not more than 3% by weight of deleterious substances. Maximum size aggregate for shotcrete is ¾” per CBC 1908A.3. When tested for organic impurities by ASTM C40 method, fine aggregate color not darker than reference standard color. When tested for soundness by ASTM C88 method, grading No. 2 of ASTM C1436, loss after 5 cycles not over 10% of fine aggregate.

C. Water: Potable, clean, fresh, free from acid, alkali, organic matter or other impurities liable to be detrimental to the shotcrete.

D. Admixtures: Admixtures shall conform to ASTM C1141 and only be used upon approval of the Owner's Representative.

PART 3 - EXECUTION

3.1 EXECUTION

A. Inspection:

1. Prior to all Work of this Section carefully inspect the installed Work of other trades and verify that all such Work is complete to the point where this installation may properly commence.
2. Verify that items to be imbedded in shotcrete are in place and that shotcrete may be placed to the lines and elevations shown on the Drawings, with all required clearance from reinforcement.

B. Discrepancies:

1. In the event of discrepancy, immediately notify the Owner's Representative.
2. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.
3. Failure to notify the Owner's Representative and give written notice of discrepancies shall constitute acceptance by the Contractor of existing conditions as fit and proper to receive the Work.

3.2 PREPARATION

A. General:

1. Thoroughly clean all areas where shotcrete is to be placed to insure proper bonding of shotcrete.
2. Where shotcrete is to be placed against smooth surfaces (i.e., cast-in-place concrete), sandblast surfaces to receive shotcrete to provide clean aggregate surface, thereby insuring proper bond between materials.

B. Ground Wires: Adequate ground wires, to be used as screeds, shall be installed to establish the thickness and surface planes of the shotcrete work. Ground wires shall be placed so that they are tight and true to line and grade and in such a manner that they can be easily tightened.

3.3 PROPORTIONING AND MIXING

A. Accurately control proportion of water to Portland cement to produce thorough and uniform hydration of the shotcrete that, when shot, forms a homogeneous mass containing neither sags nor dry sand formation. Proportion by mass per ASTM C94 or by volume per ASTM C685.

B. Shotcrete shall have a minimum compressive strength of 4,000 PSI at 28 days. Shotcrete material shall have a water/cement ratio of 0.40-0.45 per ACI 506R, Chapter 6, Proportioning and Preconstruction Testing; Section 6.3.3, Wet Mix Process.

C. Discontinue shotcrete work if the time between the addition of mixing water to cement and aggregate, or cement to aggregates, and placement of shotcrete exceeds ninety (90) minutes when the ambient temperature is below 85 degrees Fahrenheit or exceeds sixty (60) minutes when the ambient temperature is above 85 degrees Fahrenheit. Batch, mix and deliver wet-mixture shotcrete per ASTM C94 or C685.

D. Hot Weather Shotcreting – Unless otherwise specified, do not place shotcrete when shotcrete temperature is above 95°F, unless prequalification testing shows that the required quality of materials can be achieved at high temperatures. The temperature of reinforcement and receiving surfaces shall be below 90°F prior to shotcrete placement.

E. Cold Weather Shotcreting – Unless otherwise specified, shooting may proceed when ambient temperature is 40°F and rising. Stop shooting when ambient temperature is 40°F and falling, unless measures are taken to protect the shotcrete. Shotcrete material temperature, when shot, shall not be less than 50°F. Do not place against frozen surfaces.

3.4 SHOTCRETE PLACING, FINISHING, AND CURING

A. Operations: Utilize a standard type of air compressor, capable of providing a minimum of 250 cubic feet of air per minute per nozzle.

B. Placing: Except when shooting reinforcing, hold the nozzle perpendicular to and 2-1/2 to 3 feet from surface. At reinforcing bars, hold the nozzle so as to direct shotcrete behind the bars, and shoot each side of each bars separately. A nozzleman's helper equipped with an air jet shall precede the nozzle and blow out rebound or sand lodged behind bars, on forms, or placed shotcrete. Placing shotcrete horizontal members from the top is not allowed unless approved methods are employed to eliminate all rebound. Material shall emerge from the nozzle in a uniform flow. If flow becomes intermittent for any reason, direct the nozzle away from the surface until the flow is again steady and constant. Do not reuse rebound or loose sand for any purpose.

C. Puddled Shotcrete: Use of "puddled shotcrete" in which the air pressure is reduced and the water content is increased to facilitate placing in difficult locations is not allowed. Do not place shotcrete where nozzle stream cannot impinge directly on the involved surface. Where difficult shooting conditions occur, obtain proper results by maintaining correct air pressure and water ratio and reduce supply of material.

D. Construction Joints: Form joints with sloping beveled edges. Clean and dampen the hardened joint surfaces before placing additional shotcrete. Square edged construction joints are not allowed. The film of laitance which forms on the surface of the shotcrete shall be removed

within approximately two hours after application by brushing with a stiff broom. If this film is not removed within two hours, it shall be removed by thorough wire brushing or sand blasting. Construction joints over eight hours old shall be thoroughly cleaned with air and water prior to receiving shotcrete.

E. Finishing: Rod exposed surfaces to true planes and lines on reaching the thickness and plane established by forms and ground wires. Tamp and wood float surfaces level and provide a rough raked finish. Carefully coordinate finish requirements with other trades (ceramic tile, pool plaster) to insure shotcrete finish is appropriate substrate for final finish material.

F. Curing: Keep shotcrete continuously damp for not less than seven (7) days after placing. Use sealed curing sheeting or other approved curing method where water curing is not feasible. Do not use curing compound of any kind.

3.5 DEFECTIVE WORK

A. Cut out, remove and replace, or repair to the satisfaction of the Owner’s Representative, shotcrete not meeting minimum strength, not true, plumb or level, not to required elevations, containing cracks detrimental to performance or appearance, containing shavings, debris or with honeycombs or voids.

B. Promptly perform Work required to repair, patch, replace, render properly cleaned surfaces (by sandblasting if necessary) or otherwise make good any defective shotcrete at Contractor's expense, including all expense of additional inspection, tests, or supervision made necessary as a result of defective shotcrete.

3.6 CLEAN-UP

A. Upon completion of the Work of this Section, immediately remove all swimming pool shotcrete materials, debris and rubbish occasioned by this work to the approval of the Owner's Representative.

END OF SECTION

SECTION 13 11 04 - SWIMMING POOL CERAMIC TILE

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish and install all swimming pool ceramic tile detailed on the Drawings, including, but not limited to, the following:

1. Waterline Face Tile (deep gutter)
2. Gutter Cap Tile (deep gutter)
3. Lane Line / Target Tile / 4'-6" Depth Tile
4. Depth Marker Tile (at cantilever deck at deep gutter)
5. Depth / Caution Marker Tile (at gutter pool decks).
6. Trim Tile (at steps).

1.2 QUALITY ASSURANCE

A. All Work of this Section shall be performed or supervised by the Swimming Pool Subcontractor.

B. Qualifications of Workers:

1. The contractor / subcontractor for this portion of the Work shall have been successfully engaged in the respective trade for at least five (5) years immediately prior to commencement of this work and shall demonstrate to the approval of the Owner’s Representative that his record of workmanship is satisfactory.
2. For actual construction operations, use only thoroughly trained and experienced workers completely familiar with the materials and methods specified.
3. Provide at least one person who shall be present at all times during execution of this portion of the Work and who shall be thoroughly familiar with the type of materials being installed, the referenced standards, and the requirements of this Work, and who shall direct all Work performed under this Section.

C. Standards: In addition to complying with all pertinent codes and regulations:

1. Manufacture of all tile shall be in accordance with ANSI A-137.
2. Install ceramic tile in accordance with the recommendations contained in 2021Handbook for Ceramic Tile Installation of the Tile Council of America, Inc.

D. Tolerances: Install all swimming pool ceramic tile straight, true, plumb and square within a tolerance horizontally of one in 200 and a tolerance vertically of one in 500. Waterline and gutter bullnose tile shall be level to 1/8” (+/- 1/16”) around entire perimeter of swimming pool(s).

1.3 SUBMITTALS AND SUBSTITUTIONS

A. Provide submittals in accordance with the requirements of Section 01 33 00.

B. Samples: Submit five (5) samples of each color and pattern in the specified groups. Character samples can be representative for review prior to screening of actual tile.

C. Master Grade Certificate: Prior to opening ceramic tile containers, submit a Master Grade Certificate, signed by the manufacturer of the tile used and issued when the shipment is made, stating the grade, kind of tile, identification marks for the tile containers, and the name and location of the Project.

D. Specifications: Submit five (5) copies of manufacturer's recommended installation specifications for this Work.

1.4 PRODUCT HANDLING

A. Delivery: Deliver all materials to the Project Site in the manufacturer's original unopened containers with all labels intact and legible.

B. Storage: Store all materials under cover in a manner to prevent damage and contamination, and store only the specified materials at the Project site.

C. Protection: Use all means necessary to protect swimming pool ceramic tile before, during and after installation and to protect the installed Work of all other trades.

D. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the approval of the Owner's Representative.

PART 2 - PRODUCTS

2.1 TILE

A. Waterline Face Tile:

1. Material: All waterline face tile shall be glazed ceramic tile (Group 3 standard) as manufactured by Dal-Tile or approved equal.
2. Size: 6 x 6 inches.
3. Color: Dal-Tile #D-129, 'Sky Blue'. Contact Kylee Midura kylee.midura@daltile.com (858)344-0019.

B. Gutter Cap Tile:

1. Material: All gutter cap tile shall be glazed ceramic tile (Group 3 standard) as manufactured by Dal-Tile or approved equal.
2. Size: 2-1/2 x 6 inches (#A-7250).
3. Color: Dal-Tile #D-129, 'Sky Blue'.

C. Lane Line / Target Tile / 4'-6" Depth Tile:

1. Material: Group 3 quality, non-slip frost proof unglazed ceramic mosaic tile with absorption rate of less than 1% as manufactured by Dal-Tile or approved equal.
2. Size: 1 x 1 inches.
3. Color: Dal-Tile #D-311, 'Black' in 25 Yard direction and end wall target tile. Dal-Tile #D-023, 'Galaxy Blue' at 4'-6" depth tile.

D. Depth Marker Tile (At Cantilever Deck Face at Deep Gutter):

1. Material: All depth marker tiles shall be glazed ceramic tile as manufactured and/or distributed by Dal-Tile, Precision Tile Co., or approved equal.
2. Size: 4-1/4 x 4-1/4 inches.
3. Color: Dal-Tile #X-114, 'Desert Gray' with Black silk screen numbers.
4. Trim: Furnish trim pieces as indicated on the Drawings.

E. Depth / Caution Marker Tile (at pool deck at deep gutter):

1. Material: Group 3 quality, frost proof unglazed ceramic mosaic tile with absorption rate of less than 1% as manufactured by Dal-Tile or approved equal.
2. Size: 1 x 1 inches.
3. Color: Dal-Tile #D-311, 'Black' letters and numbers on #D-014, 'Light Gray' field.

F. Trim Tile (on underwater steps):

1. Material: Group 3 quality, non-slip frost proof unglazed ceramic tile with absorption rate of less than 1% as manufactured by Dal-Tile or approved equal.
2. Size: 1 x 1 inches with S-812 quarter round. Color: Dal-Tile #D-311. 'Black.'
3. Size: 2 x 6 inches with integral quarter round. Color: Black, non-slip. Inlays #CPC00022.

2.2 MORTAR

A. Laticrete 3701 fortified mortar #LCR-37-1017

B. Site mortar mix shall comply with ASTM C270 standards.

1. Sand for mortar: Comply with requirements of fine aggregate for concrete.
2. Cement: Type 1 Portland Cement, conforming to ASTM C150
3. Hydrated Lime: Conforming to ASTM C206 or 207, Type S.
4. Water: From a potable source.

C. Water: from a potable source.

D. Mortar shall meet ASTM C627.

2.3 THIN SET MORTAR

A. Laticrete 254 Platinum. Laticrete, Custom or equal.

B. Water from a potable source.

C. Mortar shall meet ASTM C627.

2.4 GROUT

A. All tile grout shall be waterproof grout complying with the recommendations of referenced standards. Grout color shall be grey for dark backgrounds, white for light backgrounds (verify colors with Architect).

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS

A. Inspection:

1. Prior to all Work of this Section, carefully inspect the installed Work of other trades and verify that all such Work is complete to the point where this installation may properly commence.
2. Verify that ceramic tile can be installed in accordance with the original design and all referenced standards.

B. Discrepancies:

1. In the event of discrepancy, immediately notify the Owner’s Representative.
2. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved
3. Failure to notify the Owner’s Representative and give written notice of discrepancies shall constitute acceptance by the Contractor of existing conditions as fit and proper to receive its Work.

3.2 INSTALLATION

A. Method:

1. Install all ceramic tile in strict accordance with installation method P601-90 of the 2021 Handbook for Ceramic Tile Installation of the Tile Council of America, Inc.
2. Be certain to install all ceramic tile perfectly level, flush, plumb, and to the finish grades and elevations indicated on the Drawings.

B. Interface:

1. Carefully establish and follow the required horizontal and vertical elevations to insure proper and adequate space for the work and materials of other trades.

2. Coordinate and cooperate as required with other trades to insure proper and adequate interface of ceramic tile Work with the Work of other trades.

3.3 GROUTING

A. Follow grout manufacturer's recommendations as to grouting procedures and precautions.

B. Remove all grout haze, observing grout manufacturer's recommendations as to use of acid and chemical cleaners.

3.4 EXTRA STOCK

A. Provide one (1) unopened box of extra tile for 2.1A, 2.1B, and 2.1C for Owners use at a future time.

3.5 CLEAN-UP

A. Upon completion of the swimming pool ceramic tile installation, thoroughly clean and polish the exposed surfaces of tile work. Completely clean work area of debris and rubbish occasioned by this Work and dispose of to the approval of the Owner’s Representative.

END OF SECTION

SECTION 13 11 05 -SWIMMING POOL PLASTER

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Swimming pool plaster and waterproofing of swimming pool structures as indicated on the Drawings and herein specified.

B. Start-up and operation instructions to Owner's operations and maintenance personnel and properly balance swimming pool water chemistry until the Owner takes occupancy.

1.2 QUALITY ASSURANCE

A. Qualifications of Workers:

1. The entity performing the work of this Section shall have been successfully engaged in the respective trade for at least five (5) years immediately prior to commencement of the Work.
2. For actual construction operations, use only trained and experienced workers with a minimum of three (3) years experience with the materials and methods specified.
3. Provide at least one person who shall be present at all times during execution of the work of this Section, with a minimum of five (5) years experience with the type of materials being installed, the referenced standards, and who shall direct all Work performed under this Section.

B. Standards: Swimming pool plaster shall conform with requirements of Chapter 31B of California Building Code, latest edition. In addition, meet requirements of applicable portions of most current edition of the "Technical Manual," National Plasterers Council, Wauconda, Illinois.

C. Start-up:

1. Furnish a swimming pool water chemistry consultant, with a minimum of five (5) years experience, possessing either AFO (Aquatic Facility Operator) or CPO (Certified Pool Operator) certification(s), to supervise and properly balance swimming pool water chemistry.
2. Demonstrate to the Owner's Representative that all systems are fully operational and that calcium hardness, total alkalinity, chlorine residual and pH levels are within specified limits.
3. Standards: Furnish labor and chemicals as required to condition the water properly to the following specifications:

a.	Calcium Hardness:	200-400 parts per million (PPM)
b.	Total Alkalinity:	80-100 PPM
c.	Chlorine Residual:	1.00 to 2.00 PPM
d.	pH Factor:	7.2 to 7.6

1.3 SUBMITTALS AND SUBSTITUTIONS

A. Provide submittals in conformance with the requirements of Section 01 33 00.

B. Submit proof of qualifications as specified in Article 1.2.A and 1.2.C.1 of this Section.

1.4 PRODUCT HANDLING

A. Delivery: Deliver materials to the Project Site in the manufacturer's original unopened containers with all labels intact and legible.

B. Storage: Store materials under cover in a manner to prevent damage and contamination, and store only the specified materials at the Project Site.

C. Protection: Use all means necessary to protect the swimming pool plaster before, during, and after installation and to protect the installed Work specified in other Sections.

D. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the approval of the Owner's Representative.

1.5 ENVIRONMENTAL CONDITIONS

A. No plastering shall be done under unsuitable conditions of weather or temperature. No plastering shall be done when prevailing temperature is 40 degrees Fahrenheit or less.

B. Do not install plaster during rain and, if rain commences after plastering has begun, immediately protect the plaster from rain by all means necessary until the plaster has set.

C. Do not install plaster during wind greater than 10 mph and, if wind commences after plastering has begun, immediately protect the plaster from wind by all means necessary until the plaster has set.

PART 2 - PRODUCTS

2.1 CEMENT / AGGREGATE

A. Luna Quartz® tiny pebble finish by Wet Edge Technologies. Altima® quartz finish by Wet Edge Technologies. Pebble-Fina® pool finish by Pebble Technologies.

2.2 COLOR

A. All swimming pool plaster shall be white in color. Wet Edge Technologies shall be Luna Quartz® "Polar White". Wet Edge Technologies shall be Altima® "White". Pebble Technology shall be Pebble-Fina® "Classico". Contractor to obtain written approval on selected pebble color from the local Health Department prior to installation. Submit cut sheet, color sample and written approval for review by Architect and Owner.

2.3 WATER

A. Water for swimming pool plaster shall be clean and free from injurious amounts of acid, alkali, and organics.

2.4 GUTTER, PUMP PIT, BACKWASH PIT & SURGE CHAMBER WATERPROOFING

A. Xypex, Miracote Membrane C, or approved equal. Mix and apply per manufacturer's recommendations for specific application. Color shall be Gray.

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS

A. Inspection:

1. Prior to Work of this Section, carefully inspect the installed Work of other trades and verify that all such Work is complete to the point where this installation can properly commence.
2. Verify that swimming pool plaster can be installed in accordance with the original design and all referenced standards, including proprietary application techniques and application training/certifications.

B. Discrepancies:

1. In the event of discrepancy, immediately notify the Owner's Representative.

2. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.
3. Failure to notify the Owner's Representative and give written notice of discrepancies shall constitute acceptance by the Contractor of existing conditions as fit and proper to receive the Work.

3.2 INSTALLATION OF GUTTER, PUMP PIT, BACKWASH PIT & SURGE CHAMBER WATERPROOFING

A. Provide two (2) coats of the specified gutter and surge chamber waterproofing prior to plastering the swimming pool. Prepare surfaces to receive waterproofing and cure in conformance with manufacturer's recommendations. Provide steel trowel application method to ensure uniform smooth, dense surface finish.

3.3 INSTALLATION OF POOL PLASTER

A. Outdoor Pools or Spas:

1. Completion of other work: DO NOT commence plastering of swimming pool(s) or spa(s) until the following conditions have been met:

a. The Health Department and/or other governing agencies have approved the pool(s) and/or spas) for plaster.
b. All concrete pool deck construction is complete and the pool decks have been thoroughly cleaned.
c. All landscaping in areas adjacent to the pool(s) or spa(s) is complete and the landscape irrigation system is operable.
d. All painting in the pool area is complete.
e. All welding and grinding in locations adjacent to the pool area are complete.
f. The backwash sewer connection is complete.
g. Pool(s) and/or spa(s) area(s) perimeter fencing installation is complete.
h. All trash and debris have been removed from areas adjacent to the pool(s) or spa(s), particularly those areas that are normally upwind from the pool(s) or spa(s).
i. All dust raising construction and/or activities in areas adjacent to the pool(s) or spa(s) are complete or mitigated.
j. The circulation pump(s) is/are operational.
k. The mechanical system has been flushed sufficiently to remove all dirt and debris from the piping system.
l. All necessary chemicals (Chorine, pH adjuster, Sodium Bicarbonate and Calcium Chloride or any other required chemicals) are on site and ready for use.
m. Obtain written approval from the Owner’s Representative and the Architect.

B. Indoor Pools or Spas:

1. Completion of Other Work: DO NOT commence plastering of swimming pool(s) or spa(s) until the following conditions have been met:

a. The Health Department has approved the pool(s) and/or spa(s) for plaster.
b. All work above the pool(s) and/or spa(s) is complete.
c. All painting in the pool area is complete.
d. All welding and grinding in locations adjacent to the pool area are complete.
e. The backwash sewer connection is complete.
f. All concrete pool deck construction is complete and the pool decks have been thoroughly cleaned.
g. The circulation pump(s) is/are operation.
h. The mechanical system has been flushed sufficiently to remove all dirt and debris from the piping system.

i. All necessary chemicals (Chlorine, Acid, Sodium Bicarbonate and Calcium Chloride) are on site and ready to use.
j. Obtain written approval from the Owner's Representative and the Architect.

C. Contractor accepts all liability from damage done to the pool plaster if the pool(s) or spa(s) is (are) plaster before the completion of the above listed items or without the written approval of the Owner's Representative and the Architect.

D. POOL PLASTER AUTHORIZATION FORM:

1. The pool(s) and or spa(s) at Compton Community College is/are hereby approved for the installation of the pool plaster. Pursuant to the requirements of specification section 13 11 05, paragraph 3.3.

Owner	Date
Architect / Project Manager	Date

E. Preparation:

1. Do not apply plaster over dirt, rust, scale, grease, moisture, scuffed surfaces or conditions otherwise detrimental to the formation of a durable plaster finish.
2. Consult with manufacturer on application to specific surfaces being treated. Follow manufacturer's recommendation for curing of cast-in-place concrete or shotcrete surfaces prior to application of plaster.
3. Protect ceramic tile, decking, deck equipment, gratings, fittings and other items by suitable covering or masking.
4. Mask or remove all hardware, hardware accessories, machined surfaces, plates, lighting fixtures and similar items in place not to receive pool plaster. Following completion of plaster for each space or area remove masking. Re-install all removed items utilizing workers skilled in the trades involved.

F. Application:

1. Finish shall be applied to a uniform thickness of 3/8" to ½" over the entire surface. The walls shall be scratch-coated followed by a finish coat. Material applied to the floor after the walls have been applied shall be accelerated to assure uniform setting time throughout the pool surface.
2. Float the plaster to a uniform plane and trowel to a smooth, dense, impervious surface using extreme care to avoid stains.
3. Take special care in finishing around pool fittings, making sure to mask off or plug openings so as not to fill such openings with excess plaster. Be certain to completely enclose pool fittings with plaster to insure a leak-proof seal around pipes, fittings, lights, anchors, etc.
4. Accurately interface with the finish planes of items installed by other trades.
5. Quartz and pebble plaster finish is to be applied by a licensed applicator as approved by the manufacturer, and in accordance with manufacturer's training.

3.4 CURING

A. Preparation: Anticipate the need for required equipment and have all such equipment immediately available for use upon completion of pool plastering.

B. Pool Filling:

1. After the plaster has sufficiently dried and before drying has proceeded to a damaging point, cure the plaster by gradually filling the pool with water, preventing all damage to finished plaster surfaces.
2. Flow the water continuously until the pool is filled.
3. When the weather is hot and/or water pressure is low, keep the pool walls damp while the pool is filling.
4. Coordinate with Contractor to ensure that the pool is continuously monitored while filling to prevent overfill.

3.5 EQUIPMENT ACTIVATION

A. All water chemistry and filtration mechanical equipment shall be operational upon filling of pool after plaster. Chemicals and other related support items as supplied by Contractor, shall be in supply at start-up.

B. For the first fourteen (14) calendar days after completion of the pool plaster, brush all plastered surfaces at least twice a day and coordinate with General Contractor to ensure that the plaster is carefully maintained after the initial fourteen-day period. In addition, coordinate with the Contractor to ensure that pool filtration equipment is continuously running during the initial fourteen-day period.

C. Start-up and provide qualified personnel to operate pool equipment for a period not less than fourteen (14) days after the pool is placed in operation, or until the Owner takes occupancy of the facility or letter of substantial completion. During this time, Contractor shall instruct and supervise the Owner's personnel in the various operating and maintenance techniques involved. Contractor shall be responsible for supply of chemicals during this not less than fourteen (14) day period and at time of turnover to Owner, chemical storage tanks shall be full. (Owner's personnel shall be fully trained and capable of assuming swimming pool maintenance tasks, training may begin before Owner takes occupancy).

3.6 CLEAN-UP

A. Upon completion of swimming pool plaster, remove all materials, equipment and debris occasioned by this Work and leave the job site in a clean and presentable condition. Perform all such clean-up to the approval of the Owner’s Representative.

3.7 WARRANTY

A. All applicators must provide a minimum of five (5) year warranty for application and workmanship additional to the manufacturer’s warranty for product.

END OF SECTION

SECTION 13 11 06 - SWIMMING POOL EQUIPMENT

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Supply and install pool equipment items as required for this Work as indicated on the Drawings and specified herein.

1.2 QUALITY ASSURANCE

A. All Work of this Section shall be performed or supervised by the Swimming Pool Subcontractor.

B. Qualifications of Workers:

1. The contractor / subcontractor for this portion of the Work shall have been successfully engaged in the respective trade for at least five (5) years immediately prior to commencement of this work and shall demonstrate to the approval of the Owner's Representative that his record of workmanship is satisfactory.
2. For actual construction operations, use only thoroughly trained and experienced workers completely familiar with the materials and methods specified.
3. Provide at least one person who shall be present at all times during execution of this portion of the Work and who shall be thoroughly familiar with the type of materials being installed, the referenced standards, and the requirements of this Work, and who shall direct all Work performed under this Section.

C. All equipment supplied or work performed shall comply with regulations governing public swimming pools and spas as contained within Chapter 31 of California Building Code, latest edition.

1.3 SUBMITTALS AND SUBSTITUTIONS

A. Provide submittals in accordance with the requirements of Section 01 33 00.

B. Required submittals include:

1. Swimming Pool Safety Equipment and Maintenance Equipment as specified in Article 2.1 and 2.2 of this Section.
2. Swimming Pool fittings, Deck and Mechanical Equipment as specified in Article 2.3-2.16 of this Section.

C. Submit proof of qualifications as specified in Article 1.2 A of this Section.

D. The equipment shown on the plans represent the first listed items in the technical specifications. The Contractor shall be responsible for all required field coordination and installation of any approved equal product to provide a fully working and warranted system. The Contractor shall submit detailed shop drawings for any products used other than the first listed specified items. Contractor provided shop drawings shall include details and quality equal to the original plans and construction documents. The Contractor shall provide any and all required engineering including but not limited to structural and anchorage requirements for any proposed equipment other than the first listed specified equipment. The Contractor is responsible to provide a factory certified representative(s) to start-up and provide on-site training for all swimming pool mechanical equipment provided.

1.4 PRODUCT HANDLING

A. Protection: Use all means necessary to protect swimming pool equipment items before, during and after installation and to protect the installed Work of all other trades.

SECTION 13 11 07 - SWIMMING POOL MECHANICAL

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Swimming pool mechanical piping as indicated on the Drawings for circulation and filtration systems, pool water heating systems, chemical control systems, booster pump systems and appurtenances.

B. Domestic water system from points of connection within swimming pool mechanical equipment room to make-up water system.

C. Filter backwash piping to point of connection with backwash retention pit as required.

1.2 QUALITY ASSURANCE

A. Qualifications of Workers:

1. The entity performing the work of this Section shall have been successfully engaged in the respective trade for at least five (5) years immediately prior to commencement of the Work.
2. For actual construction operations, use only trained and experienced workers with a minimum of three (3) years experience with the materials and methods specified.
3. Provide at least one person who shall be present at all times during execution of the work of this Section, with a minimum of five (5) years experience with the type of materials being installed, the referenced standards, and who shall direct all Work performed under this Section.

B. Standards:

1. All equipment supplied or work performed shall comply with Chapter 31 of California Building Code, latest edition.
2. Work shall be performed in accordance with the applicable editions of all National, State and local codes, laws, regulations and ordinances, including the following:

    a. American National Standards Institute (ANSI).
    b. American Society for Testing Materials (ASTM).
    c. American Waterworks Association (AWWA).
    d. American Welding Society (AWS).

3. Do not construe anything in the Drawings or Specifications to permit Work not conforming to these requirements.

1.3 SUBMITTALS AND SUBSTITUTIONS

A. Provide submittals in conformance with the requirements of Section 01 33 00.

B. Required submittals include:

1. Pipe and Fittings as specified in Article 2.2 of this Section.
2. Valves as specified in Article 2.3 of this Section.
3. Pressure / Vacuum Gauges as specified in Article 2.4 of this Section.
4. Pipe Hangers and Supports as specified in Article 2.5 of this Section.
5. Sleeves and Waterstops as specified in Article 2.6 of this Section.

C. Submit proof of qualifications as specified in Article 1.2 A of this Section.

1.4 PRODUCT HANDLING

A. Delivery: Deliver all materials to the Project Site in the manufacturer's original unopened containers with all labels intact and legible.

B. Storage: Store all materials under cover in a manner to prevent damage and contamination, and store only the specified materials at the Project site.

C. Protection: Use all means necessary to protect swimming pool mechanical items before, during and after installation and to protect the installed Work specified in other Sections.

D. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the approval of the Owner's Representative and at no additional cost to the Owner.

1.5 JOB CONDITIONS

A. Cooperate with entities performing Work specified in other Sections to so that no conflict of new construction or occupied space may occur. Should any installation Work be done without such craft coordination, that Work so installed shall be removed and re-installed.

PART 2 - PRODUCTS

2.1 PRODUCT QUALITY

A. Materials and equipment shall be new, of the best quality for the purpose intended, and shall be clearly marked with the manufacturer's name and nameplate data or stamp and rating. As far as practicable, materials and equipment shall be of one manufacturer.

2.2 PIPE AND FITTINGS

A. PVC Schedule 40: Type 1, normal impact, NSF approved for solvent welding applications, ASTM Specification D-1785, color shall be white. Dura, Lasco, or approved equal.

B. PVC Schedule 80: Type 1, normal impact, NSF approved for solvent welding applications, ASTM Specification D-1785, color shall be gray. Dura, Lasco, or approved equal.

C. CPVC Schedule 80 Influent/Effluent Heater Piping: Type 1, normal impact, NSF approved for solvent welding applications, ASTM Specification D-1785, color shall be gray. Dura, Lasco, or approved equal.

D. PVC DR25: Conforming to ASTM D-1784, use with epoxy coated bell and spigot-type fittings or epoxy coated mechanical joint by flange adapters with epoxy coated cast iron fittings as specified in Article 2.02 (F), below. Johns-Manville "Big Blue", Diamond Plastics, or approved equal.

E. Copper Tubing: ASTM Specification B-88, hard drawn, with ANSI Standard B16.22 wrot copper fittings.

F. Steel: ASTM Specification A-120, Schedule 40 black or galvanized pipe with ASTM A-47 150 lb. banded malleable iron threaded fittings.

G. Cast Iron: ASTM Specification B16.1, cast iron flanged fittings, provide epoxy coating as required for use with chlorinated water.

2.3 VALVES

A. Ball Valves:

1. For pool system: True-Union design, PTFE seat material with FPM or FKM Double O-ring stem seals, locking handle, NSF certified. PVC schedule 80 body for below grade installation. PVC Schedule 80 body for above grade installation. Furnish ball valves on

all pip diameters 2 ½" or less with a rating of at least 200psi at 73° F, Asahi, Nibco, or Ipex.

2. For copper pipe system: 3-piece full-port bronze body valve with Teflon seat, 'Apollo', 'Nibco' or approved equal.

B. Butterfly Valves:

1. Epoxy coated cast or ductile iron body, 316 stainless steel disc and stem, viton seat material, furnish hand wheel/gear operators on all valves 8" and larger. DeZurick, Keystone, or Ipex.
2. PVC body, PVC disc and EPDM construction suitable for chlorinated water applications. Stem shall be of 316 stainless steel and non-wetted. Valves shall be self-gasketed design with a convex sealing arrangement. Valves 1-1/2" – 10" shall be rated to 150 psi and 12" valves shall be rated to 100 psi at 70°F. Asahi Pool-Pro, no known equal.

C. Check Valves: Wafer-type, epoxy coated cast or ductile iron body, 316 stainless steel plates and shaft, viton seat material. Centerline, Metraflex, or approved equal.

D. Competition Pool Surge Chamber Float Valve: EPD #2-0020-231 Float Control Valve, 12"-line size, as manufactured by Environmental Products Division of Doughboy Recreational, Rancho Cucamonga, CA, no known equal. Two (2) required.

E. Surge Chamber Isolation Valve: Butterfly valve, tapped lug style, bronze body, stainless steel stem, bronze disc, phenolic back-up ring, EPT seat material. Provide stainless steel shaft extension, shaft housing and tool operator located 2'-0" above floor level with deck access grate as required. DeZurick, Keystone, Asahi, Spears, or Ipex.

F. RP Backflow Preventer: Febco #835-B for 2" and smaller; #825 for 2-1/2" and larger. Febco, Watts, or approved equal.

G. Make-up Water Control: Cla-Val make-up water control valve with ductile iron body/cover, bronze trim, globe pattern, Buna-N rubber seals. Pilot system materials to consist of bronze/brass with stainless steel wetted parts and Buna-N rubber seals.

System to include: 3" Cla-Val' solenoid control valve #136-01BY; 3" duct iron, epoxy coated body with cast iron disc retainer and diaphragm washer, bronze trim, flanged globe pattern, 120 V at 60Hz. Solenoid wiring shall be wired to water chemistry controller. Provide 6" air gap at fill point. One (1) system required.

2.4 PRESSURE / VACUUM GAUGES

A. Furnish and install pressure and vacuum gauges on the discharge and suction sides of all pumps. 2" – 2 ½" dial, bottom connection, chrome ring, shut-off cock and snubber. Ranges shall be selected to indicate between mid-point and two-thirds of maximum range under design conditions. Marsh, Trerice, or approved equal.

2.5 PIPE HANGERS AND SUPPORTS

A. General:

1. The requirements of this Section relate to various requirements of the Agreement, General and Supplementary Conditions, Specifications, Drawings, and modifying documents which are part of the Construction Contract. Responsibility for coordination of all such applicable requirements will be that of the Contractor.

B. Description:

1. This section provides guidelines and limitations for the support of all mechanical, electrical, plumbing or architectural items from the building structure, and for the seismic bracing of such items.

2. Design and install all support and bracing systems as required for the swimming pool systems. Provide for attachment to portions of the building structure capable of bearing the loads imposed. Design these systems to not overstress the building structure.

C. Quality Assurance:

1. Design and install all support systems to comply with the requirements of the 2019 California Building Code, Chapter 16A.
2. Seismic bracing for mechanical, electrical and plumbing systems is to be per OPM Design #0043-13, see plans for additional information.

D. Submittals:

1. Submit shop drawings for all substructures and attachment methods.
2. Submit proposed alternative methods of attachment for review and approval by the Architects and DSA, prior to deviating from the requirements given below.
3. For all pipe hangers and support systems, refer to OPM Design #0043-13

E. Materials:

1. Use Mason West, Kin-Line, Grinnel, or approved equal.
2. Support all pipelines individually with hangers, each branch having at least one hanger. Lateral brace as noted and required.
3. Support piping near floor with steel stanchions welded to end plates secured to pipe and floor.
4. Support vertical piping at each floor level. Install coupling in piping at each support. Coupling shall rest on and transmit load to support. Isolate copper from steel supports with vinyl electrician's tape around pipe and coupling.
5. Use Stoneman "Trisolator," Unistrut, or approved equal, isolators at each hanger and other support points on bare copper tubing system.
6. For PVC pipe, space hangers four (4) feet apart for pipe sizes 1" and under, five (5) feet apart for pipe sizes 1-1/4" to 2", and six (6) feet apart for pipe sizes over 2". Space hangers for horizontal pipes at a maximum of six (6) feet for copper 2" and smaller and for steel 1-1/4" and smaller; ten (10) feet for copper 2-1/2" and larger and for steel 1-1/2" and larger.
7. Size hanger rods, screws, bolts, nuts, etc., according to manufacturer's sizing charts.
8. Trapeze hangers may be used for parallel lines.
9. Use galvanized or cadmium plated hangers, attachments, rods, nuts, bolts, and other accessories in pool mechanical room, high humidity areas, or where exposed to weather. Hot dip galvanize all items which are not factory furnished. Plating for hinged movements must be done at the factory.
10. Lateral Bracing: To prevent swaying of the piping systems, provide angle iron bracing and anchor into wall or overhead framing. Piping shall be braced or anchored in such a way as to resist a horizontal force of 50% of its operating weight in any direction.
11. Do not use wire or other makeshift devices for hangers.
12. Furnish all substructures and fasteners required to comply with the limitations given below. Use material as specified in the various sections and as appropriate to their use.

F. Guidelines & Limitations:

1. Each Contractor will coordinate the load requirements from all subcontractors so that no combination of loads overstresses the building structure or exceed the limitations given below.
2. Concrete Structure:

    a. Support all loads hung from concrete structure with cast-in-place inserts, unless drilled-in anchors are specifically approved in writing prior to placing the concrete.

b. Concrete anchors must not penetrate into reinforcing bars. Where the anchors boring indicates the presence of reinforcing bar, patch hole with an epoxy type grout and relocate anchor 12 diameters away.
c. Individual expansion anchors cannot support any loads greater than 300 pounds or manufacturer's specified load capacity without approval.

3. Steel Structure:

a. Hang no more than 20 pounds per metal deck rib in any span.
b. At beams, hang all beam loads greater than 40 pounds concentric to beam, not off the flanges.
c. Attached no loads to the beams or girders greater than the following without specific approval from the architect;

1) Roof beams and girders: 300-pound point load or 600-pound total load for a single span.

G. Seismic Bracing:

1. Install seismic bracing to not ground out vibration and sound isolation systems.
2. All items of mechanical and electrical equipment 60" or more in height are to be seismically braced whether such bracing is shown or not.

2.6 SLEEVES AND WATERSTOPS

A. Provide sleeves where work of this Section passes through fire rated partitions, floors and ceilings, concrete slabs or exterior of structure. Caulk clearance space using sealant appropriate for application in conformance with manufacturer's recommendations and Title 24 of California Code of Regulations. 3m, Dow Corning, or approved equal. In lieu of sleeves and caulking, "Link Seal" products may be used.

B. Provide prefabricated waterstops as indicated on the Drawings at all pipe penetrations through structures containing stored water (i.e., swimming pools, balance/surge tanks, etc.) to insure leak-proof seals.

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS

A. Inspection:

1. Prior to Work of this Section, carefully inspect the installed Work of other trades and verify that such work is complete to the point where this installation may properly commence.
2. Verify that items of this Section may be installed in accordance with the original design and referenced standards.

B. Discrepancies:

1. In the event of discrepancy, immediately notify the Owner's Representative.
2. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.
3. Failure to notify the Owner's Representative and give written notice of discrepancies shall constitute acceptance by the Contractor of existing conditions as fit and proper to receive his work.

3.2 ABBREVIATIONS AND SYMBOLS

A. Abbreviations and symbols on the Drawings are those most commonly used. Obtain clarification from the Owner's Representative on any questionable items before bid.

3.3 GENERAL PIPING REQUIREMENTS

A. Size any section of pipe for which size is not indicated or any intermediate section erroneously shown undersized the same size as the largest pipe connecting to it. Sizes listed are nominal.

B. Cut pipe accurately to job measurements and install without springing or forcing, true to line and grade, generally square with building and/or structures and adequately supported to prevent undue stress on pipe, fittings and accessories.

C. Make changes of direction with manufactured fittings. Street ells, bushings, reducing flanges, close nipples or bending of pipe is not allowed.

D. Use great care to install piping in accordance with best practice. Plastic pipe shall be “snaked” in trenches to allow for thermal expansion.

E. All above grade, below grade and buried or imbedded PVC shall be installed using solvent weld fittings. Also, each and every fitting and pipe end shall be prepared with solvent primer. Fittings shall be joined individually and with enough time between assembly of adjacent joints to allow them to seal solidly. After joining, an even ring of primer must be visible around the entire fitting. If any fittings are installed without visible primer, the fitting shall be removed and discarded and piping recut, rechamfered and joint made up again using a new fitting. All procedures, methods and techniques used to make up solvent weld joints shall be in strict accordance with manufacturer's recommendations.

F. Arrange pipe and hangers to allow for expansion, contraction and structural settlement. No pipe shall contact structure except penetrations as shown on the Drawings.

G. Provide dielectric connections between copper and dissimilar metals. In copper systems, threaded piping. Including connections to equipment shall be brass pipe and fittings. Install dielectric connections in vertical sections of piping only.

H. Run pipe full size through shut-off valves, balancing valves, etc. Change pipe size within three (3) pipe diameters of final connection to control valves, fixtures and other equipment.

I. Provide unions or flanges at connections to equipment, on service side of valves and elsewhere as required to facilitate ease of maintenance.

J. Locate equipment shut-off valves as close to equipment as possible maintaining easy valve access.

K. Make all connections between domestic water systems and equipment or face piping with approved backflow prevention devices as required.

L. All PVC pipe exposed to direct sunlight shall be painted with two coats of Exterior Acrylic Semi-Gloss Paint, Sherwin Williams or equal. Color to be selected by the Architect. Prior to painting the PVC pipes, the exterior of all PVC pipes shall be wiped with Methyl Ethyl Ketone, or an approved equal, to remove the glaze from the pipes.

M. The Main Drain pipe must run either level or uphill from the main drain sump, through the surge pit (if applicable) and then to the circulation pump.

3.4 TRENCH EXCAVATION AND BACKFILL

A. Excavation:

1. Excavate and backfill trenches as required for the Work of this Section. Conform to requirements of Section 13 11 01.
2. The Contractor shall perform all excavation of every description and of whatever materials encountered, to the depths indicated on the Drawings or as necessary. The Contractor shall dispose of the excavated materials not required or suitable for backfill as directed and shall perform such grading as may be necessary to prevent surface water

from flowing into the trenches. The Contractor shall provide adequate equipment for the removal of storm or subsurface waters, which may accumulate in the excavated areas.

B. Trenching:

1. Excavate trenches to lines and grades as indicated on the Drawings and with banks as nearly vertical as practicable.
2. Bottoms of trenches shall be accurately graded to provide uniform bearing on undisturbed soil for the entire length of each section of pipe.
3. The width of the trench at and below the top of the pipe shall be such that the clear space between the barrel of the pipe and the trench wall shall not exceed 8” on either side of the pipe. The width of trench above the top of pipe may be wider if necessary.
4. Over-depth excavations shall be filled with tamped sand to required grades.
5. Excavations of five (5) feet or more in depth shall be shored or supported in conformance with rules, and regulations of State and Federal Governments. Shoring shall be constructed, maintained and removed in a manner to prevent caving of the excavation walls or other load on the pipe.

C. Backfilling:

1. Material for backfilling of pipes shall be approved granular material less than two (2) inches in diameter obtained from the excavation. No material of a perishable, spongy or otherwise unsuitable nature shall be used as backfill.
2. Backfilling of pipe trenches shall commence immediately after installation and testing to preclude damage to the installed pipe. Backfill around pipe shall be carefully placed so as not to displace or damage the pipe and shall be carried up symmetrically on each side of the pipe to one foot above the top of the pipe. The material shall be carefully compacted or consolidated before additional backfill is placed.
3. Backfill above an elevation of one foot above the top of pipe in conformance with requirements of Section 31 23 23. Material for balance of backfill shall be approved granular material less than six (6) inches in diameter taken from the excavation.
4. Unless otherwise indicated on the Drawings, all pipe shall have a minimum of eighteen (18) inches of cover.

3.5 GENERAL EQUIPMENT REQUIREMENTS

A. Position equipment to result in good appearance and easy access to all components for maintenance and repairs.

B. Install piping, flues, breeching and ducts so that they do not interfere with equipment access.

C. Install level, secure and out of moisture. Provide shims, anchors, support straps, angles, grouted bases, or other items as required to accomplish proper installation.

D. All screws, nuts, bolts and washers shall be galvanized, cadmium plated or stainless steel. After fabrication, hot-dip galvanize unfinished ferrous items for outdoor, below grade or other use subject to moisture.

E. Extend 1/2” Schedule 40 black steel pipe lubrication tubes from all hard to reach locations to front of equipment or to access points. Terminate with proper type of lubrication fitting.

3.6 VALVES AND STRAINERS

A. If no shut-off is indicated, provide ball valves at inlet connections and balance valves at outlet connections to fixtures and equipment. Provide proper valve trim for service intended.

B. Use no solder end valves unless noted otherwise; provide adapters in copper tubing systems.

C. Locate valves with stems above horizontal plane of pipe. In general, locate valves within six (6) feet of floor, out from under equipment, in accessible locations with adequate clearance around hand wheels or levers for easy operation.

D. Provide all valves, cocks and strainers, full pipe size unless indicated otherwise.

E. Provide hand wheel operators on all valves 6” and larger, under 6” lever operators may be used.

F. Provide tool operated valve with stainless steel shaft extension and 'on deck' tool operation for surge chamber butterfly isolation valve.

3.7 IDENTIFICATION OF PIPING

A. Identify each valve by a numbered brass tag with hole and brass chain mounted on valve stem or handle. Tag to be a minimum of 1” in diameter and numbers at least 1/4” high stamped into tag. Valves and plumbing shall be labeled clearly with the source or destination descriptions.

B. Install an identification chart in a plastic or glass framed enclosure, which schematically illustrates the proper operation of all piping systems and indicates number and location of all valves and control devices within the system.

C. The direction of flow for the recirculation equipment shall be labeled clearly with directional symbols such as arrows on all piping in the equipment area. Where the recirculation equipment for more than one pool is located on site, the equipment shall be marked as to which pool the system serves.

3.8 TESTS

A. Perform tests in presence of Owner’s Representative with no pressure loss or noticeable leaks.

B. Do not include valves and equipment in tests. Include connection to previously tested sections if systems are tested in sections.

C. Perform tests as follows:

System	Test Pressure	Test Medium	Duration
Skimmer lines and Lawson Drain sump lines	20 psig	Water*	4 hours
Pool Piping	50 psig	Water*	4 hours
Pool Main Drains	30 psig	Water*	4 hours
Domestic Water	150 psig	Water*	4 hours

***Never test PVC pipe or fittings with air or other gases, always use water.**

3.9 PIPE MATERIAL APPLICATION

A. PVC Schedule 40: Below grade swimming pool piping and domestic water piping up to 12” line size; use standard solvent weld fittings.

B. PVC Schedule 80: Above grade swimming pool piping up to 12” line size; use solvent weld Schedule 80 or epoxy coated cast iron fittings.

C. Type L Hard Copper: Above grade domestic water piping.

D. CPVC Schedule 80; Pool Heater Piping.

E. Schedule 40 Steel: Natural gas piping.

3.10 CUTTING AND DRILLING

A. Cutting or drilling necessary for installation of Work of this Section shall be done only with approval of Owner’s Representative.

3.11 CLOSING-IN OF UNINSPECTED WORK

A. Do not cover or enclose Work before testing and inspection. Re-open Work prematurely closed and restore all Work damaged.

3.12 QUIETNESS

A. Quietness is a requirement. Eliminate noise, other than that caused by specified equipment operating at optimum conditions, as directed by Owner's Representative.

3.13 FLUSHING OF LINES

A. Flush or blow out pipes free from foreign substances before installing valves, stops or making final connections. Clean piping systems of dirt and dust prior to initial start-up.

B. Just prior to plastering the pool, under the observations of the IOR, the pool mechanical system shall be flushed using the pool circulation pump. Circulate water through the mechanical system until the effluent water from the pool return heads runs clean.

3.14 CLEAN-UP

A. After all Work has been tested and approved, the Swimming Pool Subcontractor shall thoroughly clean all parts of the equipment installations, including all pool pipe and fittings in the pool mechanical room. Exposed parts shall be cleaned of cement, plaster and other materials and all grease and oil spots removed with solvent.

B. The Swimming Pool Subcontractor shall remove debris from the Project site. Cartons, boxes, packing crates and excess materials not used, occasioned by this work shall be disposed of to the satisfaction of the Owner's Representative.

C. If the above requirements of clean up are not performed to the satisfaction of the Owner's Representative, the Owner reserves the right to order the work done, the cost of which shall be borne by the Swimming Pool Subcontractor.

END OF SECTION

B. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the approval of the Owner's Representative.

PART 2 - PRODUCTS

2.1 SAFETY EQUIPMENT

A. First Aid Kit for 50 Persons with two (2) wool blankets: Marine Rescue or approved equal. Quantity as required by the Department of Health, two (2) minimum.

B. Rescue Tubes (minimum 49" long) and Life Ring Buoy (minimum 24" in diameter), U.S. Coast Guard Approved: Marine Rescue or approved equal. Quantity as required by the Department of Health, two (2) minimum.

C. 3/16" diameter Throw Rope, complete with lemon foot, for use with Life Ring Buoy: Kiefer, United Industries, or approved equal. Quantity as required by the Department of Health, two (2) minimum.

D. Rescue Hooks, 16' long x 1-1/2" aluminum pole and stainless-steel mounting hardware: Kiefer, Pentair or approved equal. Quantity as required by the Department of Health, two (2) minimum.

E. Pool Safety Signs: As required by the Department of Health. Submittal required. Placement at the pool site shall be in conformance with Health Department Inspector. Two (2) sets minimum.

F. Spine Board: C.J. Penton Aquatics long board with "L" bracket head immobilizer with foam pads and Velcro strap, 4 Velcro body straps, or equal. One (1) required.

2.2 MAINTENANCE EQUIPMENT

A. Commercial Pool Vacuum: Commercial Pool Vacuum: Provide pool vacuum cart with a 155-square foot single-cartridge filter, lid-mounted handle, separate lid-mounted bracket for electrical cord, and two rubber-tired ball bearing wheels with grease fittings. Cart and filter shall be fabricated from schedule 304 stainless steel with welds treated and passified. Provide Whisperflo pump with a 1 1/2 hp, 115/230 volt, maximum 20 amp draw @ 120 volts, single phase motor and integral trap. Pump shall be UL and NSF listed, have 2" suction and 1 1/2" discharge fittings, and have a brass priming valve with hose bib. Entire pump assembly shall be anchored to vacuum cart with two stainless steel bolts. Provide a 100 foot 10 AWG 3/C SJ electrical cord with ground fault interrupter (GFI) plus. Cord shall be wired to a double pole, 30-amp switch which shall be mounted on pump motor. One (1) required.

B. Heavy Duty Vacuum Hose: 2" x 50' with hose connector. Pentair, Smooth Bore or approved equal. One (1) required.

C. Utility Pole: 24' fiberglass with connectors. Pentair, Skimlite or approved equal. One (1) required.

D. Commercial Vacuum Head: 24" wide "flexible" vacuum head. Pentair Model #R201186 or approved equal. One (1) required.

E. Pool Wall Brush: 36" wide professional quality. Pentair or approved equal. Two (2) required.

F. Leaf Skimmer: 30" x 8" x 12", professional quality. Pentair, Spectrum or approved equal. Two (2) required.

G. Photometer Water Quality Test Kit: 'Palin' Pool Test 9 Premier Kit Model SP709E with 120V plug-in power supply, Three (3) "AAA" batteries and a total dissolved solids sensor. The test kit shall also include the following test reagents in addition to those provided within the kit package:

50 Qty	Total Alkalinity
50 Qty	Calcium Hardness $CaCO_3$
250 Qty	Free Chlorine
250 Qty	Total Chlorine
50 Qty	Free Chlorine Extended Range
50 Qty	Total Chlorine Extended Range
50 Qty	Copper
250 Qty	pH

2.3 FITTINGS

A. Main Drain Frame & Grate (18" x 36"). Lawson Aquatics #MLD-FG-1836 x 34" depth, VGBA compliant, two (2) required. Hayward 1-1/2" collector tubes #SP1056 and Hayward 1-1/2" hydrostatic relief valves #SP1055, or approved equal, two (2) required, one per main drain sump. Contractor shall provide to the Owner a Certificate of Compliance, signed by a licensed design professional, for main drain sump(s) and frame(s) and grate(s), as required by the Virginia Graeme Baker Act.

B. Gutter Outlet Frame & Grate (12"x12"): Lawson Aquatics #MLD-FGD-1212. Eighteen (18) required.

C. Floor Return Inlet 1-1/2" Adjustable: StaRite #8417-0000, United Industries, or approved equal. Sixty-two (62) required.

D. Swimming Pool Underwater Lights: J & J Electronics 'PureWhite LED' #LPL-F5W-120-100 (100' cords, field verify) with polished stainless steel face rings, 87 watt LED and LWC. Stainless steel niches, Pentair #78210600 with 1" hubs, or approved equal. Forty-two (42) required.

E. Junction Box for Underwater Lights, completed with strain reliefs: Hydrel #1719, Appleton or approved equal. Twenty-two (22) required.

2.4 DECK EQUIPMENT

A. Starting Platform Anchors: KDI-Paragon 'Competitor' #23103DW, 6" deep. Thirteen (13) required in concrete. Paragon 'Competitor' #23074, cover for dual wedge, 'Competitor' #23303, cover removal tool, two (2) required. 'Paragon' Track Start, 'SR Smith' legacy or approved equal.

B. Adjustable Starting Platforms: Platforms shall be 'Paragon' Track Start Competitor #24527, side step with track start plus platform kit which includes an adjustable backplate kit, side hand grip kit. Sand finish platform top shall be provided with school color and logo top. Thirteen (13) required. 'Paragon', 'SR Smith' or equal.

C. Stanchion Sockets: 1.90" I.D. Bronze. KDI-Paragon 38201TC, no known equal. Nineteen (19) required.

D. Stanchion Posts: 1.90" O.D. x .145 wall. KDI-Paragon, eleven (11) #38106, and eight (8) #38301, no known equal.

E. Lane Line Anchors: Heavy eye bolt with insert. KDI-Paragon #73017/18 or equal. Forty-nine(49) required.

F. Lane Line Cup Anchors: Spectrum #58316 Stainless steel 4" cup anchors. Three (3) required.

G. Racing Lanes: #200-34200, 'Competitor', 'Anti Wave' or approved equal, verify colors with Owner prior to ordering; 25-yard lanes; fourteen (14) required. Provide vinyl covered stainless steel lane line extensions, Knorr System model #EP-009-0020 or approved equal. Two (2) per lane line. Provide floating water polo side goal tethers, eight (8) total. Provide two (2) additional lanes to be utilized with floating water polo as side lanes. Provide four (4) dedicated stationary water polo lanes.

H. Racing Lane Reel with Cover: KDI-Paragon #75111SS with cover #75133, no known equal. Six (6) required.

I. Moveable Lifeguard Chair: 1.90" O.D. x .065 wall. KDI-Paragon 20302, no known equal. Two (2) required.

J. Figure 4 Grab Rails: KDI-Paragon #30102, 1.90" O.D. x .109" wall, no known equal. Five (5) sets required.

K. Recessed Steps, Set of 3: KDI-Paragon #32102, no known equal. Five (5) sets of three required.

L. Hand Rails: Paragon Custom three bend per plans, 1.09" O.D x .065” wall, no known equal. Five (5) required.

M. Cross-Braced Ladder: Paragon #42123 Custom, no known equal. Two (2) required.

N. Anchor Sockets for Grab Rails, Hand Rails & Ladders: KDI-Paragon 28102, no known equal. Thirty-four (34) required.

O. Stainless Steel Escutcheon Plates for Grab Rails, Hand Rails & Ladders: KDI-Paragon 28301, no known equal. Thirty-two (32) required.

P. Stationary Water Polo Goals: KDI-Paragon 36104, 36201, Antiwave or approved equal. Furnish complete with anchors and nets. Two (2) pair required.

Q. Floating Water Polo Goals: ‘Sundog’ custom floating waterpolo goals with nets and tethers or approved equal. One (1) pair required.

R. Disabled Lift: Spectrum Traveler XRC 500 #27610 ‘Swim-Lift’ self-operated or approved equal. Furnish with anchors, cover, extra battery and transporter cart. One (1) lift required. Furnish with two (2) anchors.

S. Backstroke Pennants: ‘Champion’ 3/16” diameter vinyl coated cable #50-175; ‘Champion’ hardware package #53-030, and ‘Champion’ 12” x 18” vinyl coated polyester pennants #53-020 Lincoln Equipment, Knorr Systems or equal.

T. Pool Cover System: (T-Star or equal)

1. A pool cover system as described below shall be provided and shall include all the specified features, without exception. Submittal data must include complete documentation relating to all the specified features and include manufacturer's sales literature, specification sheets, and installation/operation/maintenance manuals. Upon written request by the specifying agent, the following samples must be provided: samples of tubing used for storage reel winding tubes and end frames; a sample winding tube bearing; a sample castor wheel assembly; and a cover sample measuring at least 8" x 11", including weighted side edge, reinforced end edge, and grommet.
2. Cover Material:

    a. Material shall be woven, 10 by 10 count per inch, high-density polyethylene, ultraviolet stabilized film fabric, laminated to both sides of 1/8" thick, closed cell, medium density, white, polyethylene foam. The woven polyethylene film fabric shall be coated on both sides with an ultraviolet stabilized, chemically resistant polyethylene coating. The combination of film, foam and woven components shall be non-toxic, non-absorbent, non-permeable and buoyant. Color shall be blue on upper surface and black on under surface. In addition to the above, cover must meet the following requirements:

Thickness	1/8 inch minus or plus 10%
Foam Density	2 lbs. per cubic foot
Weight	5 oz. per square foot
Tensile Strength	318 lbs. (ASTM D3597)
Tear Strength	60 lbs. (ASTM D2261-71)
Bursting Strength	(Mullen Tester): 425 psi (ASTM 751-73)
Service Temperature	-40°F to +160°F
K Factor	.25 BTU/sq. ft.-hr-°F/inch (ASTM D2326)
Reinforced Edge Tear Strength	1225 lbs. pull strength, corner to corner
Open Seam Tear Strength	70 lbs.

3. Cover Design Criteria:

   a. Cover panels shall totally cover the surface of the pool without gaps or overlaps with reinforced cutouts to accommodate rounded corners, step areas, rails, etc. Cover panels shall be of the following quantities and sizes:

Qty.	Size
8	14 feet, 5 inch x 75 feet, 1 inch
3	13 feet x 75 feet, 1 inch, with rail cuts

   b. Along end and side edges of each panel, a weighted material shall be sewn in and shall be continuous, non-corrosive and conform to the flat shape of the cover. End edges shall be reinforced with a double layer of polyethylene-coated film fabric and designed in such a manner as to prevent panels from dividing when they are being pulled across the water. On all corners, weighted edge shall wrap corners and be itself encapsulated by the two layers of end reinforcement. The entire corner construction shall be reinforced with an 1/8" thick load dispersion plate and non-corrosive grommet.

   c. Both ends of each cover panel shall be equipped with no less than three (3) non-corrosive grommets and quick-release loops for easy connection to the storage reel or to the next cover panel. All sewing shall be ultra-violet stabilized and chemically resistant 100% polyester thread. Main body seams shall be welded, glued or heat sealed. Complete mechanical attachment with lock-stitched thread shall be required. Warning labels consistent with the recommendations of the Federal Consumer Protection Agency shall be permanently affixed to each end of each cover panel and to the sides of perimeter panels.

4. Storage Reels:

   a. The following quantity, type, and size of storage reels shall be provided:

Qty.	Winding Tubes Per Reel	Length of Winding Tubes
3	3	16 Foot
1	2	16 Foot

   b. Storage reel frame, winding tubes, castors, brake shafts, cranks and fasteners shall be made of type 304 stainless steel. Each reel shall have six wheels, each of which shall be 6 inches in diameter, be rated at 1150 pounds load capacity and be made of solid polyurethane. Wheels shall be lubricateable through grease fittings on stainless steel axle shafts and have stainless steel swivel yoke assemblies. The reel shall have two frame mounted, screw-type brakes with pads that lock directly to the pool deck and have a total of 18 square inches of total braking

surface. Castor brakes or other types of foot-operated or lever-operated brakes will not be considered equal. Each winding tube shall be 4 1/2 inches in diameter; have a wall thickness of .120 inches; and shall consist of continuous length of tubing without joints or welds. Reels with tubes fabricated from two or more pieces of tubing joined together will not be acceptable. End frames shall be fabricated from 1 1/2 inch square Schedule 304 stainless steel box beam tubing with .120" wall thickness. To facilitate field repair, 3/8" stainless steel bolts, nuts and washers shall be used to connect major reel frame parts, wheels, brakes, bearings and winding tubes. Reels that use welding to connect these components will not be considered equal. Winding tube bearings shall be heavy duty, self-aligning, pillow block ball bearings with set screws to secure tube shafts and prevent their lateral movement. All bearings shall be lubricateable through grease fittings. Plastic surface bearings will not be acceptable.

c. Each storage reel shall be provided with a protective cover constructed of vinyl-laminated polyester cloth, 1000 denier, totaling 13 ounces per square yard.

5. Measuring and Training:

a. A representative of the manufacturer shall visit pool site to confirm measurements prior to fabrication of cover, and once cover is delivered, train operating personnel and supervise initial installation of cover.

6. Warranty:

a. Cover panels shall be provided with manufacturer's three- year full replacement warranty covering defects in material and workmanship. Storage reel shall be provided with manufacturer's 10-year warranty covering defects in material and workmanship.

2.5 SWIMMING POOL STRAINER(S):

A. 'Mer-Made' F.O. series FRP reducing basket strainer: One (1) 12" x 8" standard with acrylic lid and two (2) stainless steel strainers each. (150 lbs. each).

2.6 SWIMMING POOL CIRCULATION PUMP(S)

A. 'Paco' #6015-7; 6" x 8" x15", Type 'LC' end suction centrifugal pump; 1150 RPM 460V, 3PH, 40HP; rated at 1,650 GPM @ 60ft. TDH; 87% efficient; premium efficiency TEFC motor; epoxy coat all wet surfaces. 'Paco', 'Aurora' or equal. (760 lbs.) Provide 'SPCS' Eko-Flex pump control system variable speed drive model SPCS040EF4 system 21" x 49" x 17" deep. Coordinate mounting location to maintain desired clearances. 460V 3PH (177lbs.)

2.7 SWIMMING POOL FILTERS:

A. 'EKO3 Systems' Gen 2 #42230-1206-T-5 Automatic Filter Control (AFC) fully automatic hi-rate permanent media filter with 115 sq. ft. of filter area rated at 1,725 GPM at 15.0 GPM/sq. ft. complete with 12" face piping, 6" backwash, seismic anchorage. Provide all utilities, piping, valving etc. (9475 lbs. each tank). EKO3 Gen 2 System or equal. Provide Signet MK-515 flowsenor with digital readout. One (1) system total.

2.8 SWIMMING POOL HEATER(S):

A. Indirect fired pool heating package system; 'Aquas' Crest SmartTouch control condensing modulating boiler, titanium heat exchanger with CPVC connections, factory assembled skid mounted package, California code controls, 1 ½" natural gas connection, 4" water connections, 8" diameter air inlet and 8" diameter sidewall vent size, PVC vented; 1,500,000 BTU per hour input, 97% efficient. Provide ¾" cold water connection 'Lochinvar APO1500N", weight = 3,500 lbs. each. Two (2) total.

2.9 CHLORINE FEED/STORAGE SYSTEM(S):

A. Provide 'Chem-Tainer' 500 Gallon #TC5971DC; dual storage/containment tank with lid seismically restrained; (4,165 lbs.). Complies with Fed. Reg. #40CFR-264-163. Feed system(s) shall be 'LMI' #SD43-88P-KSI; 288 GPD @ 15 PSI with FRP shelf bracket. Hard pipe to point of injection.

2.10 ACID STORAGE/FEED SYSTEM:

A. Provide 'Chem-Tainer' 150 Gallon #TC3448DC; dual storage/containment tank with lid seismically restrained; Operating weight = (1,250lbs). One (1) total. Complies with Fed. Reg. #40CFR-264-163. Provide 60-gallon acid vapor recovery system. One (1) total.

2.11 CARBON DIOXIDE STORAGE/FEED SYSTEM(S):

A. Provide one (1) 'NOVO-600', 600 lb. cryogenic liquid CO_2 storage tank with remote fill port. 594 liquid lbs. (5195 cubic feet of gaseous CO_2 at NTP) one (1) total. Provide EKO^3 PH-MTS CO_2 high efficiency feed system with alkalinity control, 0 to 160 SCFH feed capacity booster pump, piping injector, flowmeter, relays and acid feed alkalinity control. Provide hard wired 'Analox' #APIKIT CO2 detector with audible and visual alarms in each chemical room, UL 1971 standard listed, one (1) total.

2.12 WATER CHEMISTRY CONTROLLER(S):

A. Provide ethernet connection to BECS #CS-BECSYS7-BP-E water chemistry controller. Provide complete system control package. 'Becsys System 7', 'Impact', 'Wallace and Tiernan' or approved equal. One (1) total.

2.13 BACKWASH PIT

A. 6'-0" x 10'-0" x 5'-0" deep with 6" ø P-trap outlet to sewer. Coordinate waterproofing per Section 131105. Coordinate with structural and plumbing plans.

2.14 FILL SYSTEM

A. 3" Cla-Val fill system to include 3" Cla-Val solenoid control valve #136-01BY, 3" duct iron, epoxy coated body with cast iron disc retainer and diaphragm washer, bronze trim, flanged globe pattern, 120V at 60hz. Solenoid wiring shall be wired to water chemistry controller. Provide 6" air gap at fill point.

2.15 EYEWASH / SHOWER

A. Haws Model #8300-8309CRP barrier free combination eyewash/shower with corrosion resistant protection. See MEP sheets for supply piping. Two (2) total.

2.16 POOL OPERATOR WORKSTATION DECK

A. 'Total Lab Solutions' epoxy counter top with drop in sink and two (2) end cabinets. Furnish with wall mounted two (2) faucets 'Broen Boss' or approved equal. See MEP plans for water supply piping.

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS

A. Inspection:

1. Prior to installing the items of this Section, carefully inspect the installed Work of other trades and verify that all such Work is complete to the point where this installation may properly commence.
2. Verify that the swimming pool equipment items may be installed in strict accordance with original design, pertinent codes and regulations, and the manufacturers' recommendations.

B. Discrepancies:

1. In the event of discrepancy, immediately notify the Owner’s Representative.
2. Do not proceed with installation in areas of discrepancy until all such discrepancies are fully resolved.
3. Failure to notify the Owner’s Representative and give written notice of discrepancies shall constitute acceptance by the Installer of existing conditions as fit and proper to receive its Work.

3.2 INSTALLATION

A. Supply and install items of swimming pool equipment in strict accordance with applicable codes and regulations, the original design, and the manufacturer's published recommendations, anchoring firmly and securely for long life under hard use.

B. Coordinate with other trades to insure all imbedded items are set plumb and flush. Railing ends must have anchor sockets and escutcheon plates. Be certain that deck equipment and railings are properly bonded prior to imbedding.

C. All equipment shall be braced and/or anchored to resist horizontal force acting in any direction using the criteria shown on the Drawings.

3.3 START-UP AND INSTRUCTION

A. The Contractor shall provide a factory certified representative(s) to start-up and certify proper installation, operation and full warranty status of all swimming pool mechanical equipment. The Contractor shall provide not less than two 8-hour days of on-site training for facility staff in the operation and maintenance of the swimming pool mechanical equipment and systems. The two 8-hour days shall be separated by a minimum of seven calendar days and be completed within the 14-day start-up period.

3.4 EQUIPMENT ACTIVATION

A. All water chemistry and filtration mechanical equipment shall be operational upon filling of pool after plaster. Chemicals and other related support items as supplied by Contractor, shall be in supply at start-up.

B. For the first fourteen (14) calendar days after completion of the pool plaster, brush all plastered surfaces at least twice a day and coordinate with General Contractor to ensure that the plaster is carefully maintained after the initial fourteen-day period. In addition, coordinate with the Contractor to ensure that pool filtration equipment is continuously running during the initial fourteen-day period.

C. Start-up and provide qualified personnel to operate pool equipment for a period not less than fourteen (14) days after the pool is placed in operation, or until the Owner takes occupancy of the facility or letter of substantial completion. During this time, Contractor shall instruct and supervise the Owner's personnel in the various operating and maintenance techniques involved. Contractor shall be responsible for supply of chemicals during this not less than fourteen (14) day period and at time of turnover to Owner, chemical storage tanks shall be full. (Owner's personnel shall be fully trained and capable of assuming swimming pool maintenance tasks, training may begin before Owner takes occupancy).

3.5 CLEAN-UP

A. Upon completion of swimming pool equipment, remove all debris, materials and equipment occasioned by this Work to the approval of the Owner's Representative.

END OF SECTION

SECTION 13 11 08 - SWIMMING POOL ELECTRICAL

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide labor, materials and equipment as required to install the swimming pool electrical system including but not limited to:

1. A complete and operable system of service equipment, switchboards, panelboards, conduits, switches, time clocks and wiring for power and lighting, motor control centers.
2. Junction and/or pull boxes, conduits, disconnects, starters, contactors, wiring and connection of all motors and mechanical equipment, including connection and wiring of line voltage controls associated with the mechanical systems.
3. Swimming pool underwater lighting systems.
4. Swimming pool timing system outlets and scoreboard.
5. Complete grounding system as required and shown on the Drawings.
6. Complete equipotential bonding system as required and shown on the Drawings.
7. Adjusting and preliminary operation of the completed electrical system as described in Article 3.6, A of this Section.
8. Cleaning of all completed Work and installation adjustment of all trim and decorative items.

1.2 QUALITY ASSURANCE

A. Qualifications of Workers:

1. The entity performing the work of this Section shall have been successfully engaged in the respective trade for at least five (5) years immediately prior to commencement of the Work.
2. For actual construction operations, use only trained and experienced workers with a minimum of three (3) years experience with the materials and methods specified.
3. Provide at least one person who shall be present at all times during execution of the work of this Section, with a minimum of five (5) years experience with the type of materials being installed, the referenced standards, and who shall direct all Work performed under this Section.

B. Ordinances and Codes: Materials and construction shall conform with all applicable code requirements, including:

1. National Electrical Code, latest edition; Electrical Safety Orders of the State of California; Department of Industrial Relations; regulations of the State Fire Marshal; rules and regulations of the Board of Underwriters of the Pacific, UL 50, 50E and NEMA 250 rating.
2. Chapter 31 of California Building Code, latest edition.

C. Verification of Conditions:

1. The locations shown on the Drawings are diagrammatic only and the exact finish location of equipment and materials cannot be indicated. Therefore, locations of all Work and equipment shall be verified to avoid interferences, preserve head room and keep openings and passageways clear. Changes shall be made in locations of equipment and materials which may be necessary to accomplish these purposes.

D. Preliminary Operations and Testing:

1. Motor driven equipment shall be tested for correct rotation and completion of all connections.

1.3 SUBMITTALS AND SUBSTITUTIONS

A. Provide submittals in conformance with the requirements of Section 01 33 00. Requests for substitutions shall conform with requirements of Article 1.10.A of Section 13 11 00.

B. Required submittals include:

1. Conduit and Fittings as specified in Article 2.2 of this Section.
2. Panelboards as specified in Article 2.6 of this Section.
3. Circuit Breakers as specified in Article 2.07 of this Section.
4. Motor Starters as specified in Article 2.10 and 2.11 of this Section.
5. Fuses as specified in Article 2.13 of this Section.
6. Time Clocks as specified in Article 2.14 of this Section.
7. Ground Fault Circuit Interrupters as specified in Article 2.15 of this Section.
8. NEC required corrosion resistant enclosures, cabinets and boxes as specified in Article 2.8, 2.11, 2.16 & 218 of this Section.

C. Submit proof of qualifications as specified in Article 1.2.A of this Section.

1.4 PRODUCT HANDLING

A. Delivery: Deliver all materials to the Project Site in the manufacturer's original unopened containers with all labels intact and legible.

B. Storage: Store all materials under cover in a manner to prevent damage and contamination, and store only the specified materials at the Project site.

C. Protection: Use all means necessary to protect swimming pool electrical materials before, during, and after installation and to protect the installed Work specified in other Sections.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Materials shall be new, in unbroken packages and bear the U.L. label of approval.

B. Equipment of one type shall be by same manufacturer. One type of equipment for classifications such as:

1. Switchboards, panels, buss duct, disconnect switches and allied items.
2. Conduit.
3. Wire.
4. Conduit fittings.
5. Fixtures of the same general type.
6. Wiring devices.

2.2 CONDUIT AND FITTINGS

A. Conduit within or under buildings or where exposed outdoors shall be rigid metal threaded, hot dipped galvanized, or U.L. approved plastic except where noted otherwise on the Drawings. Metallic conduit shall be of the same metal between outlets or terminals.

B. Use flexible metallic conduit only for short connections of motors and where specifically called for on Drawings. Maximum length shall be 40". Use only liquid tight flexible metal conduit. Install an unbroken #12 AWG insulated copper grounding conductor in each liquid tight flexible conduit with permanent connection at motor junction box and service panel ground.

C. Protect, before installation, metallic conduit runs in all slabs laid on grade or in contact with the earth or exposed in damp locations, with two (2) heavy coats of asphaltum rust-resisting compound.

D. Encase conduits 2-1/2" or larger run underground, outside, or under buildings, in concrete envelopes a minimum of 3" thick, except as indicated otherwise on Drawings or stubouts. Conduits 2 and smaller laid 18" below finish surface in soil.

E. Low voltage runs underground outside buildings, 1-1/4" or smaller, may be G.I. or sherardized steel conduit, with machine applied wrapping equal to double wrap or Scotch-Wrap #50 tape, half lapped and quadrupled at joints in lieu of concrete encasement.

F. Service conduits through foundations or concrete members shall run through metal sleeves with adequate clearances for full movement of the conduit. Do not run conduits through footings.

G. Secure conduits run exposed on surfaces with one hole heavy-duty straps or fasten with matching fittings to inserts or trapezes, parallel to building walls and ceilings.

H. Cap all conduit or duct stub-outs with standard factory caps; except cap threaded steel conduit with B.I. water pipe caps in outdoor locations.

I. Use conduit fittings as manufactured by Crouse-Hinds Company, Appleton Electric Co., or approved equal.

J. Employ U.L. liquid tight fittings for use with liquid tight flexible metal conduit.

K. Use unions as manufactured by Appleton, O-Z/Gedney, or approved equal. The use of running threads will not be permitted.

L. Exposed conduit and fittings in chemical rooms shall be nonmetallic rigid polyvinyl chloride, corrosion resistant rated suitable for installation in corrosive environments and in accordance with the latest NEC requirements.

2.3 EQUIPOTENTIAL BONDING/GROUNDING

A. Bond together and ground to a common ground at a single point all metallic conduit, piping systems, pool reinforcing steel, metal parts of ladders, lifeguard stands, handrails and their supports and the like. The solid copper bonding conductor shall not be smaller than #8 copper.

2.4 WIRING CONNECTIONS

A. Make connections without strain on conductors, allowing the conductors to take a natural position after connections or taps are made. Include all strand of wire in making the connection.

B. Make connections for wiring by one of the following means:

1. Make all taps or connections to conductors with compression type connectors except those smaller than #8 B&S gauge may have soldered connections. Solderless connections for #10 AWG or smaller may be used and shall be "Scotchlok", Buchanan, or approved equal. For #8 AWG or larger, they shall be T&B "LockTite", Burndy "Versitaps", or approved equal.
2. All cable or conductor terminal lugs shall be Burndy "Quicklug", Ilsco, or approved equal. Two piece stamped lugs and solder lugs will not be approved.
3. Paint taped splices in damp or outdoor locations with two (2) coats of insulating paint.
4. Tag all branch circuit wires with circuit number at the panelboard and at each point of use with linen or plastic tags.

2.5 CONDUCTORS

A. Copper RHW or THW. Do not make splices between boxes.

2.6 COLOR CODING

A. Neutrals (identified conductors shall be white).

B. Phase conductors shall be red for phase B; blue for phase C.

C. Green shall be used for mechanical equipment and receptacle grounds only.

2.7 MOTOR WIRING

A. Make final connections to motors with the required AWG (Minimum #12), Flamenol machine tool wire, 19 strand. Control wiring for equipment shall be Flamenol machine tool wire, 19 strand of required AWG. Provide corrosion resistant junction boxes at each item of equipment to change from standard building wiring to machine tool wire.

B. Phase motors as proper in direction of rotation.

2.8 PANELBOARDS

A. Panelboards shall be flush or surface mounting as indicated with circuit breakers as shown on panel schedule, hinged lockable doors, index card holders and proper bussing.

B. Where indicated on the drawings, panelboards shall be furnished with subfeed breakers and/or lugs, split bussing, contractors, time switches, relays, etc., as required.

C. All panelboards shall be keyed alike.

D. All panelboard enclosures shall be corrosion resistant rated in accordance with the latest NEC requirements.

E. Furnish corrosion resistant panelboard enclosures and terminal cabinets with Yale 46515 flush locks and LL806 keys except where indicated otherwise herein. Fasten the trim to panel boards and terminal cabinet by means of concealed, bolted or screwed fasteners accessible only when the door is open.

F. Panelboards 208/120 volt, three phase, 4 wire, S/N or 120/240 volt, single phase, 3 wire, S/N.

Panelboard types as manufactured by:	
Westinghouse	Type B10B
General Electric	Type NLAB
Square D	Type NQOB

G. Panelboards for 480/277 volt, three panes, 4 wire, S/N.

Panelboard types as manufactured by:	
Westinghouse	Type Pow-R-Line 2
General Electric	Type AE
Square D	Type NEHB
Sylvania	Type NH1B
I.T.E.	Type Approved Equal

H. Panelboard for bussing sizes thru 400 amp shall be 20" wide surface mounted type. Recess mounted type shall have a 20" wide (maximum) recess metal enclosure with trim plate cover extending 1" on all sides of enclosure. Depth shall be 5-3/4" nominal. Height of panel as required for devices.

I. Provide 6" additional gutter space in all panels where double lugs are required, or where cable size exceeds bus size. Minimum bottom gutter space shall be 6" high. 12" additional gutter space may be required for aluminum feeders where used.

J. Panelboards shown on the drawings with relays, time clocks or other control devices shall have a separate metal barriered compartment mounted above panel with separate hinged locking door to match panelboard. Provide mounting sub-base in cabinet for control devices and wiring terminal strips.

K. Panelboard shall have a circuit index card holder removable type, with clear plastic cover. Index card shall have numbers imprinted to match circuit breaker numbers.

2.9 CIRCUIT BREAKERS

A. Breakers shall have a minimum short circuit interrupting rating of 10,000A symmetrical for panelboard voltage thru 240 volt and 14000A for panelboards thru 600 volts or as specified on the drawings. In no case shall the interrupting rating be less than the bus withstand rating unless noted otherwise on the drawings.

B. Circuit breakers as manufactured by the following companies only are acceptable:

1. General Electric Company
2. Square D Company
3. Westinghouse Company
4. I.T.E. Company

C. Circuit breakers shall be arranged in the panels so that the breakers of the proper trip settings and numbers correspond to the numbering in the panel schedules on the drawings. Circuit numbers of breakers shall be black-on-white micarta tabs or other previously approved method. Circuit number tabs which can readily be changed from front of panel will not be accepted. Circuit number tabs shall not be attached to or be a part of the breaker.

D. Where two or three pole breakers occur in the panels, they shall be common trip units. Single pole breakers with tie-bar between handles will not be accepted.

E. All circuit breakers shall be padlockable in the "off" position. Locking facilities shall be riveted or mechanically attached to the circuit breaker (submit sample for approval). Other means of attachment shall not be accepted without prior written approval of Architect.

F. Where branch circuit breakers supply the power to motors and signal systems, the breakers shall be furnished with lockout clips, mounted in the "on" position. The breakers shall be able to trip automatically with lockout clips in place.

G. Panelboard circuit breakers shall be bolt-on type.

2.10 BUSSING

A. Bussing shall be rectangular cross section copper, or full length silver or tin-plated aluminum.

B. Bussing shall be braces to withstand symmetrical short circuit ratings as follows or as noted on drawings. In no case shall bus short circuit bracing be less than specified circuit breakers.

C. Each panelboard shall be equipped with a ground bus secured to the interior of the enclosure. The bus shall have a separate lug for each ground conductor. No more than one conductor shall be installed per lug.

2.11 POOL MECHANICAL EQUIPMENT ENCLOSURES, TERMINAL CABINETS & MISC CABINETS

A. All pool mechanical equipment enclosures, terminal cabinets and miscellaneous cabinets in the pool mechanical room or chemical storage rooms shall be corrosion resistant rated in accordance with the latest NEC requirements. Enclosures and all cabinets shall be flush mounted (except where noted a surface) of the size indicated on the drawings, and complete with hinged lockable doors and the number of 2-way screw terminals required for termination of all conductors. Terminal cabinet locks to operated form same key used for panelboards. The trim to terminal cabinets shall be fastened by means of concealed bolted or screwed fasteners accessible behind door to terminal cabinets. Terminal cabinets shall have 5/8" plywood backing.

B. Provide engraved nameplate on each enclosure and cabinet indicating its designation and system (i.e., Swimming Pool - Panel 'SP').

2.12 MOTOR CONTROL INDIVIDUAL STARTERS

A. Manual Motor Starters:

1. Provide flush or surface mounting manual motor starters with number of poles and size of thermal overload heaters as required for the motor being controlled (equipped with overload heaters, one for each motor lead). Back boxes shall be supplied with all flush mounting starters whether they are toggle type requiring only a 4" square outlet box or the larger type requiring a special box and cover designed to accept the particular unit. All box types shall be corrosion resistant rated in accordance with the latest NEC requirements.
2. Unless otherwise noted on the drawings, all manual starters for single phase motors, smaller than 1 h.p., shall be the compact toggle type. Manual starters for all single phase motors, 1 to 5 h.p., and all three phase motors up to 5 h.p. shall be the heavy duty type.
3. Where manual motor starter is shown with pilot light, the pilot light shall be installed in a separate outlet box adjacent to the starter outlet, and engraved nameplate in indicate function of pilot light.
4. The following motor starters as manufactured by:

Manufacturer	**Single Phase 1HP and Below**	**Others**
Arrow Hart	Type RL	Type LL
General Electric	CR 101	Class CR 1062
I.T.E.	Class C10, C11 or C12	Class C20
Square D Company	Class 2510, Type A	Class 2510, Type B & C
Westinghouse	Type MS	Type A100
Allen Bradley	Approved Equal	Approved Equal.

B. Individual Magnetic Motor Starters:

1. Magnetic motor starters shall be A.C. line voltage, across-the-line units in a corrosion resistant rated enclosure in accordance with the latest NEC requirements.
2. All starters located outside of a building whether or not indicated shall be W.P. (weatherproof), and all starters noted W.P. shall be furnished in a corrosion resistant rated stainless steel enclosure in accordance with the latest NEC requirements.
3. Starter shall be horsepower rated for the motor controlled, and shall be equipped with properly sized overload elements. Every pole shall be with overload element.
4. Verify the exact motor current and voltage characteristics with the Contractor supplying the motor before installation of a starter.
5. Each starter shall be equipped with "Hand-Off-Auto" switch or stop-start pushbutton as required.
6. Coils shall be designed to operate on voltage indicated on control diagrams and have built-in-under the voltage release for coil circuit to drop motor starter off the line when the line voltage drops below normal operating voltage.
7. The coil control circuit shall be independently fused, sized to protect coil.
8. Starters to be equipped with running pilot light indication with a "Push-to-Test" feature.
9. Magnetic starters shall have a minimum of two auxiliary contacts. Additional auxiliary contacts shall be provided as required to comply with the requirements of the wiring diagrams on the electrical and mechanical drawings and the description of the function in the Mechanical Section of the Specifications.
10. Starters shall comply with NEMA standards, size and horsepower ratings as indicated on drawings.
11. The following types of magnetic motor starters as manufactured by:

Manufacture	Type
General Electric	Class CR 106
I.T.E.	Class A20
Square D Company	Class 8536
Westinghouse	Type A200 (Size 4 Max.) or Class II-200 (Sizes 5-8)

2.13 INDIVIDUAL COMBINATION MOTOR STARTERS

A. Combination starter shall incorporate fused disconnect switch and individual magnetic motor starter. Combination starters shall be mounted in a corrosion resistant rated enclosure in accordance with the latest NEC requirements.

B. Starters shall comply with NEMA standards, size and horsepower ratings as indicated on drawings General Electric, Square D, Westinghouse or I.T.E.

C. The disconnect handle used on combination starters shall control the disconnect device with the door opened or closed. The disconnect handle shall be clearly marked as to whether the disconnect device is "ON" or "OFF", and shall include a two-color handle grip, the black side visible in the "OFF" position indicating a safe condition, and the red side visible in the "ON" position indicating an unsafe or danger condition.

D. All starters used in combination starters shall be manufactured in accordance with the latest published NEMA standards, sizes, and horsepower ratings. These starters shall be furnished with three melting alloy type thermal overload relays.

E. Thermal units shall be of one-piece construction and interchangeable. The starter shall be inoperative if a thermal unit is removed.

2.14 MOTOR CONTROL CENTER, INTERLOCKS AND CONTROL DEVICES

A. Refer to mechanical and plumbing drawings and specifications and provide all control devices including timeswitches, relays and interconnection of starters as required.

B. Mount all relays and timeswitches in a separate compartment in motor control center unless otherwise indicated.

C. Whether shown on mechanical and plumbing drawings or control center schedules or not, where motors are controlled by external devices (i.e., thermostats, relays, float or pressure switches, etc.) or interlocked with other motors, each motor starter to be equipped with a "Hand-Off-Auto" selector switch in starter cover. Other starters equipped with a "Start' Stop" pushbutton station in starter cover. The Contractor shall be responsible to submit a complete and detailed set of shop drawings, electrical schematic design along with electrical component cut sheets from the MCC panel or the interlock control device manufacturer. RSD Total Control: Allan Pearson 949-380-7878, South Coast Controls: Anthony Ellis 714-998-5656 or approved equal.

2.15 FUSES

A. Fuses shall be dual element, current limiting type, U.L. Class RK5 unless otherwise indicated on the drawings. Provide one spare set of fuses of each size and type in each motor control center.

2.16 TIME CLOCKS

A. Time clocks shall be provided for all underwater lighting systems and swimming pool circulation pumps not controlled by filter microprocessors.

B. Contacts shall have a minimum rating of 40 amperes at 277V.

C. Timing motor shall be heavy duty synchronous, self starting, high torque type, and shall be rated at 120, 208, 240, 277 volt 60 Hz.

D. Motor shall operate normally at temperature range of -60 degrees Fahrenheit to +120 degrees Fahrenheit.

E. Dial shall be 3" diameter, clearly calibrated with day/night zones and 24 hour rotation, with gear to provide one revolution yearly which automatically varies the on/off settings each day according to seasonal changes. Day and month of the year shall show clearly through calendar window on the dial.

F. Time clocks shall be equipped with 7-spoke omitting wheel marked with days of the week.

G. Time clocks shall be housed in a corrosion resistant rated enclosure in accordance with the latest NEC requirements.

H. Acceptable manufacturers are Intermatic, Tork, Paragon, or approved equal.

2.17 GROUND FAULT CIRCUIT INTERRUPTERS

A. Minimum rating shall be 20 amperes, 125V, 5 milliampere trip setting, Class A per UL943.

B. Manufacturer to be Crouse-Hinds, Leviton, or approved equal.

2.18 BOXES

A. Boxes shall be of the size required by ordinances or larger, must be corrosion resistant in accordance with the latest NEC requirements where concealed or exposed on ceilings or walls.

B. Outlets to be surface where wiring is exposed and flush in areas where conduit is concealed.

C. Provide surface outlets with proper corrosion resistant surface covers. Box and cover shall be deep enough to provide at least 1/4" clearance between back of device and back of box. Where box contains more than one device, use a corrosion resistant rated gang box with proper cover in accordance with the latest NEC requirements. Surface outlet boxes shall be of the threaded hub type wherever below 8'0".

D. If necessary for cable installation, additional pull boxes or junction boxes may be installed in accessible locations. Exposed pull boxes and junction boxes shall be corrosion resistant rated in accordance with the latest NEC requirements.

E. Where exposed to weather pull boxes larger than outlet boxes are required, galvanized code gauge sheet steel boxes may be used with covers attached by brass machine screws may be used. Boxes exposed to the weather shall be approved for the purpose, and conduit entrances shall be on the bottom made by means of an interchangeable hub with gasket and adapter nut. Pull boxes not shown on Drawings may be added only after approval of size and location is obtained.

F. For outlets exposed to weather or where noted, cast outlet boxes shall be Crouse-Hinds, Appleton, or approved equal. Boxes shall have proper number and size hubs. Device plates, covers, adapters and boxes shall be as manufactured by Crouse-Hinds, Appleton, or approved equal.

G. Exposed junction boxes, outlet boxes and pull boxes for pool chemical rooms shall be non - metallic suitable for a corrosive environment and in accordance with the latest NEC requirements.

2.19 IDENTIFICATION MARKINGS

A. Plainly mark all motor and electrical appliance control equipment indicating the equipment controlled with engraved metal tags.

B. Provide laminated plastic nameplates on panelboards on the outside of the door at the top indicating panel designation and feeder source.

C. Provide laminated plastic nameplates on distribution switchboards and motor control centers at the top center indicating panel designation and feeder source.

D. Identify each distribution switchboard and motor control center circuit breaker with a laminated plastic nameplate indicating its' use.

E. Type panelboard directories on the forms provided with the equipment, indicating the use of each branch circuit breaker.

F. Fasten all laminated plastic nameplates to surfaces with two (2) or more screws.

PART 3 - EXECUTION

3.1 INSPECTION

A. Verify conditions at the Project site before submitting bid. Be responsible for providing all necessary wiring for the new electrical systems. Wherever wiring is being disrupted due to remodeling or changes, reconnect existing and provide new wiring circuits to accomplish a fully operable system at no additional cost to the Owner.

3.2 COORDINATION

A. The Drawings are essentially diagrammatic and indicate the desired location, size, routes, connection points, etc., and are to be followed as closely as possible. Proper judgment must be exercised in executing the Work so as to provide the best possible installation in the available space and to overcome difficulties, limitations or interference wherever encountered. Be responsible for the correct placement of this Work, the proper location and connection in relation to Work of other trades, for determining the exact location of all conduits, outlets and equipment, and for installing the conduits in such a manner as to conform to the structure, avoid obstruction, preserve headroom and keep openings and passageways clear. Particular attention is directed to the close coordination required on exposed Work. Locations shown on Architectural or Mechanical Drawings if different than those shown on Electrical Drawings should be communicated to the Owner’s Representative in writing for clarification.

3.3 INSTALLATION

A. Trenching and Backfill: Conform with requirements of Section 13 11 01. Provide minimum cover as required by Code.

B. Conduit Installation:

1. Conduit and metallic raceway systems shall be mechanically and electrically continuous from sources of current to all outlets in a manner to provide a continuous grounding path. Close ends of conduit during construction to prevent entrance of dirt or moisture.
2. Securely fasten conduit to the building construction within three feet of each outlet and within every ten feet thereafter. Secure it to boxes, cabinets, pull boxes, terminals with two locknuts and ends equipped with bushings or a terminal fitting. Cut square with ends carefully reamed.
3. Make bends or elbows so that the conduit will not be injured or flattened.
4. Use insulated metallic bushings in all places where bushings are required.
5. Run exposed conduits level or plumb and parallel to the construction members of the building. No cutting across or diagonal runs will be permitted. Neatly surmount structural obstructions encountered on conduit runs by the use of fittings or pull boxes.
6. Identify feeder conduits by stamped metal tags secured to exposed section of conduit in main or sub-panels.
7. Make up all threaded conduit joints gas and watertight with conductive sealer except conduit above ground in dry indoor locations.
8. Rigidly support all boxes independently of the conduit system.

C. Connections to Equipment:

1. Fully connect, in an approved manner, all electrical outlets, apparatus, motors, equipment, fixtures, wiring devices and appliances whether they are installed under the Electrical Contract or not, which require electrical connections, to the corresponding electrical system outlet.
2. Where the Work of this Section requires connections to be made to equipment that is furnished and set-in-place under other Sections, obtain such roughing-in dimensions from the manufacturer or supplier of each item as required and assume full responsibility for the installation of the connections thereto.

3.4 ADJUSTMENT AND CLEAN-UP

A. Preliminary Operation: Should the Owner's Representative deem it necessary to operate the electrical installation or any part thereof prior to Substantial Completion of the Work, consent to such preliminary operation and supervise conduction of same. Subcontractor shall pay all costs occasioned by such operation. Preliminary operation shall not be construed as an acceptance of any Work installed under this Contract.

B. Clean-up: Upon completion of the Work of this Section, immediately remove all swimming pool electrical materials, debris and rubbish occasioned by this Work to the approval of the Owner's Representative.

END OF SECTION

SECTION 13 31 00 - FABRIC STRUCTURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes folded plate structural supports and canvas shaped in 2 principal directions prefabricated fabric structures (PFS):

1.2 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate structural support of canvas cover with adjacent supporting assemblies.

1.3 SUBMITTALS

A. Data: Manufacturer/fabricator product data, including installation instructions for each component of the PFS. Include laboratory test reports and other data, where applicable.
B. Shop drawings:

1. Large scale, dimensioned shop drawings for the PFS. Include complete details and schedules for fabrication and shop assembly, and details, schedules, procedures and diagrams showing the sequence of erection.

C. Samples: Of fabric, 36-inch square minimum, and full-size samples of fittings.

1.4 QUALITY ASSURANCE

A. Source quality control:

1. Materials and fabrication procedures are subject to inspection and tests in the mill, shop or yard at the Architect's option. Such inspections and tests will not relieve the Contractor of responsibility for providing materials and fabrication procedures in compliance with specified requirements.
2. Materials and fabrication procedures shall comply with Code and regulations of authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 FABRICATORS

A. Van Nuys Awning, 2580 Azurite Circle, Newbury Park, CA 91320, arly@vannuysawning.com, basis of design.
B. Eide Industries, Inc., 16215 Piuma Avenue, Cerritos, California USA 90703. www.eideindustries.com
C. Or equal.

2.2 MATERIALS

A. Fabric: See FA-1, Drawing A300.

1. Serge Ferrari Soltis Perform 92. Color: Velvet Red 92-2152.

B. Structural supports: See 05 12 00.
C. Cables and fittings: Type 302/3-304, polished stainless-steel components consisting of cables, and end fittings.
D. Finishes on exposed and concealed ferrous metal surfaces shall be a high performance coating as specified in Section 09 96 00.

2.3 FABRICATION

A. In accordance with Section 05 12 00 and 05 12 13 and to match approved samples.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine the conditions under which this work is to be performed and correct unsatisfactory conditions.
B. Correct unsatisfactory conditions before proceeding with installation.

3.2 ERECTION

A. Comply with the PFS manufacturer recommendations, the approved shop drawings and the applicable requirements of Sections referenced above.
B. After installation, restore marred or abraded surfaces to original condition using same paint or coating as factory-applied finishes, when the results are acceptable to the Architect, otherwise replace damaged equipment.

END OF SECTION

SECTION 13 17 35 - EXTREMITY WHIRLPOOL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Extremity Whirlpool.

B. Related Items:
1. Mechanical: Refer to Division 22.
2. Electrical: Refer to Division 26.

1.2 SUBMITTALS

A. Comply with Section 01 33 00, unless otherwise indicated.

B. Product Data: Manufacturer's specifications and technical data including the following.
1. Detailed specification of construction and fabrication.
2. Manufacturer's installation instructions.

C. Shop Drawings: Indicate dimensions, description of materials and finishes, general construction, specific modifications, component connections, anchorage methods, hardware, and installation procedures.

D. Quality Control Submittals:
1. Statement of qualifications.
2. Professional certifications.
3. Field Quality Control Submittals is specified in Part 3.

E. Contract Closeout Submittals: Comply with Section 01 77 00.
1. Operating and maintenance manuals.
2. Special warranties.

1.3 QUALITY ASSURANCE

A. Installer's Qualifications: Firm experienced in installation or application of systems similar in complexity to those required for this Project.

B. Regulatory Requirements: Conform to applicable portions of the following.
1. Electrical Testing Laboratories (ETL).
2. National Sanitation Foundation (NSF).
3. Underwriters Laboratory (UL).

1.4 DELIVERY, STORAGE, AND HANDLING

A. Packing and Shipping: Deliver products in original unopened packaging with legible manufacturer's identification.

B. Storage and Protection: Comply with manufacturer's recommendations.
1. Store in a cool, dry place out of direct sunlight.
2. Protect from the elements and from damage.
3. Store at a temperature of not less than 40 degrees F.

1.5 PROJECT CONDITIONS

A. Environmental Requirements: Maintain ambient temperature above 40 degrees F. during and 24 hours after installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   1. Extremity Whirlpool E Series 24E-45-M (www.rehaboutlet.com)

B. Model should include the following features:
   1. 45 Gallon tank capacity.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions: Examine areas and conditions under which Work is to be performed and identify conditions detrimental to proper or timely completion.
   1. Verify correct power at disconnect switch.
   2. Verify correct water supply and anti-siphon devices have been installed.
   3. Do not proceed until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's recommendations.

3.3 FIELD QUALITY CONTROL

A. Tests: Test installation for leaks and for proper operation.

3.4 ADJUSTING

A. Adjust equipment and apparatus to ensure proper working order and conditions.

3.5 DEMONSTRATIONS

A. Demonstrate operation and maintenance to Owner and Operator.

END OF SECTION

DIVISION 14
CONVEYING SYSTEM

SECTION 14 24 00 - HYDRAULIC PASSENGER ELEVATORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes: Hydraulic passenger elevators as shown and specified. Elevator work includes:

1. Standard pre-engineered hydraulic passenger elevators.
2. Elevator car enclosures, hoistway entrances and signal equipment.
3. Operation and control systems.
4. Jack(s).
5. Accessibility provisions for physically disabled persons.
6. Equipment, machines, controls, systems and devices as required for safely operating the specified elevators at their rated speed and capacity.
7. Materials and accessories as required to complete the elevator installation.

B. Related Sections:

1. Division 1 General Requirements: Meet or exceed all referenced sustainability requirements.
2. Division 3 Concrete: Installing inserts, sleeves, and anchors in concrete.
3. Division 4 Masonry: Installing inserts, sleeves, and anchors in masonry.
4. Division 5 Metals:
    a. Providing hoist beams, pit ladders, steel framing, auxiliary support steel and divider beams for supporting guide-rail brackets.
    b. Providing steel angle sill supports and grouting hoistway entrance sills and frames.
5. Division 9 Finishes: Providing elevator car finish flooring and field painting unfinished and shop primed ferrous materials.
6. Division 16 Sections:
    a. Providing electrical service to elevators, including fused disconnect switches.
    b. Emergency power supply, transfer switch and auxiliary contacts.
    c. Heat and smoke sensing devices.
    d. Convenience outlets and illumination in control room, hoistway and pit.
7. Division 22 Plumbing
    a. Sump pit and oil interceptor.
8. Division 23 Heating, Ventilation and Air Conditioning
    a. Heating and ventilating hoistways and/or control room.

C. Work Not Included: General contractor shall provide the following in accordance with the requirements of the Model Building Code and ANSI A17.1 Code. For specific rules, refer to ANSI A17.1, Part 3 for hydraulic elevators. State or local requirements must be used if more stringent. The cost of this work is not included in the thyssenkrupp Elevator’s proposal, since it is a part of the building construction.

1. Elevator hoist beam to be provided at top of elevator shaft. Beam must be able to accommodate proper loads and clearances for elevator installation and operation.

2. Supply in ample time for installation by other trades, inserts, anchors, bearing plates, brackets, supports and bracing including all setting templates and diagrams for placement.
3. Hatch walls require a minimum two hours of fire rating. Hoistway should be clear and plumb with variations not to exceed 1/2" at any point.
4. Elevator hoistways shall have barricades, as required.
5. Install bevel guards at 75° on all recesses, projections or setbacks over 2" (4" for A17.1 2000 areas) except for loading or unloading.
6. Provide rail bracket supports at pit, each floor and roof. For guide rail bracket supports, provide divider beams between hoistway at each floor and roof.
7. Pit floor shall be level and free of debris. Reinforce dry pit to sustain normal vertical forces from rails and buffers.
8. Where pit access is by means of the lowest hoistway entrance, a vertical ladder of non-combustible material extending 42" minimum, (48" minimum for A17.1-2000 areas) shall be provided at the same height, above sill of access door or handgrips.
9. Machine room to be enclosed and protected.
10. Machine Room temperature must be maintained between 55º and 90º F.
11. If machine room is remote from the elevator hoistway, clear access must be available above the ceiling or metal/concrete raceways in floor for oil line and wiring duct from machine room.
12. Access to the machinery space and machine room must be in accordance with the governing authority or code.
13. Provide an 8” x 16” cutout through machine room wall, for oil line and wiring duct, coordinated with elevator contractor at the building site.
14. All wire and conduit should run remote from the hoistways.
15. When heat, smoke or combustion sensing devices are required, connect to elevator control cabinet terminals. Contacts on the sensors should be sided for 12 volt D.C.
16. Install and furnish finished flooring in elevator cab.
17. Finished floors and entrance walls are not to be constructed until after sills and door frames are in place. Consult elevator contractor for rough opening size. The general contractor shall supply the drywall framing so that the wall fire resistance rating is maintained, when drywall construction is used.
18. Where sheet rock or drywall construction is used for front walls, it shall be of sufficient strength to maintain the doors in true lateral alignment. Drywall contractor to coordinate with elevator contractor.
19. Before erection of rough walls and doors; erect hoistway sills, headers, and frames. After rough walls are finished; erect fascias and toe guards. Set sill level and slightly above finished floor at landings.
20. To maintain legal fire rating (masonry construction), door frames are to be anchored to walls and properly grouted in place.
21. The elevator wall shall interface with the hoistway entrance assembly and be in strict compliance with the elevator contractor's requirements.
22. General Contractor shall fill and grout around entrances, as required.
23. Elevator sill supports shall be provided at each opening.
24. All walls and sill supports must be plumb where openings occur.
25. For applications with jack hole, free and clear access to the elevator pit area for the jack hole-drilling rig is required.
26. Where jack hole is required, remove all spoils from jack hole drilling.
27. When not provided by Elevator Contractor, jack hole shall accommodate the jack unit. If required the jack hole is to be provided in strict accordance with the elevator contractor's shop drawings.
28. Locate a light fixture (200 lx / 19 fc) and convenience outlet in pit with switch located adjacent to the access door.

29. A light switch and fused disconnect switch for each elevator should be located inside the machine room adjacent to the door, where practical, per the National Electrical Code (NFPA No. 70).
30. For signal systems and power operated door: provide ground and branch wiring circuits, including main line switch.
31. For car light and fan: provide a feeder and branch wiring circuits, including main line switch.
32. Wall thickness may increase when fixtures are mounted in drywall. These requirements must be coordinated between the general contractor and the elevator contractor.
33. Provide supports, patching and recesses to accommodate hall button boxes, signal fixtures, etc..
34. Locate telephone and convenience outlet on control panel.

D. Product data: When requested, the elevator contractor shall provide standard cab, entrance and signal fixture data to describe product for approval.

E. Shop drawings:

1. Show equipment arrangement in the corridor, pit, and hoistway and/or optional control room. Provide plans, elevations, sections and details of assembly, erection, anchorage, and equipment location.
2. Indicate elevator system capacities, sizes, performances, safety features, finishes and other pertinent information.
3. Show floors served, travel distances, maximum loads imposed on the building structure at points of support and all similar considerations of the elevator work.
   Indicate electrical power requirements and branch circuit protection device recommendations.

F. Powder Coat paint selection: Submit manufacturer’s standard selection charts for exposed finishes and materials.

G. Plastic laminate selection: Submit manufacturer’s standard selection charts for exposed finishes and materials.

H. Metal Finishes: Upon request, standard metal samples provided.

I. Operation and maintenance data. Include the following:

1. Owner’s manuals and wiring diagrams.
2. Parts list, with recommended parts inventory.

J. Manufacturer Qualifications: An approved manufacturer with minimum 15 years of experience in manufacturing, installing, and servicing elevators of the type required for the project.

1. The manufacturer of machines, controllers, signal fixtures, door operators cabs, entrances, and all other major parts of elevator operating equipment.
   a. The major parts of the elevator equipment shall be manufactured by the installing company, and not be an assembled system.
2. The manufacturer shall have a documented, on-going quality assurance program.
3. ISO-9001:2000 Manufacturer Certified
4. ISO-14001:2004 Environmental Management System Certified
5. LEED Gold certified elevator manufacturing facility.

K. Installer Qualifications: The manufacturer or an authorized agent of the manufacturer with not less than 15 years of satisfactory experience installing elevators equal in character and performance to the project elevators.

L. Regulatory Requirements:

1. ASME A17.1 Safety Code for Elevators and Escalators, latest edition or as required by the local building code.
2. California Building Code, current edition.
3. NFPA 70 National Electrical Code.
4. NFPA 80 Fire Doors and Windows.
5. Americans with Disabilities Act - Accessibility Guidelines (ADAAG)
6. Section 407 in ICC A117.1, when required by local authorities
7. CAN/CSA C22.1 Canadian Electrical Code
8. CAN/CSA B44 Safety Code for Elevators and Escalators.
9. California Department of Public Health Standard Method V1.1–2010, CA Section 01350.

M. Fire-rated entrance assemblies: Opening protective assemblies including frames, hardware, and operation shall comply with ASTM E2074, CAN4-S104 (ULC-S104), UL10(b), and NFPA Standard 80. Provide entrance assembly units bearing Class B or 1 1/2 hour label by a Nationally Recognized Testing Laboratory (2 hour label in Canada).

N. Inspection and testing:

1. Elevator Installer shall obtain and pay for all required inspections, tests, permits and fees for elevator installation.
2. Arrange for inspections and make required tests.
3. Deliver to the Owner upon completion and acceptance of elevator work.

O. Sustainable Product Qualifications:

1. Environmental Product Declaration:
    a. GOOD: If Product Category Rules (PCR) are not available, produce a publicly available, critically reviewed life-cycle assessment conforming to ISO 14044 that has at least a cradle to gate scope.
    b. BEST: If Product Category Rules (PCR) are available, produce and publish an Environmental Product Declaration (EPD) based on a critically reviewed life-cycle assessment conforming to ISO 14044, with external verification recognized by the EPD program operator.
2. Material Transparency:
    a. GOOD: Provide Health Product Declaration at any level
    b. BETTER: Provide Health Product Declaration (HPD v2 or later). Complete, published declaration with full disclosure of known hazards, prepared using the Health Product Declaration Collaborative's "HPD builder" on-line tool.
    c. BEST: Cradle to Cradle Material Health Certificate v3, Bronze level or higher.
3. LEED v4 – Provide documentation for all Building Product Disclosure AND Optimization credits in LEED v4 for product specified.
4. Living Building Challenge Projects: Provide Declare label for products specified.

P. Manufacturing shall deliver elevator materials, components and equipment and the contractor is responsible to provide secure and safe storage on job site.

Q. Temporary Use: Elevators shall not be used for temporary service or for any other purpose during the construction period before Substantial Completion and acceptance by the purchaser unless agreed upon by Elevator Contractor and General Contractor with signed temporary agreement.

R. Provide the hole for the jack unit (if required by the type of jack provided), based on excavation through normal soil or clay which can be removed by manual digging or by standard truck-mounted regular drilling unit. Provide a casing if required to retain the walls of the hole. General contractor shall remove excavation spoils deposited in the elevator pit.

1. If a physical obstruction or hindrance is encountered below the ground surface, including boulders, rock, gravel, wood, metal, pilings, sand, water, quick sand, caves, public utilities or any other foreign material, obtain written authorization to proceed with excavating using special excavation equipment.
2. Maintain a daily log of time and material costs involved.
   Elevator contractor will be compensated on a time and material basis for additional costs incurred after encountering the physical obstruction or hindrance, including the cost of the special excavation equipment.

S. Warranty: Submit elevator manufacturer's standard written warranty agreeing to repair, restore or replace defects in elevator work materials and workmanship not due to ordinary wear and tear or improper use or care for 12 months after final acceptance.

T. Furnish maintenance and call back service for a period of 12 months for each elevator after completion of installation or acceptance thereof by beneficial use, whichever is earlier, during normal working hours excluding callbacks.

1. Service shall consist of periodic examination of the equipment, adjustment, lubrication, cleaning, supplies and parts to keep the elevators in proper operation. Maintenance work, including emergency call back repair service, shall be performed by trained employees of the elevator contractor during regular working hours.
2. Submit parts catalog and show evidence of local parts inventory with complete list of recommended spare parts. Parts shall be produced by manufacturer of original equipment.
3. Manufacturer shall have a service office and full time service personnel within a 100 mile radius of the project site.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer: Design based around AZtech Elevator Company’s hydraulic elevator.

2.2 MATERIALS, GENERAL

A. Elevator Cab materials including frame, buttons, lighting, wall and ceiling assembly, laminates and carpet shall have an EPD and an HPD, and shall meet the California Department of Public Health Standard Method V1.1–2010, CA Section 01350 as mentioned in 1.03.9 of this specification.

B. Colors, patterns, and finishes: As selected by the Architect from manufacturer's full range of standard colors, patterns, and finishes.

C. Steel:

1. Shapes and bars: Carbon.
2. Sheet: Cold-rolled steel sheet, commercial quality, Class 1, matte finish.
3. Finish: Factory-applied baked enamel for structural parts, powder coat for architectural parts. Color selection must be based on elevator manufacture’s standard selections.

D. Plastic laminate: Decorative high-pressure type, complying with NEMA LD3, Type GP-50 General Purpose Grade, nominal 0.050" thickness. Laminate selection must be based on elevator manufacture's standard selections.

E. Flooring: See Materials Legend.

2.3 HOISTWAY EQUIPMENT

A. Platform: Fabricated frame of formed or structural steel shapes, gusseted and rigidly welded with a wood sub-floor. Underside of the platform shall be fireproofed. The car platform shall be designed and fabricated to support one-piece loads weighing up to 25% of the rated capacity.

1. Sling: Steel stiles bolted or welded to a steel crosshead and bolstered with bracing members to remove strain from the car enclosure.
2. Guide Rails: Steel, omega shaped, fastened to the building structure with steel brackets.
3. Guides: Slide guides shall be mounted on top and bottom of the car.
4. Buffers: Provide substantial buffers in the elevator pit. Mount buffers on continuous channels fastened to the elevator guide rail or securely anchored to the pit floor. Provide extensions if required by project conditions.
5. Jack: A jack unit shall be of sufficient size to lift the gross load the height specified. Factory test jack to ensure adequate strength and freedom from leakage. Brittle material, such as gray cast iron, is prohibited in the jack construction. Provide the following jack type: Twin post holeless. Two jacks piped together, mounted one on each side of the car with a polished steel hydraulic plunger housed in a sealed steel casing having sufficient clearance space to allow for alignment during installation. Each plunger shall have a high pressure sealing system which will not allow for seal movement or displacement during the course of operation. Each Jack Assembly shall have a check valve built into the assembly to allow for automatically re-syncing the two plunger sections by moving the jack to its fully contracted position. The jack shall be designed to be mounted on the pit floor or in a recess in the pit floor. Each jack section shall have a bleeder valve to discharge any air trapped in the section.
6. Automatic Self-Leveling: Provide each elevator car with a self-leveling feature to automatically bring the car to the floor landings and correct for over travel or under travel. Self-leveling shall, within its zone, be automatic and independent of the operating device. The car shall be maintained approximately level with the landing irrespective of its load.
7. Wiring, Piping, and Oil: Provide all necessary hoistway wiring in accordance with the National Electrical Code. All necessary code compliant pipe and fittings shall be provided to connect the power unit to the jack unit.
8. Pit moisture/water sensor located approximately 1 foot above the pit floor to be provided. Once activated, elevator will perform "flooded pit operation", which will run the car up to the designated floor, cycle the doors and shut down and trip the circuit breaker shunt to remove 3 phase power from all equipment, including pit equipment.
9. Motorized oil line shut-off valve shall be provided that can be remotely operated from the controller landing service panel. Also a means for manual operation at the valve in the pit is required.

2.4 POWER UNIT

A. Power Unit (Oil Pumping and Control Mechanism): A self-contained unit consisting of the following items:

1. An oil reservoir with tank cover.
2. An oil hydraulic pump.
3. An electric motor.

4. An oil control valve with the following components built into single housing; high pressure relief valve, check valve, automatic unloading up start valve, lowering and leveling valve, and electro-magnetic controlling solenoids.

B. Pump: Positive displacement type pump specifically manufactured for oil-hydraulic elevator service. Pump shall be designed for steady discharge with minimum pulsation to give smooth and quiet operation. Output of pump shall not vary more than 10 percent between no load and full load on the elevator car.

C. Motor: Standard manufacture motor specifically designed for oil-hydraulic elevator service. Duty rating shall be selected for specified speed and load.

D. Oil Control Unit: The following components shall be built into a single housing. Welded manifolds with separate valves to accomplish each function are not acceptable. Adjustments shall be accessible and be made without removing the assembly from the oil line.

1. Relief valve shall be adjustable and be capable of bypassing the total oil flow without increasing back pressure more than 10 percent above that required to barely open the valve.
2. Up start and stop valve shall be adjustable and designed to bypass oil flow during start and stop of motor pump assembly. Valve shall close slowly, gradually diverting oil to or from the jack unit, ensuring smooth up starts and up stops.
3. Check valve shall be designed to close quietly without permitting any perceptible reverse flow.
4. Lowering valve and leveling valve shall be adjustable for down start speed, lowering speed, leveling speed and stopping speed to ensure smooth "down" starts and stops. The leveling valve shall be designed to level the car to the floor in the direction the car is traveling after slowdown is initiated.
5. Provided with constant speed regulation in both up and down direction. Feature to compensate for load changes, oil temperature, and viscosity changes.
6. Solid State Starting: Provide an electronic starter featuring adjustable starting currents.
7. Oil Type: Provide a zinc free, inherently biodegradable lubricant formulated with premium base stocks to provide outstanding protection for demanding hydraulic systems, especially those operating in environmentally sensitive areas.

2.5 HOISTWAY ENTRANCES

A. Doors and Frames: Provide complete hollow metal type hoistway entrances at each hoistway opening bolted\knock down construction.

1. Manufacturer's standard entrance design consisting of hangers, doors, hanger supports, hanger covers, fascia plates (where required), sight guards, and necessary hardware.
2. Main landing door & frame finish: ASTM A1008 steel panels, factory applied powder coat finish.
3. Typical door & frame finish: ASTM A 366 steel panels, factory applied powder coat finish.

B. Interlocks: Equip each hoistway entrance with an approved type interlock tested as required by code. Provide door restriction devices as required by code.

C. Door Hanger and Tracks: Provide sheave type two point suspension hangers and tracks for each hoistway horizontal sliding door.

1. Sheaves: Polyurethane tires with ball bearings properly sealed to retain grease.
2. Hangers: Provide an adjustable device beneath the track to limit the up-thrust of the doors during operation.
3. Tracks: Drawn steel shapes, smooth surface and shaped to conform to the hanger sheaves.

D. Hoistway Sills: Extruded metal, with groove(s) in top surface. Provide mill finish on aluminum.

2.6 PASSENGER ELEVATOR CAR ENCLOSURE

A. Car Enclosure:

1. Walls: Cab type a laminate wall design, durable wood core finished on both sides with high pressure plastic laminate.
2. Reveals and frieze: Not applicable
3. Canopy: Cold-rolled steel with hinged exit.
4. Ceiling: Suspended type, LED lighting with translucent diffuser mounted in a metal frame. Framework shall be finished with a factory applied powder coat finish.
5. Cab Fronts, Return, Transom, Soffit and Strike: Provide panels faced with No. 4 brushed stainless steel
6. Doors: Horizontal sliding car doors reinforced with steel for panel rigidity. Hang doors on sheave type hangers with polyurethane tires that roll on a polished steel track and are guided at the bottom by non-metallic sliding guides.
7. Door Finish: Stainless steel panels: No. 4 brushed finish.
8. Cab Sills: Extruded aluminum, mill finish.
9. Handrail: Provide 1.5" diameter cylindrical metal on side and rear walls on front opening cars and side walls only on front and rear opening cars. Handrails shall have a stainless steel, No. 4 brushed finish.
10. Ventilation: Manufacturer’s standard exhaust fan, mounted on the car top.
11. Protection pads and buttons: Provide one set of vinyl protection pads with metal grommets for the project. Provide pad buttons on cab front(s) and walls.

B. Car Top Inspection: Provide a car top inspection station with an “Auto-Inspection” switch, an "emergency stop" switch, and constant pressure "up and down" direction and safety buttons to make the normal operating devices inoperative. The station shall give the inspector complete control of the elevator. The car top inspection station shall be mounted in the door operator assembly.

2.7 DOOR OPERATION

A. Door Operation: Provide a direct or alternating current motor driven heavy duty operator designed to operate the car and hoistway doors simultaneously. The door control system shall be digital closed loop and the closed loop circuit shall give constant feedback on the position and velocity of the elevator door. The motor torque shall be constantly adjusted to maintain the correct door speed based on its position and load. All adjustments and setup shall be through the computer-based service tool. Door movements shall follow a field programmable speed pattern with smooth acceleration and deceleration at the ends of travel. The mechanical door operating mechanism shall be arranged for manual operation in event of power failure. Doors shall automatically open when the car arrives at the landing and automatically close after an adjustable time interval or when the car is dispatched to another landing. AC controlled units with oil checks, or other deviations are not acceptable.

1. No Un-Necessary Door Operation: The car door shall open only if the car is stopping for a car or hall call, answering a car or hall call at the present position or selected as a dispatch car.
2. Door Open Time Saver: If a car is stopping in response to a car call assignment only (no coincident hall call), the current door hold open time is changed to a shorter field programmable time when the electronic door protection device is activated.

3. Double Door Operation: When a car stops at a landing with concurrent up and down hall calls, no car calls, and no other hall call assignments, the car door opens to answer the hall call in the direction of the car's current travel. If an onward car call is not registered before the door closes to within 6 inches of fully closed, the travel shall reverse, and the door shall reopen to answer the other call.
4. Nudging Operation: The doors shall remain open as long as the electronic detector senses the presence of a passenger or object in the door opening. If door closing is prevented for a field programmable time, a buzzer shall sound. When the obstruction is removed, the door shall begin to close at reduced speed. If the infra-red door protection system detects a person or object while closing on nudging, the doors shall stop and resume closing only after the obstruction has been removed.
5. Door Reversal: If the doors are closing and the infra-red beam(s) is interrupted, the doors shall reverse and reopen. After the obstruction is cleared, the doors shall begin to close.
6. Door Open Watchdog: If the doors are opening, but do not fully open after a field adjustable time, the doors shall recycle closed then attempt to open six times to try and correct the fault.
7. Door Close Watchdog: If the doors are closing, but do not fully close after a field adjustable time, the doors shall recycle open then attempt to close six times to try and correct the fault.
8. Door Close Assist: When the doors have failed to fully close and are in the recycle mode, the door drive motor shall have increased torque applied to possibly overcome mechanical resistance or differential air pressure and allow the door to close.

B. Door Protection Device: Provide a door protection system using microprocessor controlled infra-red-light beams. The beams shall project across the car opening detecting the presence of a passenger or object. If door movement is obstructed, the doors shall immediately reopen.

2.8 CAR OPERATING STATION

A. Car Operating Station, General: The main car control in each car shall contain the devices required for specific operation mounted in an integral swing return panel requiring no applied faceplate. Wrap return shall have a No. 4 brushed stainless-steel finish. The main car operating panel shall be mounted in the return and comply with handicap requirements. Pushbuttons that illuminate using long lasting LED’s shall be included for each floor served, and emergency buttons and switches shall be provided per code. Switches for car light and accessories shall be provided.
B. Emergency Communications System: Integral phone system provided.
C. Auxiliary Operating Panel: Not Required
D. Column Mounted Car Riding Lantern: A car riding lantern shall be installed in the elevator cab and located in the entrance. The lantern, when illuminated, will indicate the intended direction of travel. The lantern will illuminate, and a signal will sound when the car arrives at a floor where it will stop. The lantern shall remain illuminated until the door(s) begin to close.
E. Special Equipment: Not Applicable

2.9 CONTROL SYSTEMS

A. Controller: The elevator control system shall be microprocessor based and software oriented. Control of the elevator shall be automatic in operation by means of push buttons in the car numbered to correspond to floors served, for registering car stops, and by "up-down" push buttons at each intermediate landing and "call" push buttons at terminal landings.

B. Automatic Light and Fan shut down: The control system shall evaluate the system activity and automatically turn off the cab lighting and ventilation fan during periods of inactivity. The settings shall be field programmable.

C. Emergency Power Operation: (10-DOA) Upon loss of the normal power supply, building-supplied standby power is available on the same wires as the normal power supply. Once the loss of normal power is detected and standby power is available, the elevator is lowered to a pre-designated landing and the doors are opened. After passengers have exited the elevator, the doors are closed and the car is shut down. When normal power is restored, the elevator automatically resumes operation.

D. Special Operation: Not Applicable

2.10 HALL STATIONS

A. Hall Stations, General: Provide buttons with white-illuminating or blue-illuminating LED halos to indicate that a call has been registered at that floor for the indicated direction. Provide 1 set of pushbutton risers.

1. Provide one pushbutton riser with faceplates having a No. 4 brushed stainless-steel finish.

a. Phase 1 firefighter's service key switch, with instructions, shall be incorporated into the hall station at the designated level.

B. Floor Identification Pads: Provide door jamb pads at each floor. Jamb pads shall comply with Americans with Disabilities Act (ADA) requirements.

C. Hall Fixtures: Wall mounted hall fixtures shall be provided with necessary push buttons and key switches for elevator operation. Wall mounted hall fixtures shall have a Brushed Stainless Steel.

1. Hall fixtures shall feature round, mechanical, buttons in applied mount face frame. Hall fixtures shall correspond to options available from that landing. Buttons shall be in a vertically mounted fixture. Hall fixtures shall not be jambmounted.

a. Hall Position Indicator.
b. Hall lanterns.

D. Special Equipment: Not Applicable

2.11 MISCELLANEOUS ELEVATOR COMPONENTS

A. Oil Hydraulic Silencer: Install multiple oil hydraulic silencers (muffler device) at the power unit location. The silencers shall contain pulsation absorbing material inserted in a blowout proof housing.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Before starting elevator installation, inspect hoistway, hoistway openings, pits and/or control room, as constructed, verify all critical dimensions, and examine supporting structures and all other conditions under which elevator work is to be installed. Do not proceed with elevator installation until unsatisfactory conditions have been corrected in a manner acceptable to the installer.

B. Installation constitutes acceptance of existing conditions and responsibility for satisfactory performance.

3.2 INSTALLATION

A. Install elevator systems components and coordinate installation of hoistway wall construction.

1. Work shall be performed by competent elevator installation personnel in accordance with ASME A17.1, manufacturer's installation instructions and approved shop drawings.
2. Comply with the National Electrical Code for electrical work required during installation.

B. Jack unit excavation (if required by the type of jack provided): Drill or otherwise excavate below elevator pit construction as required to install the jack unit.

1. Install casing for jack unit.
2. Provide HDPE jack protection system for all in ground jacks.
3. Set casing for jack unit assembly plumb, and partially fill with water settled sand, eliminating voids. Back fill depth shall be sufficient to hold the bottom of the jack in place over time.

C. Perform work with competent, skilled workmen under the direct control and supervision of the elevator manufacturer's experienced foreman.

D. Supply in ample time for installation by other trades, inserts, anchors, bearing plates, brackets, supports, and bracing including all setting templates and diagrams for placement.

E. Welded construction: Provide welded connections for installation of elevator work where bolted connections are not required for subsequent removal or for normal operation, adjustment, inspection, maintenance, and replacement of worn parts. Comply with AWS standards for workmanship and for qualification of welding operators.

F. Coordination: Coordinate elevator work with the work of other trades, for proper time and sequence to avoid construction delays. Use benchmarks, lines, and levels designated by the Contractor, to ensure dimensional coordination of the work.

G. Install machinery, guides, controls, car and all equipment and accessories to provide a quiet, smoothly operating installation, free from side sway, oscillation or vibration.

H. Alignment: Coordinate installation of hoistway entrances with installation of elevator guide rails for accurate alignment of entrances with cars. Where possible, delay final adjustment of sills and doors until car is operable in shaft. Reduce clearances to minimum safe, workable dimensions at each landing.

I. Erect hoistway sills, headers, and frames before erection of rough walls and doors; erect fascia and toe guards after rough walls finished. Set sill units accurately aligned and slightly above finish floor at landings.

J. Lubricate operating parts of system, where recommended by manufacturer.

3.3 FIELD QUALITY CONTROL

A. Acceptance testing: Upon completion of the elevator installation and before permitting use of elevator, perform acceptance tests as required and recommended by Code and governing regulations or agencies. Perform other tests, if any, as required by governing regulations or agencies.

B. Advise Owner, Contractor, Architect, and governing authorities in advance of dates and times tests are to be performed on the elevator.

C. Make necessary adjustments of operating devices and equipment to ensure elevator operates smoothly and accurately.

D. Before final acceptance, remove protection from finished surfaces and clean and polish surfaces in accordance with manufacturer's recommendations for type of material and finish provided. Stainless steel shall be cleaned with soap and water and dried with a non-abrasive surface; it shall not be cleaned with bleach-based cleansers.

E. At completion of elevator work, remove tools, equipment, and surplus materials from site. Clean equipment rooms and hoistway. Remove trash and debris.

1. Use environmentally preferable and low VOC emitting cleaners for each application type. Cleaners that contain solvents, pine and/or citrus oils are not permitted.

F. At time of Substantial Completion of elevator work, or portion thereof, provide suitable protective coverings, barriers, devices, signs, or other such methods or procedures to protect elevator work from damage or deterioration. Maintain protective measures throughout remainder of construction period.

G. Instruct Owner's personnel in proper use, operations, and daily maintenance of elevators. Review emergency provisions, including emergency access and procedures to be followed at time of failure in operation and other building emergencies. Train Owner's personnel in normal procedures to be followed in checking for sources of operational failures or malfunctions.

H. Make a final check of each elevator operation, with Owner's personnel present, immediately before date of substantial completion. Determine that control systems and operating devices are functioning properly.

I. Elevator Qty. 1

1. Elevator Model: Endura Above-Ground (1-Stage).
2. Elevator Type: Hydraulic Passenger.
3. Rated Capacity: 3500 lbs.
4. Rated Speed: 150 ft./min.
5. Travel: 13'-4" (verify).
6. Landings: 2 total.
7. Openings:

    a. Front: 2.
    b. Rear: 0.

8. Clear Car Inside: 6' - 8" wide x 5' – 4-1/2" deep.
9. Cab Height: 8'-0" standard.
10. Hoistway Entrance Size: 3' - 6" wide x 7'-0" high
11. Door Type: Single Speed.
12. Power Characteristics: 460 volts, 3 Phase, 60 Hz.
13. Seismic Requirements: Zone 4.
14. Hoistway Dimensions: 8' - 4" wide x 6' - 11" deep.
15. Pit Depth: 4' - 0".
16. Button & Fixture Style: Match College standard.
17. Special Operations: None.

END OF SECTION

DIVISION 21
FIRE SUPPRESSION

SECTION 21 05 00 - COMMON WORK RESULTS FOR FIRE SUPPRESSION

PART 1 GENERAL

1.1 SUMMARY

A. Section includes pipe, fittings, valves, and connections for sprinkler system.

B. Related Sections:
1. Div. 3/ Section 03 10 00 - Concrete Forming and Accessories: Execution requirements for inserts and sleeves specified by this section.
2. Div. 9/ Section 09 90 00 - Painting and Coating: Execution requirements for piping painting specified by this section.

1.2 REFERENCES

A. American Society of Mechanical Engineers:
1. ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings.
2. ASME B16.11 - Forged Steel Fittings - Socket-Welding and Threaded.
3. ASME B16.25 - Buttwelding Ends.
4. ASME B16.3 - Malleable Iron Threaded Fittings.
5. ASME B16.4 - Gray Iron Threaded Fittings.
6. ASME B16.5 - Pipe Flanges and Flanged Fittings.
7. ASME B16.9 - Factory-Made Wrought Steel Buttwelding Fittings.

B. ASTM International:
1. ASTM A47 – Standard Specification for Ferric Malleable Iron Castings.
2. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
3. ASTM A135 - Standard Specification for Electric-Resistance-Welded Steel Pipe.
4. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
5. ASTM A795 – Standard Specification for Black and Hot-Dipped Zink-Coated (galvanized) Welded and Seamless Steel Pipe for Fire Protection Use

C. American Welding Society:
1. AWS D1.1 - Structural Welding Code - Steel.

D. American Water Works Association:
1. AWWA C110 - American National Standard for Ductile-Iron and Grey-Iron Fittings, 3 in. through 48 in. (75 mm through 1200 mm), for Water and Other Liquids.
2. AWWA C111 - American National Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
3. AWWA C151 - American National Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water.
4. AWWA C105 – Polyethylene Encasement for Ductile Iron Pipe Systems.

E. National Fire Protection Association:
1. NFPA 13 - Installation of Sprinkler Systems. 2019 edition
2. NFPA 13R Standard for installation of sprinkler systems in low riser residential occupancy. 2019 edition

3. NFPA 24 - Installation of Private Fire Service Mains and Their Appurtenances. 2019 edition
4. NFPA 14- Standard for installation of standpipe and hose system 2019 edition
5. NFPA 25- Standard for inspection, testing, and maintenance of water-based fire protection systems 2020 edition

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Shop Drawings: Indicate pipe materials used, jointing methods, supports, floor and wall penetration seals. Indicate installation, layout, weights, mounting and support details, and piping connections.

C. Product Data: Submit manufacturers' catalogue information. Indicate valve data and ratings.

D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.

B. Project Record Documents: Record actual locations of components and tag numbering.

C. Operation and Maintenance Data: Submit spare parts lists.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with NFPA 13 standard.

B. Maintain one copy of each document on site.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum three years documented experience approved by manufacturer.

1.7 PRE-INSTALLATION MEETINGS

A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.

B. Convene minimum one week prior to commencing work of this section.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.

B. Deliver and store valves in shipping containers, with labeling in place.

C. Furnish cast iron and steel valves with temporary protective coating.

D. Furnish temporary end caps and closures on piping and fittings. Maintain in place until installation.

1.9 WARRANTY

A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.

B. Furnish five-year manufacturer: warranty for basic fire suppression materials and methods.

1.10 EXTRA MATERIALS

A. Section 01 70 00 - Execution and Closeout Requirements: Spare parts and maintenance products.

B. Furnish two sets of valve stem packing for each size and type of valve installed.

PART 2 PRODUCTS

2.1 VALVES

A. Manufacturers:
1. Milwaukee.
2. Stockham.
3. Kennedy.
4. Mueller.
5. Victaulic
6. Substitutions: Section 01 60 00 - Product Requirements.

B. Gate Valves:
1. Up to and including 2 inches: bronze body and trim, rising stem, hand wheel, solid wedge or disc, threaded ends. Similar to Stockham Model No. B-133.
2. Over 2 inches: Iron body, bronze trim, rising stem pre-grooved for mounting tamper switch, hand wheel, OS&Y, solid bronze or cast-iron wedge, flanged ends. Similar to Stockham Model No. G-634.

C. Globe or Angle Valves:
1. Up to and including 2 inches: bronze body, bronze trim, rising stem and hand wheel, inside screw, renewable Buna n Seat disc, threaded ends, with back seating capacity. Similar to Kennedy Model No. 98-SD. Ball Valves:
2. Up to and including 2 inches: bronze two-piece body, brass, chrome plated bronze, or stainless-steel ball, Teflon seats and stuffing box ring, lever handle, threaded ends. Similar to Kennedy Model No. 775.

D. Butterfly Valves:

1. Bronze Body: Stainless steel disc, resilient replaceable seat, threaded or grooved ends, extended neck, hand wheel and gear drive and integral indicating device, and built-in tamper proof switch rated 10 amp at 115-volt AC.
2. Cast or Ductile Iron Body: Cast or ductile iron, chrome or nickel-plated ductile iron or aluminum bronze disc, resilient replaceable EPDM seat, wafer, lug, or grooved ends. With extended neck, hand wheel and gear drive and integral indicating device, and external tamper switch rated 10 amp at 115-volt AC.

E. Check Valves:
1. Up to and including 2 inches: Bronze body and swing disc, rubber seat, threaded ends. Similar to Stockham Model No. B-319Y.
2. Over 2 inches: Iron body, bronze trim, swing check, renewable disc and seat, flanged ends. Similar to Stockham Model No. G-939.
3. 4 inches and Over: Iron body, bronze disc with stainless steel spring, resilient seal, threaded, wafer, or flanged ends.

2.2 BURIED PIPING

A. Double Iron: AWWA C151.
1. Fittings: AWWA C110, ductile iron standard thickness.
2. Joints: AWWA C111, rubber gasket.
3. Mechanical Couplings: Shaped composition sealing gasket, steel bolts, nuts, and washers.
4. Jackets: AWWA C105, polyethylene jacket for corrosive soils.
5. Mega lug Flange Restrainer fitting or AMES ES-A in-building riser

2.3 ABOVE GROUND PIPING

A. Steel Pipe: ASTM A53/A53M, Grade B; ASTM A135; ASTM A135 UL listed, threaded light wall for mains larger than 2 inches; or ASTM A795; Schedule 40 black, outside applications shall be galvanized pipe. Pipes shall have a corrosion resistance ratio (CRR) of 1.00 or greater per UL listing. Piping shall be black carbon steel, except in FM approved dry systems, where pipe shall be hot-dipped galvanized to meet ASTM A795 zinc coating specifications. Pipe shall be Schedule 40 or equal; for 2 inches and smaller. Threaded joints and fittings. Schedule 10 for pipes size 2-1/2 inches or larger. Victaulic or grooved fittings may be used.
1. Steel Fittings: ASME B16.9, wrought steel, butt welded; ASME B16.25, butt weld ends; ASTM A234/A234M, wrought carbon steel and alloy steel; ASME B16.5, steel flanges and fittings; or ASME B16.11, forged steel socket welded and threaded.
2. Cast Iron Fittings: ASME B16.1, flanges, and flanged fittings; or ASME B16.4, threaded fittings.
3. Malleable Iron Fittings: ASME B16.3, threaded fittings, or ASTM A47.

2.4 PIPE HANGERS AND SUPPORTS

A. Conform to NFPA 13/NFPA 13R.

B. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Carbon steel, adjustable swivel, split ring.

C. Hangers for Pipe Sizes 2 inch and Over: Carbon steel, adjustable, clevis.

D. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.

E. Wall Support for Pipe Sizes to 3 inches: Cast iron hook.

F. Wall Support for Pipe Sizes 4 inches and Over: Welded steel bracket and wrought steel clamp.

G. Vertical Support: Steel riser clamp.

H. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

PART 3 EXECUTION

3.1 PREPARATION

A. Ream pipe and tube ends. Remove burrs.

B. Remove scale and foreign material, from inside and outside, before assembly.

C. Prepare piping connections to equipment with flanges or unions.

3.2 INSTALLATION

A. Install piping in accordance with NFPA 13 for sprinkler systems and NFPA 24 for service mains.

B. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.

C. Install piping to conserve building space, to not interfere with use of space and other work.

D. Group piping whenever practical at common elevations.

E. Pipe through floors, wall, and ceilings, at head locations, shall be equipped with approved sleeves and escutcheons. Escutcheons shall be polished chrome plated.

F. Install pipe sleeve at piping penetrations through footings, walls, and floors. Seal pipe and sleeve penetrations to maintain fire resistance equivalent to fire separation.

G. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

H. Pipe Hangers and Supports:
1. Install in accordance with NFPA 13.
2. Install hangers to with minimum 1/2-inch space between finished covering and adjacent work.
3. Place hangers within 12 inches of each horizontal elbow.
4. Use hangers with 1-1/2-inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
5. Support vertical piping at every floor. Support riser piping independently of connected horizontal piping.

6. Where installing several pipes in parallel and at same elevation, provide multiple or trapeze hangers.
7. Prime coat exposed steel hangers and supports. Refer to Section 09 90 00. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

I. Slope piping and arrange systems to drain at low points. Install eccentric reducers to maintain top of pipe level.

J. Prepare pipe, fittings, supports, and accessories for finish painting. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding. Refer to Section 09 90 00.

K. Do not penetrate building structural members unless indicated.

L. Where more than one piping system material is specified; Install compatible system components and joints. Install flanges, union, and couplings at locations requiring servicing.

M. Die cut threaded joints with full cut standard taper pipe threads with red lead and linseed oil, or other non-toxic joint compound applied to male threads only.

N. Install valves with stems upright or horizontal, not inverted. Remove protective coatings after installation.

O. Install gate or butterfly valves for shut-off or isolating service.

P. Install drain valves at main shut-off valves, low points of piping and apparatus.

Q. Sprinkler system shall be provided with complete drainage facilities in accordance with UBC Std drain discharge shall not spill on grade. It shall go into a sewer.

R. Where inserts are omitted, drill through concrete slab from below and install through-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.

S. Upon completion and prior to acceptance of installation, Contractor shall subject system, including underground supply connections, to tests required by CBC Std and shall furnish CFC with a certificate of compliance as required.

T. Close nipples shall not be used. Threaded unions shall not be installed in concealed areas unless provided with an approved access panel.

U. Fire sprinkler systems piping hanger and supports shall conform to the UBC Std requirements.

V. Underground pipe shall be laid on a flat undisturbed sand bed. After required pressure-leak test, pipe shall be covered with sand not less than 6 inches thick, prior to backfilling.

W. Piping to a sprinkler head in the elevator machine room or elevator shaft shall not go out of the room or shaft.

X. Provide shunt trip on sprinklers located in the elevator machine rooms and elevator hoist way unless the sprinklers are located 2 feet or less from the pit floor.

3.3 INTERFACE WITH OTHER PRODUCTS

A. **Inserts:**
1. Install inserts for placement in concrete forms.
2. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
3. Install hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

3.4 CLEANING

A. Div. 01/ Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.

B. Clean entire system after other construction is complete.

END OF SECTION 21 05 00

SECTION 21 13 13 - FIRE-SUPPRESSION SPRINKLER SYSTEM

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Fire sprinkler system for protection of buildings.

C. Related Requirements: The requirements of this Section, NFPA 13 and NFPA 14 shall take precedence over requirements found in the following:

1. Division 01 - General Requirements.

2. Section 07 84 13: Penetration Fireproofing.

3. Section 22 05 00: Plumbing Common Work.

4. Section 31 23 23: Excavation and Fill for Utilities.

5. Section 33 11 00: Site Water Distribution Utilities.

1.02 SUBMITTALS

A. Manufacturer’s Data:

1. Submit complete and detailed equipment and material list of items to be furnished and installed under this section.

2. Submit manufacturer's specifications and other data required to demonstrate compliance the plans and specified requirements.

B. Drawings:

1. Submit shop drawings of wet pipe fire protection sprinkler system in compliance to NFPA 13, Standard for the Installation of Sprinkler Systems, Sprinkler systems shall comply with the provisions of NFPA 13.

2. Shop drawings shall fully comply with the most stringent provisions of this specification and plans, and with the applicable codes and standards.

3. Shop drawings shall be same size as the Contract Drawings and shall be produced using AutoCAD.

C. Regulatory Requirements:

1. Installation of fire sprinkler system shall not vary from the plans unless alterations have been approved by the State Fire Marshal at DSA.

2. Complete DSA standard testing forms and get sign-off by the Project Inspector.

D. Closeout Submittals: Submit in accordance to Section 01 77 00, Contract Closeout, and as specified herein:

1. Record Drawings:

a. Record drawings of installed Work shall be maintained current on the Project site, available for Fire Marshal and the Project Inspector to review.

b. At completion of installation submit Record Drawings signed by installing Contractor in AutoCad format, including:

1). Record Specifications.

2). Record Product Data: Include specific model, type and size for equipment and material installed.

3. Record Test Results.

4. Maintenance Manuals.

1.03 QUALITY ASSURANCE

A. Comply with applicable national or local codes and standards.

B. Except where exceeded by the requirements of these specifications, the following are made part of this section: prints and details, and provisions of the NFPA 13 Standard for Installation of Sprinkler Systems Standard for the Installation

C. Qualifications of Manufacturer: Products used in work of this section shall be produced by manufacturers regularly engaged in manufacture of similar items and with a 5 year history of successful production that is acceptable to the Architect.

D. Qualifications of Installer: Installer shall have a current C-16 license in the State of California in the installation of fire sprinkler systems.

1.04 FIRE SERVICE WATER CONNECTION

A. Fire Service Mains shall be provided with approved Meter Service Backflow protection. An approved Reduced Pressure Principle Backflow Prevention Assembly (RP) to meet minimum backflow protection requirements for meter service protection (MSP) shall be provided on the fire main, according to the California Plumbing Code (CPC) and according to the current City of Compton Requirements.

1.05 PRODUCT HANDLING

A. Comply with the provisions specified in Sections 22 05 00 and 22 05 13.

1.06 COORDINATION

A. Coordinate activities in accordance with provisions of Section 22 05 00.

1.07 JOB CONDITIONS

A. Unscheduled utility flow interruptions are not permitted. Schedule service interruptions in advance, with the OAR.

1.08 EXTRA MATERIALS FOR MAINTENANCE

A. Provide spare sprinkler heads in quantity equal to 2 percent of total number of each type of sprinkler head installed. There shall be no less than two heads of each type and temperature rating provided, and in no case less than six spare sprinkler heads per building. There shall be no fewer than 6 spare sprinkler heads for up to 300 sprinkler heads installed; no less than 12 spare sprinkler heads for up to 1,000 sprinkler heads installed; and no less than 24 spare sprinkler heads for the sites with more than 1,000 sprinkler heads installed. Spare sprinkler heads shall be kept inside of spare sprinkler head box(s). A spare sprinkler wrench for each type of sprinkler head shall also be provided inside of each spare sprinkler head box, at each building. Locations of spare sprinkler boxes shall be located at:

1. Fire Sprinkler Riser, when enclosed and secure.

PART 2 - PRODUCTS

2.01 FIRE PROTECTION SYSTEM DESCRIPTION

A. General: Provide systems complete including, but not limited to:

1. Provide underground and above ground sprinkler and standpipe piping including trenching and backfilling. Materials and equipment shall be UL/FM listed and approved as required by NFPA for their application. Required signage shall be provided and installed as required by NFPA 13.

2. Provide overhead sprinkler system with sprinklers installed as required according to type, location and temperature rating.

B. Sprinkler Heads:

1. Provide chrome pendant spray type sprinkler heads with matching escutcheons in areas with finished ceilings. Exterior escutcheons shall be poly-coated or concealed type to prevent rusting and oxidation.

2. Provide upright sprinklers in areas with exposed piping.

3. Provide poly-coated glass bulb corrosion resistance type sprinklers heads in areas exposed to a corrosive environment such as parking garages and coastal air.

4. Sprinklers shall be glass bulb type, with hex-shaped wrench boss integrally cast into the sprinkler body to reduce the risk of damage during installation,

5. Sprinklers in concealed spaces, exterior locations, and other areas that will experience over 100 degrees F ambient temperature shall be furnished with 200 to 225 degree rated sprinklers. Sprinkler heads in boiler rooms, furnace rooms, or heater rooms shall be furnished with sprinklers rated at 250 to 290 degrees F. If a sprinkler is directly affected by a spotlight, steam, or other heat source, a 350 degree F or higher sprinkler head shall be furnished. Sprinkler heads in other locations, unless otherwise noted, shall be 155 to 165 degrees F rated.

6. Automatic fire sprinkler head type shall be as follows:

   a. In areas with ceiling heights of nine-feet or lower, sprinkler heads installed shall be recessed or fully concealed.

   b. Ceilings eight-feet or lower shall be provided with fully concealed sprinkler heads.

   c. Areas with ceiling height of nine-feet or lower, that are not constantly supervised such as corridors, arcades, students restrooms, and other restrooms shall be provided with fully concealed sprinkler heads.

7. Sprinkler heads in light hazard occupancies are required to be Quick Response sprinklers as required in NFPA 13. Sprinkler heads shall be of the same manufacturer throughout the building/site as indicated. Sprinklers shall typically be ½ inches NPT, standard orifice, minimum 5.6 nominal K factor, UL listed for 175 psi, and listed for light and ordinary hazard occupancies.

8. Other specialized sprinkler heads such as walk-in refrigerator or freezer heads, side wall, ¾ inches sprinklers above 5.6 K factor, and those sprinklers with a K factor below 5.6, shall only be used where required by project condition. Large drop sprinkler heads and extended coverage sprinkler heads shall not be installed.

9. Sprinkler head location shall be designed and installed in an aesthetically pleasing manner and should generally be located in center of 24-inch by 24-inch ceiling tiles and in center of 24-inch by 48-inch ceiling tiles in the 24-inch direction and no closer than 12-inch from the edge in the 48-inch direction.

10. UL/FM listed Sprinkler head guards shall be provided on Sprinkler heads installed at seven feet six inches above floor or lower in exposed locations, or that are deemed subject to damage. Sprinkler head guards shall securely fasten with bolt-on feature to the base of the sprinkler or be a factory installed guard. Guards shall also be provided on upright and sidewall heads where sprinklers are installed at seven feet six-inch heights or lower.

C. Fire Sprinkler and Standpipe Systems:

1. Underground piping: Comply with the requirements of Section 33 1100, Site Water Distribution Utilities.

2. Provide an underground UL/FM listed PVC or Ductile iron supply line connected to detector check meter or water main as indicated. Install site water mains no closer than 10'- 0" parallel to the building foundations. Underground fire water lines shall be installed 36 inches below grade. Tracer wire shall be installed in accordance with Section 33 1100: Site Water Distribution Utilities.

3. Fire Department Connection (FDC) with check valve (wafer type) shall be provided after the backflow preventor, and before the building fire sprinkler riser(s), located where the FDC will be accessible to the fire department from the street or sidewalk without obstructions. No shut off valve shall be allowed on the FDC line as per NFPA 13. FDCs shall have a height between two and four-foot above the ground.

4. PIVs shall be electrically supervised regardless the number of fire sprinkler served (CBC 903.4), and set at a height of three feet to the top and have the handle locked in place with a break-a-way lock.

5. Provide a UL listed, FM approved FDC, approved RP type backflow assembly, check valves, shut-off valves, drain valves, ITV, and flow indicator at the locations required. (Test-and-drain combination valves are prohibited.)

6. Flow indicator shall activate the fire alarm system between 45 and 90 seconds, and activate a local alarm on the outside of the building continuously with water flow. Connection of this switch is a part of the Work of Division 26. Shut-off including valves on the fire main backflow preventor shall be electrically supervised according to CBC 903.4,, NFPA 13 and Section 28 3100 – "Fire Detection and Alarm".

7. Pipe through ceilings at head locations shall be furnished with a two piece, or fully concealed escutcheon. Unless otherwise designated, escutcheons shall be identical and match the other escutcheons of the same type throughout the building or site. Piping through walls and ceilings shall have a split ring chrome escutcheon.

    a. Flexible stainless steel sprinkler head drop system may be used. Flexible drops shall be UL listed, FM approved, and shall be compatible with ceiling systems. Flexible drop length shall be included in the Hydraulic Calculations. The drop system shall include the required support bracing.

8. Furnish and install required signs, spare heads, special wrenches, and spare sprinkler head boxes as required to satisfy NFPA 13, NFPA 14 and this specification.

9. Sprinkler system piping shall be provided with complete drainage as required by NFPA. Test valve discharge shall be piped away from planters to asphalt areas. Furnish protection of piping against accidental or malicious damage.

10. Upon completion of the Work of this section, and before Substantial Completion, subject system, including underground supply connection, to tests required. A minimum hydrostatic test shall be two hundred pounds (200 psi) or fifty pounds (50 psi) in excess of the maximum system working pressure, whichever is greater, for two hours with no leaks or loss of pressure per NFPA 13. The Project Inspector shall be furnished with a NFPA 13 test certification.

11. Local fire sprinkler alarm requirements shall be accomplished with a vane or paddle type water flow detector switch and an electrically powered fire sprinkler horn located on the street side of the building and connected to the fire alarm control panel with secondary power provided from the fire alarm batteries. The drilled out disk shall be attached to the mounting U-bolt. Time delay shall be set at 45 to 60 seconds. Mechanically activated water bells with alarm valve and pressure switch are prohibited.

12. Seismic separation assemblies shall be located between the buildings if space allows accessibility. Otherwise they shall be located inside the building providing the most space. Swing joints may be fabricated on site using flexible groove couplings and six grooved (Victaulic) 90 degree elbows in a teepee formation (see NFPA 13, figure A.9.3.3). Seismic separation assemblies can also be made utilizing a manufactured, UL/FM listed swing joint assembly rated at a minimum 175 psi.

13. Hanging, bracing and support shall utilize only UL/FM listed approved products, and comply with NFPA 13, Chapter 9 requirements for rod and bolt sizes except for the following: 4 and 6 inch pipe shall be supported by a minimum ½ inch hanger rod, 8 inch pipe shall be supported by a minimum 5/8 inch hanger rod, 10 and 12 inch pipe shall be supported by a minimum ¾ inch hanger rod. Hanger rods in exterior locations and in parking structures shall have Electrodeposited Zinc Coating per ASTM B633 to prevent rusting.

14. Building Fire Sprinkler riser assemblies shall be provided as follows. Every building shall be provided with an accessible and electrically supervised riser shut off valve at a height not to exceed five-feet above the floor. Every building riser assembly shall be equipped with a check valve followed by a main drain valve and then the flow indicating switch and pressure gauge immediately after the shut-off valve. In cases where a riser assembly is provided for each floor in the building, a check valve, main drain and flow switch shall be provided for each floor; the main building shut-off shall not be required. An electrically supervised Post Indicator Valve located outside the building may serve as the building riser shut-off valve.

2.02 MATERIALS

A. Access Panel:

FAP-1 Square, steel, prime-coated, with vandal-proof door lock operated by Allen wrench:

Smith	Josam	Elmdor
4760		DW – AKL

B. Globe or Angle Valves: UL/FM listed.

AV-1 Bronze angle valve: 2 inches and smaller, screwed-in bonnet, threaded ends, rising stem:

Nibco	Kennedy	Fairbanks	United
T-301	98 SD	0210	126T

C. Automatic Fire Sprinkler Head, UL/FM listed:

AFSH-1 Brass pendant type for areas with suspended ceilings:

Victaulic	Tyco	Viking	Reliable
V27	TY 3231	VK302	F1FR56

AFSH-2 Brass upright type for areas with no ceilings:

Victaulic	Tyco	Viking	Reliable
V27	TY3131	VK300	F1FR300

AFSH-3 Chrome or poly coated semi recessed type with semi-recessed escutcheon:

Victaulic	Tyco	Viking	Reliable
V27	TY3231	VK302	F1FR56

AFSH-4 Fully concealed type sprinklers; chrome cover:

Victaulic	Tyco	Viking	Reliable
V38	TY3531	VK462	F4FR
		VK404	G4A

D. Backflow Prevention Assemblies:

BPV-1 Reduced Pressure Principle Backflow Prevention Assembly (RP) type for meter service protection (MSP) requirements:

Ames	Febco	Watts	Wilkins
4000SS	860 OS&Y	909 RP	975 RP
C400	880 OS&Y	957 RP	375 RP
M400		994 RP	

E. Gear Operated Butterfly Valves:

GOBFV-1 Grooved end Gear Operated Butterfly Valve, 300 psi, for fire protection sprinkler risers. UL listed, FM approved, with weatherproof gearbox and double pole/double throw monitor switch, double seal design for bubble tight shut off at 175 psi. Corrosion-resistant, fusion-bonded nylon II body coating, easy to read position indicator:

Kennedy	Nibco	Victaulic	Tyco
Figure 82M	GD-4765-8N, 300 psi	705W 300 psi	580 300 psi

GOBFV-2 Wafer Type Gear Operated. Butterfly Valve, same requirements as GOBFV-1:

Kennedy	Nibco
Figure 82W	WD-3510

300 psi

F. Check Valves:

CV-1 Bronze check valves: 2 inches and smaller, 200 psi WOG, bronze disc, swing type, conforming to MSS-SP-80-97, threaded ends:

Crane	Nibco	Stockham	United
37	T-433-Y	B-319	62T

CV-2 Iron check valves: 2-1/2 inches and larger, class 175, composition disc, swing type, bolted cap, UL listed, FM approved flanged ends:

Stockham	Kennedy	Tyco	Clow
G-940	126	Model G	F5380

CV-3 Wafer Type Check Valve:

United Wafer Check #90	Nibco KW-900-W	Mueller A-2102

CV-4 Grooved Check valve 2 ½ inch and larger:

United	Gruvlock	Reliable	Victaulic	Tyco
67	7800	Mode “G”	Series 717	590F

G. Escutcheons

ES-1 Chrome plated, or white poly-coated, 2-piece canopy (escutcheon), 2.25 to 3.5 inches in extended position:

FPPI	Tyco	Reliable
01 - 401 Chrome or White	No. 401 Chrome or White	HBC (chrome) HBW (white)

ES-2 Chrome plated or white poly coated, 2-piece recessed:

FPPI	Tyco	Reliable (semi recessed)
01 - 400	410	GF2-C (chrome)
01 - 402	420	GF2-W (white)

H. Fire Department Connections:

FDC-1 UL listed, FM approved, type, 4 inch by 2-1/2 inches by 2-1/2 inches bronze body fire department hose connection (FDC):

Crocker	Potter-Roemer	Tyco	Powhaten
6405 or 6420	5710 or 5730	86	21-201 or 31-133

I. Flow Indicators:

FIA-1 Listed by State Fire Marshal, with double pole, double-throw switch, one normally open and one normally closed, UL listed and FM approved:

Potter-Roemer	Notifier
VSRF Series	WFR Series

J. Outside Stem and Yoke Gate Valves:

OS&Y-1 Bronze Gate Valves: 2 inches and smaller, class 175, solid bronze wedge disc, OS&Y, copper silicon alloy stem, UL/FM listed, threaded ends:

Stockham	Crane	Nibco	United
B-133	459	T-14	18

OS&Y-2 Iron gate valves: 2 ½-inch and larger, class 175, IBBM, OS&Y, solid wedge disc, Teflon-impregnated packing, UL/FM listed, flanged ends:

Stockham	Crane	Kennedy	Mueller	Victaulic
G-634	467	68	A-2073	771

OS&Y-3 2 ½-inch and larger, epoxy coated, resilient wedge, 175 pounds gate valve for riser valves, P.I.V., and shut off:

Clow	Nibco	Kennedy	Mueller
F-6136	617-0	KV-4068	A-2360

K. Gate Valves:

GV-1 Bronze gate valves: 2-inch and smaller, class 175, solid bronze wedge disc, rising stem copper silicon alloy stem, UL/FM listed, threaded ends:

Stockham	Crane	Grinnell	United
B-133	459 Fig. 66	14	

GV-2 Iron gate valves: 2 ½-inch and larger, class 175, IBBM, solid wedge disc, Teflon impregnated packing, UL/FM listed, flanged ends:

Stockham	Crane	Kennedy	Mueller	Victaulic
G-634	467	68	A-2052	772

L Gear Operated Ball Valves:

GOBV-1 Threaded ball valve for sizes two inches and smaller:

Nibco KT-505W-4 Victaulic 728

M. Seismic Swing Joints:

SJ-1 UL/FM Approved flexible seismic connector with grooved, or threaded ends for seismic separation requirements.

SJ-2 Fabricated swing joints as per NFPA 13 using six groove 90 degree elbows and flexible groove couplers such as Victaulic style 75.

N. Post Indicator Valves:

PIV-1 Vertical Indicator Posts: Furnished for underground valves, post must provide a means of knowing if the valve is open or shut, UL/FM listed. (Where a backflow assembly is provided, the shutoff valves on the backflow preventer satisfy the requirement for a post indicator valve to control the fire main and FD Connection):

Stockham	Kennedy	Grinnell
G-951	2945	F-750
Clow	Mueller	Victaulic
F-576	2945	774

PIV-2 Posts Indicator valve: Furnished for underground valves. Ductile iron fusion bonded epoxy coated resilient wedge gate valves: 4 inches and larger, class 175 lb, non-rising stem, mounting plate for indicator post, UL/FM listed, flanged or mechanical ends (in accordance with NSF 61).

Stockham	Kennedy	Clow	Mueller	Victaulic
G-635	71X	F-6100	2360	772

O. Sprinkler Guards:

SPG-1 Sprinklers installed at seven feet six inches above floor or lower in exposed locations, or that are deemed subject to damage shall be equipped with a UL/FM listed, head guard. Guards shall be listed, supplied and approved for use with the sprinkler by the sprinkler manufacturer. Sprinkler head guards shall securely fasten with bolt-on feature to the base of the sprinkler or be a factory installed guard. Guards shall also be provided on upright and sidewall heads where sprinklers are installed at seven feet six-inch heights or lower.

Reliable	Viking	Tyco	FPPI	Victaulic

P. Sprinkler Horn:

SPH-1 UL/FM approved, surface-mounted, weatherproof and red finished:

Horn:	Bell:
HRK System Sensor	SSM-24-10 System Sensor
24 V-DC	24 V-DC
Weatherproof with	Weatherproof with
BBS-2 back-box for	WBB box for
Surface mount	Surface mount installation

Q. Hangers, Supports, Bracing:

HSB-1 Tolco products or UL listed and FM

R. Threaded fittings:

TF-1 Ductile iron, 300 psi rated, UL listed, FM or NFPA approved.

TF-2 Cast iron fittings, 175 psi rated, UL listed, FM or NFPA approved:

Anvil Ward Taylor

TF-3 Malleable Iron, 300 psi rated, UL, Listed, FM or NFPA approved

TF-4 Galvanized, 175 psi rated, UL Listed, FM or NFPA approved

S. Fire Sprinkler Pipes and Standpipes:

FSP-1 Fire sprinkler pipe: 1 inch through 8-inch, Schedule 40, black or galvanized steel meeting ASTM Standards A53, A135, or A795. Pipe Corrosion Resistance Ratio (CRR) shall be 1.00 or greater. Pipe may be threaded or grooved.

a. Piping 2 inches and smaller shall have threaded joints and fittings in concealed, non-accessible locations. Groove coupler connections (Victaulic, Viking VGS) on pipe sizes 1 inch through 2 inches are acceptable in accessible areas with required seismic bracing provided. Plain end connections such as “Plainlock” and “FIT” are prohibited.

b. For pipe sizes 2 ½-inch and larger, grooved type (Victaulic, Viking VGS), welded, threaded and flanged connections may be used. Any connection that does not utilize a threaded, welded or grooved connection is prohibited, except for mechanical tee bolt-on branch outlet fittings sizes 2-inch and smaller (Victaulic 920 and the 920N).

c. Submit Verification from manufacturer stating that piping material furnished meets above criteria; (i.e.: threadable pipe has a UL assigned CRR of 1.00 minimum, that it meets ASTM A53, A135 or A795, and it is UL listed, FM or NFPA approved.)

FSP-2 Ductile iron pipe, AWWA C151 (for pipes below grade). Gasketed self retaining joints per ASME/ANSI B16.4.

FSP-3 Plastic, PVC, thick wall (cast iron OD sized), DR 14 (200 PSI). UL listed for fire main service (underground). Gasketed self retaining joints - Johns Manville Blue Brute AWWA C900, JM Eagle C900 water pipe.

FSP-4 Fire Sprinkler Pipe: 1 inch through 3-inch, Copper meeting NFPA 13 Standards. Pipe may be grooved.

FSP-5 Flexible Fire Sprinkler Head Connectors: 1 inch pipe size flexible stainless steel fire sprinkler head connectors “Flex Head Industries” Models 2024, 2036, 2048, 2060 and 2072.

2.03 ACCESSORIES AND APPURTENANCES

A. Escutcheons: Polished chrome plated split-ring type for exposed piping at every penetration inside finished rooms.

B. Guards: Provide sprinklers with guards at ceiling at or under seven feet six-inch high and where subject to damage or vandalism.

C. Miscellaneous: Provide accessories and appurtenances for a complete system.

2.04 FIRE HOSE VALVES (Not Applicable).

A. Schedule Numbers:

SPV-1 Valve, Fire Hose, cast brass angle valve, UL listed and Factory Mutual approved; 1 ½-inch at 175 psi, female NPT outlet with 1 ½-inch male NPT by 1 ½-inch male NST adapter nipple.

POTTER-ROEMER	POWHATAN	UNITED
4070	500	88

SPV-2 Valve, Standpipe for 2 ½-inch for 150 or higher psig working pressure, male NST outlet for fire department hose connection. Cast brass, replaceable composition disc, and rough chromium-plated body (unless provided inside UL listed valve cabinet) with hand wheel.

POWHATAN	UNITED	POTTER-ROEMER
DXWDGV-250F DXAV5-250F	88H	4065

2.05 STANDPIPE VALVE CABINETS (Not Applicable).

A. Schedule Numbers:

SPVC-2 Surface mounted cabinet for masonry walls, same as SPVC-1.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions under which Work of this section shall be performed. Correct conditions detrimental to proper and timely completion of Work. Do not proceed until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel or groove plain end ferrous pipe ends.

B. Remove scale and foreign matter, from inside and outside of pipes, before assembly.

C. Provide piping connections to equipment with flanged or grooved connections.

3.03 INSTALLATION

A. Install underground supply line connected to detector check or water main indicated. Braced or clamped bends shall be in accordance with requirements of NFPA 24. Provide vertical clamp rods at flange and spigot piece of risers, long enough to pass through riser's base flange where required. Furnish concrete thrust blocks where required. Tracer wire shall be installed as per Section 22 0553: Plumbing Identification on PVC underground piping.

B. Install FDCs, check valves, shut-off valves, gauges, Inspector’s test and drain assemblies and flow indicator. FDC must be installed so that it is unobstructed and accessible for the Fire Department’s first response unit.

C. Pipe through floors, wall, and ceilings, at head locations, shall be furnished with required sleeves, and escutcheons and fire caulking where indicated and/or required by code. Escutcheons shall be polished chrome plated unless other finish is selected by the Architect.

D. Sprinkler system shall be provided with complete drainage facilities in accordance with CBC standards. Drain discharge may discharge into a sewer, storm drain, sump pit or street gutter. Fire sprinkler drains shall not discharge onto a playground or across a sidewalk. Discharge to plumbing fixtures is prohibited due to the inability of a plumbing fixture to receive a full flow of water from a fire sprinkler drain valve under working pressure.

E. Upon completion of the Work of this section, and before Substantial Completion, subject the entire system, including underground supply connections, to tests as required by NFPA 13, and CBC standards and furnish the Owner with a certificate of compliance as required.

F. Close nipples are prohibited. Threaded unions are prohibited. Where a threaded union or coupling is needed, a groove type fitting (Victaulic) shall be used instead. If a groove style coupling is used in a concealed area, an access panel allowing full access to that connection shall be provided.

G. Fire sprinkler systems piping hangers, seismic bracing, anchors and supports shall conform to NFPA 13, CBC and other applicable codes and the requirements of this specification.

H. Grooved joints shall be installed in accordance with the manufacturer's latest published installation instructions. Grooved ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove. Gaskets shall be of an elastomer grade suitable for the intended service, and shall be molded and produced by the coupling manufacturer.

I. Tee branch outlets on fire sprinkler mains shall be by the use of a threaded ductile iron tee fitting, a groove type tee fitting, (Victaulic), or by the use of a thread-a-let welded on by a certified welder as required by NFPA. Mechanical tee bolted branch outlet fittings are prohibited except for branch outlet sizes 2-inch and smaller.

J. Sprinkler lines within the building shall be concealed within the structure. Risers shall be installed in utility, supply rooms or similar service areas whenever possible, and shall not obstruct access, or maintenance of other equipment within the space. Mains and risers shall be located within the area protected by the sprinkler system unless otherwise approved by fire authorities having jurisdiction.

K. Sprinklers that have been dropped, damaged, have cracked bulbs, or show a visible loss of fluid shall not be installed.

L. Sprinkler bulb protectors shall be removed by hand after sprinkler installation. Tools or other devices to remove the protector that could damage the bulb in any way shall not be used.

M. Routing of piping in non-concealed exposed areas shall be subject to the Architect's review in the final shop drawings.

N. Underground piping shall have a minimum of 36 inches of cover to grade. Underground pipe shall be installed on a flat not less than 6-inch thick undisturbed sand bed. After required pressure-leak test, pipe shall be covered with sand not less than 6 inches thick, before backfilling. Comply with NFPA Standards. Piping is not allowed to be underground below the building floor slab.

O. Provide approved backflow prevention assemblies. Installations of backflow prevention assemblies shall be tested and certified by a certified Los Angeles County backflow prevention device tester prior to Substantial Completion. Tests shall be performed in the presence of the Project Inspector. Test reports shall be turned over to the Project Inspector for mailing to proper agency.

P. Provide shunt trip when sprinklers are installed in the elevator machine rooms and elevator hoist way unless the sprinklers are located 2 feet or less from the hoist way pit floor.

Q. Test valve (ITV) shall be located at the opposite end of the sprinkler system from the supply. Test-and-drain type combination valves are prohibited. ITV discharge and main drain lines shall be piped to a sump pit or to the outside of the building to within a foot from the ground where it will drain away from the building to an exterior storm drain.

R. Each building with a sprinkler riser shall be furnished with an accessible shut off riser valve installed no higher than five feet from the finish floor. Each floor shall have a separate shut off valve with flow switch, and shall be securely enclosed or secured with a chain and break-a-way lock. Also see section 2.01- C-12 of this specification.

3.04 PROTECTION

A. Protect the Work of this section until Substantial Completion.

3.05 CLEANUP

A. Remove rubbish, debris, and waste materials and legally dispose at off-project site.

END OF SECTION

DIVISION 22
PLUMBING

SECTION 22 05 00 - PLUMBING COMMON WORK

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. This Section provides the basic plumbing requirements that apply to the Work of Division 22.

B. Related Requirements:

1. Division 01: General Requirements.
2. Division 22: Plumbing
3. Division 23: Mechanical
4. Division 26: Electrical.

1.02 REGULATORY REQUIREMENTS

A. Current federal Safe Drinking Water Act (SDWA) regulations require the furnishing of lead-free pipe, solder, and flux in the installation or repair of plumbing in non-residential facilities connected to public drinking water systems. Under this regulation, solders and flux are considered lead-free when they contain 0.2 percent lead or less. Under California regulations pipes and pipe fittings are considered lead-free when they contain 0.25 percent lead or less as defined in California Assembly Bill 1953 (AB 1953). No pipe, pipe fittings, or any other fitting or fixture intended to convey or dispense water for human consumption by drinking or cooking is allowed in the domestic plumbing system, if they do not meet the low lead definition of AB 1953. Weighted average lead content of the wetted surface area of pipes, fittings and fixtures may not exceed 0.25 percent.

1. Provide lead-free water pipe, solder, and flux materials that meet the standards as outlined by the federal SDWA regulations and California AB 1953 if installed in drinking water system.
2. Collect pipe, solder, and flux material samples as required by the Project Inspector. Test samples shall be delivered to an Owner designated testing laboratory for testing of lead content.
    a. Test samples for lead content by the atomic absorption spectrophotometry method.
3. Materials found not conforming to SDWA and California AB 1953 regulations shall be deemed defective Work and shall be replaced with lead-free materials.
4. Comprehensive testing of the remaining materials for their lead content shall be performed as required by the Project INSPECTOR.

A. Materials, fabrication, equipment, and installation shall comply with industry standards and code requirements. Where manufacturer's recommendations exceed industry standards, the manufacturer's recommendation shall establish the minimum standard. As a minimum, standards from the following organizations shall apply:

1. ANSI - American National Standards Institute.
2. ASME - American Society of Mechanical Engineers.

a. ASME Boiler and Pressure Vessel Code.

b. ASME B31 - Standards for Pressure Piping.

3. ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers.

4. ASTM - American Society for Testing and Materials.

a. ASTM A53 Specification for Welded and Seamless Pipe.

5. AWWA - American Water Works Association.

6. CSA - Canadian Standards Association.

7. FM Global - Factory Mutual Global

8. IAPMO - International Association of Plumbing and Mechanical Officials.

9. NFPA - National Fire Protection Association.

10. OSHA - Occupational Safety and Health Administration.

11. NOT USED

12. UL - Underwriters Laboratories Inc.

13. Intertek (ETL Certification).

B. Materials, fabrication, equipment, and installation shall comply with federal, state, and local codes including, but not limited to, the following:

1. CBC, California Building Code, and CMC, California Plumbing Code.

a. Latest edition as adopted by the City of Compton, the County of Los Angeles, and the State of California including amendments effective on the Effective Date of the Contract.

2. California Code of Regulations, Title 8, Industrial Relations, Division 1, Chapter 4, Division of Industrial Safety.

3. OSHA - Occupational Safety and Health Administration.

4. CDPH - California Department of Public Health.

5. SCAQMD - South Coast Air Quality Management District.

C. Specifications or Drawings shall not be construed to permit deviation from the requirements of governing codes unless approval has been obtained from legally constituted authorities having jurisdiction, and the Architect. The Contract Documents may contain more stringent requirements than those legally required.

D. Permits and Fees: Refer to the General and Supplementary Conditions.

1.03 SUBMITTALS

A. Provide submittals in accordance with Section 01 3300: Submittal Procedures and with specific requirements of Division 22 sections, as applicable.

B. The above information shall become the basis for inspecting and testing materials and actual installation procedures performed in the Work.

C. Shop Drawings: Submit one additional copy when control diagrams having line voltage connections are indicated. Shop Drawings shall be specifically prepared for the Work of this Project. Drawings prepared in accordance with requirements of Section 01 31 13: Project

Coordination and Section 01 3300 may be provided by the Architect to serve as a background for the Shop Drawings. Shop Drawings shall comply with the requirements of Section 01 31 13 and Section 01 33 00 and shall indicate at a minimum:

1. Complete system layout of equipment, components, plumbing fixtures, piping, indicating service clearances, and pipe sizes, fitting types and sizes and pipe elevations, distances of pipes and equipment from building reference points and hanger support locations. The above items shall be coordinated on the shop drawings according to the requirements of Section 01 31 13.

2. Schedule and description of equipment, piping and fittings.

1.04 PROJECT RECORD DOCUMENTS

A. Comply with provisions of Section 01 77 00: Contract Closeout.

B. Project Record Drawings:

1. Provide a complete set of plumbing and fire protection drawings in AutoCAD and BIM, complete with external reference drawings, fonts, blocks and plotter pen color/line thickness settings on CD-ROM. Also submit one set of full size reproducible plots on vellum and 3 sets of prints.

2. Before Contract Completion, deliver corrected and completed prints to the OAR. Delivery of project record documents to the OAR does not relinquish responsibility of furnishing required information omitted from project record documents.

C. Operation and Maintenance Manuals:

1. Submit two copies of operation and maintenance manuals in required form and content. If no revisions are required, furnish one additional copy. If revisions are required, one copy shall be returned with instructions for changes; perform such changes and return three copies of manuals. Manuals shall be bound in accordance to Section 01 77 00. Deliver manuals to the OAR. Submit an electronic copy of the entire manual in PDF file format.

2. Contents of Manual:

a. Title sheet with Project name, including names, addresses and telephone number of Contractor, installer, and related equipment suppliers.

b. Manufacturer's operating instructions including, but not limited to, the following:

1) Identification of components and controls.

2) Trouble shooting checklist and guidelines.

3) Recommendations for optimum performance.

4) Warnings and safety precautions on improper or hazardous operational procedures or conditions

c. Manufacturer's product data and parts and maintenance booklet for each item of equipment furnished under Division 22 that includes the following as a minimum:

1) Manufacturer’s model, identification and serial numbers.

2) Exploded view of assembly drawings identifying each component or part with the relevant part number.

3) Directory of manufacturer's representatives, service contractors and part distributors.

4) Maintenance and trouble-shooting instructions, including schedule for preventive maintenance, periodic inspection and cleaning criteria.

d. Project Record Drawings: Complete set of plumbing, fire protection and control system drawings in 50 percent reduced print format shall be furnished with the manual. Submit the above record drawings on CD-ROM in AutoCAD and, if available, BIM, complete with external reference drawings, fonts, blocks, and plotter pen color/line thickness settings.

e. Testing, Adjusting, and Balancing reports: Submit as specified in Section 23 0593.

f. South Coast Air Quality Management District (SCAQMD) permits to install and operate boilers, water heaters and other fuel burning equipment and third-party source test reports as required by SCAQMD to allow start-up and operation of equipment.

g. Los Angeles County industrial waste permits.

h. Valve directory complete with location, function, size, and model of each valve with reference to the project record drawings.

i. Equipment and component identification chart complete with location, function, size, and model of each equipment or component with reference to the project record drawings.

1.05 COORDINATION

A. Contract Documents indicate extent and general arrangement of Work under Division 22. Contractor shall coordinate work in accordance with Section 01 3113 requirements and make adjustments as required to provide maximum headroom, a neat arrangement to keep passageways and openings clear to provide accessibility and provisions for maintenance, and to meet code requirements.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Delivery and Storage: Deliver materials to Project site in their original unopened containers with labels intact and legible at time of delivery. Store in strict accordance with manufacturer's recommendations.

B. Do not store plastic pipe or materials in direct sunlight.

1.07 PRELIMINARY OPERATION

A. OAR may require any portion of plumbing Work to be operated before Substantial Completion. Such operation shall be in addition to regular tests, demonstrations and instructions required under the Contract Documents, and shall be performed as required.

B. Notify the INSPECTOR at least 24 hours in advance of lighting or re-lighting pilots.

1.08 TRAINING OF OWNER PERSONNEL

A. Training of Owner's personnel shall include:

1. A minimum of 4 hours of on-site overview of the overall Plumbing System.

2. Refer to Division 22 sections for specific training on each of the components of the Plumbing System.

B. Contract shall include the cost of training Owner operation and maintenance personnel in operating, adjusting, maintenance, trouble-shooting, and Project site repair of each component, equipment, or system provided under this Contract.

C. Operational and maintenance training shall be conducted on the Project site, unless indicated otherwise.

D. Upon completion of Owner training, a completion certificate indicating the nature of the training and a description of the systems, complete with equipment and component lists shall be issued to each trainee. The certificate should be issued in duplicate with one copy retained by OAR.

E. An attendance sheet with the names and signatures of all participants attending the training shall be submitted to the OAR and kept as part of the project documents.

1.09 GUARANTEES AND DAMAGE RESPONSIBILITY

A. Sound of water flowing in piping shall not be transmitted to building structure. Operation of mechanical system shall not produce operational sounds that can be heard outside of rooms enclosing apparatus or equipment.

PART 2 – PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. Unless otherwise specified, materials and equipment shall be new, in good and clean condition. Equipment, materials, and components shall be of the make; type and model number noted on Drawings or specified. Pieces of equipment of the same type shall be by the same manufacturer.

B. Whenever an item is listed by a single proprietary name, with or without model number and type, it shall be for purpose of design only, to indicate characteristics and quality desired. Proprietary designation listed on Drawings, or listed first in Specifications, is used as a basis for design to establish a standard for quality and performance and space requirements.

C. Equipment and materials indicated or required to be installed outdoors shall be of the type that is designed, manufactured, listed or approved by authorities having jurisdiction for outdoor installation by being resistant to the adverse effects of weather. The additional protective measures against outdoor weather required by the manufacturers' installation instructions and prevalent practice shall be provided.

D. For substitution of materials or products, refer to the General Conditions.

PART 3 – EXECUTION

3.01 SERVICE INTERRUPTIONS, OFF-SITE, GAS AND WATER

A. Schedule Work so there shall be no service interruptions of existing systems or systems during normal hours of operation of affected systems and facilities.

B. When service interruptions are mandatory, arrange in advance with the OAR as to time and date of such interruptions.

C. Systems, which are interrupted, shall be returned back into operation in such manner that they will function as originally intended.

3.02 CUTTING, NOTCHING, AND BACKING

A. Conform to California Building Code, Title 24, Part 2, for notches and bored holes in wood and for pipes and sleeves embedded in concrete and for cuts in steel, as detailed on structural Drawings.

B. Where pipes pass through, or are located within one inch of any construction element, install a resilient pad, ½ inch thick minimum, to prevent contact.

C. Furnish provisions for recesses, chases, and accesses and provide blocking and backing for proper reception and installation of plumbing Work.

3.03 LOCATION OF PIPING AND EQUIPMENT

A. Location of piping, apparatus and equipment indicated on the Drawings is approximate and shall be altered to avoid obstructions, preserve headroom, and provide free and clear openings and passageways.

B. Trenches parallel to footings shall not be closer than 18 inches to the face of footings and shall not be below a plane having a downward slope of 2 horizontal to one vertical, from a line 9 inches above bottom of footing.

C. Pipe in tunnels shall be installed close to one side of tunnel to provide maximum space for passage. Pipe shall not be installed through crawl hole unless otherwise specified or detailed on Drawings.

D. Place equipment in locations and spaces indicated, disassemble and/or reassemble equipment as required by Project conditions.

3.04 TESTS AND TESTING

A. Tests shall be as required under the applicable sections of Division 22, including this Section.

B. Additional tests may be required in the case of products, materials, and equipment if:

1. Submitted items are altered, changed, or cannot be determined as exactly conforming to the Contract Documents.

2. Performance testing and results may also be required on certain items which are as specified, including fan, and pump performance.

C. Piping Tests:

1. Perform tests required to demonstrate that operation of plumbing systems and their parts are in accordance with Specifications covering each item or system, and furnish materials, instruments and equipment necessary to conduct such tests. Tests shall be performed in presence of the Inspector, and representatives of any governmental agency having jurisdiction. Work shall not be concealed or covered until required results are provided.

2. If required tests are not performed, Owner may provide in accordance with the Contract Documents.

3. Pressure gauges furnished in testing shall comply with CPC. Air shall be bled from lines requiring hydrostatic or water tests.

4. Systems shall be pressure-tested in accordance with pipe testing schedule below. Pipe test shall indicate no loss in pressure after a minimum duration of 4 hours at test

pressures indicated. Where local codes require higher test pressures than specified herein for fire sprinkler systems, local codes shall govern.

5. Fuel gas lines shall be first tested with piping exposed, before backfilling trenches or lathing; second with piping in finished arrangement, backfilled and paved where required, and walls finished.

6. Piping systems may be tested as a unit or in sections, but entire system shall successfully meet requirements specified herein, before final testing by the Inspector.

7. Repair of damage to pipes and their appurtenances or to any other structures resulting from or caused by these tests, shall be provided.

D. Pipe Testing Schedule:

System Tested	**Test Pressure (psig)**	**Test With:**
Cast-iron soil, waste, vent, storm drain, condensate drain from air conditioning equipment	10 feet of water, vertically	
Domestic water piping	200	Water
Gas piping (steel threaded or plastic)	60 (both tests)	Air
Gas piping (steel welded)	100 (both tests)	Air
Gas welding station	1-1/2 Working pressure 100 min.	Dry nitrogen

E. Equipment Performance Assurance Tests:

1. Before operating any equipment or systems, a thorough check shall be performed to determine that systems have been flushed and cleaned as required and that equipment has been properly installed, aligned, lubricated, and serviced. Factory instructions shall be checked to verify installations have been completed and recommended lubricants have been installed in bearings, gearboxes, crankcases, and similar equipment. Particular care shall be furnished in lubricating bearings to avoid damage by over-lubrication and blowing out seals. Equipment shall also be checked for damage that may have occurred during shipment, after delivery, or during installation. Damaged equipment, products, and materials shall be replaced or repaired as required.

2. Upon completion of the above, adjust the system settings to within normal operating conditions to prevent the system from being damaged upon start-up.

3. Run-test the equipment after start-up for five consecutive days. Tests shall include operation of all equipment and systems for a period of not less than two 8 hour periods at 90 percent of the full specified capacities.

4. Equipment Start-up Reports: For each equipment or system on which start-up is performed, submit 8 copies of start-up report for review by the Architect.

   a. The start-up report shall include the manufacturer's standard start-up form completed and signed by the start-up technician.

5. Provide, maintain, and pay costs for equipment, instruments, and operating personnel as required for specified tests.

6. Provide electric energy and fuel required for tests.

7. Final adjustment to equipment or systems shall meet specified performance requirements.

8. Equipment, systems, or Work deemed defective during testing shall be replaced or corrected as required. Test until satisfactory results are provided.

F. Specific Coordinated Plan for Test and Balance:

1. Provide a narrative of the operational intent that clearly describes the function and sequence of operation of each component, equipment, or system installed. Instruct designated Owner personnel in the operation of the installed systems.

2. Prior to final test and balance, plumbing equipment and systems shall be operated and tested as indicated in Article 3.04.F above to demonstrate satisfactory overall operation of the installed systems.

3. Welding performed as part of this Division may be subject to radiographic inspections at random in accordance with requirements specified in Section 22 05 13: Plumbing Basic Materials and Methods.

3.05 NOISE AND VIBRATION REDUCTION

A. Correct noise or vibration caused by plumbing systems. Provide all necessary adjustments to specified and installed equipment and accessories to reduce noise to the lowest possible level

B. Correct noise or vibration problems caused by failure to install work in accordance with Contract Documents. Include all labor and materials required as a result of such failure. Pay for re-testing of corrected noise or vibration problems by the project acoustical consultant including travel, lodging, test equipment expenses, etc.

3.06 PROTECTION, CARE AND CLEANING

A. In addition to storage criteria of the General Conditions, and provisions under Section 01 50 00: Construction Facilities and Temporary Controls, the following shall be provided:

1. Provide for the safety and good condition of materials and equipment until Substantial Completion. Protect materials and equipment from damage.

2. Protect installed Work.

3. Replacements: In case of damage, immediately provide repairs and/or replacements as required.

4. Protect covering for bearings, open connections to tanks, pumps, compressors and similar equipment.

5. Interior of piping shall be maintained free of dirt, grit, dust, and other foreign materials.

6. Fixtures, piping, finished brass or bronze, and equipment shall have grease, adhesive, labels, and foreign materials removed. Chromium, nickel plate, polished bronze or brass Work shall be polished. Glass shall be cleaned inside and out.

7. Before initial start-up and again before Substantial Completion, piping shall be drained and flushed to completely remove grease and foreign matter. Pressure regulating assemblies, traps, strainers, boilers, flush valves, and similar items shall be thoroughly cleaned. Tag system with an information tag listing responsible party and date of element, before initial start-up and again before Substantial Completion. Compressed air, oil, and gas piping shall be blown out with oil-free compressed air or inert gas.

END OF SECTION

SECTION 22 05 13 - PLUMBING MATERIALS AND METHODS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. This Section prescribes basic materials and methods generally common to the Work of Division 22.

B. Related Requirements:

1. Division 01: General Requirements.

2. Division 22: Plumbing.

3. Division 23: Mechanical.

4. Division 26: Electrical.

1.02 SUBMITTALS

A. Provide in accordance with Division 01, Section 22 05 00 and specific requirements of each section of Division 22.

B. Types of welding rods to be used.

1.03 QUALITY ASSURANCE

A. Standards: Comply with applicable national, state, and local codes and standards: ASTM, ASME, and ANSI. Federal Specifications, AWWA, SISPI, NFPA, FM, UL, CPC (California Plumbing Code), CMC (California Plumbing Code), CSA.

B. Conform to provisions of Section 22 05 00: Plumbing Common Work

C. Manufacturer of plumbing products must be third-party certified to ANSI/NSF Standard 61, Section 9 certification, and ANSI/NSF 372 to demonstrate compliance with the federal requirements for lead contribution to drinking water, the Safe Drinking Water Act SDWA, and the California Health and Safety Code Section 116875.

D. Qualifications of Manufacturer: Products used in the Work of this Section shall be produced by manufacturers regularly engaged in manufacture of similar items and with a history of successful production as reviewed by the ARCHITECT.

1.04 COORDINATION

A. Coordinate related Work in accordance with provisions of Section 01 31 13: Project Coordination.

PART 2 – PRODUCTS

2.01 GENERAL

A. Provide the following products if they are indicated in the Contract Documents or if they are required for the proper installation, function or operation of equipment, systems or components indicated in the Contract Document.

B. Provide the following products as a complete assembly with required accessories for a complete and functioning entity in compliance with governing codes and applicable standards as specified in Section 22 05 00, manufacturer's instructions or as required.

1. Omission of minor details in the Contract Documents does not waive and/or otherwise relinquish compliance with the above requirements.

2.02 MANUFACTURERS AND MATERIALS

A. Ball Valves: 2-inch and smaller:

BV-1: Class 150, 600 psi, Bronze, CWP two piece construction with reinforced TFE seats, full port, adjustable packing gland, (no threaded stem designs allowed), threaded or solder ends.

Manufacturer: Apollo Valves 77CLF-100A/77CLF-200A, NIBCO T-685-66-LF/S-685-66-LF, Hammond UP8303A/UP8513, Milwaukee UPBA400S/ UPBA450S

BV-2: Class 150, 600 psi, Stainless Steel, CWP two piece construction with reinforced TFE seats, full port, adjustable packing gland, (no threaded stem designs allowed), threaded or solder ends.

Manufacturer: Apollo Valves 76F-100, NIBCO T-585-S6-R-66-LL, Milwaukee BA260.

Ball Valves in Insulated Piping: Use extended operating handle of non-thermal conducive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation and memory stops that are fully adjustable after insulation is applied. Apollo Valves Therma-Seal, NIBCO Nib-Seal Handle.

B. Butterfly Valves:

BFV-1 Centerline Series A, 200 psi CWP tight shut-off.

1. Body: Lug type ductile iron. Suitable for bi-directional dead-end service at rated pressure without use of downstream flange.

2. Disc: Bronze, or aluminum bronze.

3. Stem: One or two-piece, 400 series stainless steel.

4. Seat and O-Rings: EPDM.

5. Upper and Lower Stem Bearings: Copper alloy or non-metallic material.

6. Operators: Valves 6 inches and smaller, with lever handle. Valves 8 inches and larger, with manual gear operator and disc position indicator.

7. Manufacturers:

   a) Valves 2.5 to 6-inch: Apollo Valves LD141, Milwaukee ML 233E, Hammond 6411-03

   b) Valves 8-inch and larger: Apollo Valves LD141, Milwaukee ML 333E, Hammond 6411-03, NIBCO LD 2000

C. Check Valves:

1. Bronze, 2-inch and smaller:

   CHV-1: 200 psi, CWP horizontal swing, Y pattern, renewable seat and disc, threaded ends.

   Manufacturer: Apollo Valves 163T-LF, NIBCO T-413-Y-LF, Milwaukee UP-509, Hammond UP-904

   CHV-2: 200 psi, CWP, bronze body, horizontal swing, Y pattern, renewable seat and disc, solder ends.

   Manufacturer: Apollo Valves 163S-LF, NIBCO S-413-Y-LF, Hammond Up-943

2. Cast Iron 2 1/2-inch and larger:

   CHV-3: Class 125, 200 psi, CWP, IBBM, renewable seat and disc, bolted cap, flanged:

   Manufacturer: Apollo Valves 910F, Crane 372, Stockham G-927, NIBCO T-918-B.

D. Earthquake Valve:

EQV-1: Mechanically triggered by seismic movement, complying with state of California seismic response specifications, UL listed and certified by D.S.A. Size and pressure as required or indicated on Drawings. (Minimum 1/4 psi, maximum 10 psi. Earthquake valve shall shut off gas automatically during an earthquake to prevent an explosion or fire. Acceptable Manufacturers: California Valve (former Koso).

1. Not sensitive to vibrations caused by passing trucks or accidental bumping.

2. Sensitive to wide amplitude G's only. Preset at factory for the correct G-rating.

3. Positive sealing from minus 10 degrees F. to 150 degrees F.

4. Visual open-close indicator.

5. Manual reset.

6. Plumb line for mounting.

7. Tripping mechanism has non-creeping rolling latch.

8. Install valve per manufacturer’s recommendations only.

E. Expansion Tank:

ET-1: Pressurized, vertical, steel expansion tank for potable water systems with FDA approved, replaceable, heavy duty, butyl rubber blend diaphragm, polypropylene lined dome, 1/2 inch, 3/4 inch, 1 inch or 1 ½-inch NPT system connection, 1/2 inch or 3/4 inch drain, 0.302 inch-32 standard automobile tire valve type charging connection, lifting rings and a floor mounting skirt for vertical installation. The tank must be constructed in accordance with Section VII of the ASME Boiler and Pressure Vessel Code and stamped for 125 psi working pressure. The tank must be also rated for a continuous working temperature of 240 degrees F. Provide weather and rust resistant coating.

Manufacturer: Apollo Valves 16XT, Bell and Gossett, Wheatley, Taco, Amtrol

F. Flow Control Valve – Manual:

FC-1: Flow control valves: Bell and Gossett Series CB circuit setter balancing valve, line size, with integral pointer (to register degree of valve opening), differential pressure meter connections with built-in check valves and lockable memory stops. Manufacturer: Apollo Valves 58A, Armstrong ARMFLO circuit-balancing valves, series CBV

G. Gate Valves:

1. Bronze, 2-inch and smaller:

GV-1: Class 125, 200 psi, CWP, bronze body and bonnet, non-rising stem, inside screw, screw-in bonnet, solid disc, threaded ends:

Manufacturer: Apollo Valves 101T-LF, NIBCO T-113-LF, Milwaukee UP105-P2, Hammond UP645

GV-2: Same as GV-1, except solder ends:

Manufacturer: Apollo Valves 101S-LF, NIBCO S-113-LF, Milwaukee UP115, Hammond UP647.

2. Iron, 2-1/2-inch and larger:

GV-3: Class 125 250 psi CWP iron body, flanged ends, bolted bonnet with wheel handle, resilient wedge, non-rising stem.

Manufacturer: Apollo Valves 610F-LFA, NIBCO F-619-RW.

GV-4: Class 125, 250 psi CWP iron body, flanged ends, bolted bonnet with 2-inch operating nut, resilient wedge, non-rising stem, fusion bonded epoxy coated. For below grade use..

Manufacturer: NIBCO F-619-RW-SON.

H. Heater Vent Pipe:

1. Schedule Number:

HVP-1 For use in intake and exhaust of high efficiency condensing type gas water heaters only as required by manufacturer. Pipe shall be PVC, Schedule 40, extruded from 100 percent virgin polyvinyl Chloride (PVC) compound, meeting requirements of class 1254-13 of ASTM D1784. Manufacturer: Spears, Charlotte.
Fittings shall be Schedule 40 molded from PVC type I compound, conforming to the requirements of specification ASTM D2466.
Manufacturer: Spears, Charlotte, Harvel Plastics Inc..

I. Piping and fittings:

1. Piping shall be continuously and permanently marked with manufacturer's name, type of material, size, pressure rating, and the applicable ASTM, ANSI, UL, or NSF listing. On plastic pipe, date of extrusion must also be marked.

2. Underground non-ferrous pressure pipes shall be installed with proper color tracer wires. Refer to color code provisions in Section 22 0553: Plumbing Identification.

J. Pipe and Fitting Requirements Schedule: Unless otherwise specified or indicated on Drawings, pipe and fittings shall be installed in accordance with the following table:

TABLE I
PIPE AND FITTING SCHEDULE

Use	Limits	Pipe	Fittings
Condensate Drain	All sizes	P-3	PF-3
Domestic Hot and Cold water,	All Sizes	P-3	PF-3
Storm and Overflow Drain	All sizes	P-1	PF-1
Natural Gas, Exterior	Underground, site only	P-5	PF-5a, and PF-5b
Natural Gas, Interior, aboveground	All sizes	P-4	PF-4a and PF-4b
Waste and Vent - Indirect	All sizes	P-2	PF-2
Waste and Vent – Sanitary/ Grease	All sizes	P-1	PF-1

1.

P-1: Cast iron: Hubless, service weight, ASTM A888, CISPI 301, conforming to CISPI 310 and installed in accordance to IAPMO IS 6.

Manufacturer: American Foundry, Tyler, AB & I.

PF-1: Cast iron, soil or waste no-hub coupling with neoprene gaskets, stainless steel corrugated shields and stainless steel clamps. 2 bands for size 1 ½-inch thru 4-inch, IAPMO, ASTM C 564 and CISPI 310.

P-2: Copper drainage tube, inside structure and above grade. Type DWV hard temper, ASTM B 306.

Manufacturer: Mueller, Anaconda, Cerro Brass, Cambridge-Lee, Halstead.

PF-2: Cast brass drainage fittings ASA B 16.23, ASTM B 42.

Manufacturer: Mueller Brass, Nibco, Stanley Flagg, Lee Brass..

P-3: Copper water tube, Type L hard, ASTM B88. (For above ground use only.)

Manufacturer: Mueller, Cambridge-Lee, Halstead.

PF-3 Copper Press-Connect pressure fittings, comply with ASME B16.51 “Copper Alloy Press-Connect Pressure Fittings”, with Ethylene Propylene Diene Monomer, EPDM O-Ring Seal in each end. Fittings with the sizes of 2-1/2” and larger shall have cross-section Grab Rings and separation rings.

Manufacturer: Viega, Mueller Industries, Apollo.

P-4: Black steel pipe, Schedule 40, ASTM A53, Type E, ERW.

Manufacturer: US Steel.

PF-7a: Malleable iron, Class 125, ANSI B 16.3, threaded or welded Schedule 40 black steel for 2-inches and below and welded for 2 ½-inch and above.

Manufacturer: Stockham.

PF-4b: Press fittings, ASME B31, Carbon Steel, – For aboveground piping 2-inches and below. Provide fittings with Hydrogenated Nitrile Butadiene Rubber, HNBR Sealing Element.

Manufacturer: Apollo Valves: Power Press, Viega: MegaPressG.

P-5: Polyethylene plastic pipe, ASTM D 2513, Standard Dimension Ratio 11 rated at 80 psi working pressure and 73° Fahrenheit for 3 inches and smaller, SDR 11.5 rated at 76 psi and 73° Fahrenheit for 4 inches and above, butt or socket type fittings, joined by heat fusion, orange or yellow color. Installer shall be certified by the manufacturer for this kind of joint installation.

Manufacturer: CPCHEM (Chevron Phillips Chemical Company LP) PE 2406.

PF-5a: Polyethylene plastic fittings, ASTM D 3261 and D 2683, Standard Dimension Ratio 11 rated at 80 psi working pressure and 73° Fahrenheit for 3 inches and smaller, SDR 11.5 rated at 76 psi at 73° Fahrenheit for 4 inches and above, butt or socket type fittings, joined by heat fusion, Installer shall be certified by manufacturer for joint installation. Color orange or yellow.

Manufacturer: CPCHEM, (Chevron Phillips Chemical Company LP).

PF-5b: Polyethylene transition risers, for PF-13a above, Transition fitting must have a minimum vertical height of 36 inches from the horizontal connection which will allow for a 6-inch steel riser above ground. Polyethylene transition risers shall be anodeless.

Manufacturer: GF Piping Systems.

K. Pipe Isolators:

PLA-1 Absorption pad shall be not less than ½ inch thick, unloaded. Pad shall completely encompass pipe. ForCopper piping

Manufacturer: Holdrite, LSP, Stoneman, Potter-Roemer, Trisolator, PR-Isolator.

L. Pressure Gage: Aluminum or steel case, minimum 4 ¼-inch dial; pressure type or combination vacuum-pressure type, with provisions for field calibration. Dial indicator to indicate pressure in psi with accuracy to within plus or minus 0.5 percent of maximum dial reading. Furnish gages with restriction screw, size 60, to eliminate vibration impulses. Black case and ring, bourdon tube of seamless copper alloy with brass tip and socket. Three way gage cock,

constructed of brass with stuffing box, 1/2 inch couplings, with fixed or movable cap nut to shut off pressure gage.

PG-1 Pressure type, black drawn steel case, 4-1/2-inch glass dial, range approximately twice line pressure.

Manufacturer: Marsh Keckley, Trerice, Weksler, Weiss.

M. Plug Valves:

PV-1 2 inches and smaller: Rockwell No.114, lubricated plug type, 200-pound., water operating gauge pressure iron body and plug, regular pattern, threaded, with indicating arc.

Manufacturer: Walworth, Homestead, WKM.

PV-2. 2 ½-inch and larger: Rockwell No.115 and No.165 lubricated plug type, 200 pound water operating gauge. Iron body and plug, regular pattern, flanged, with indicating arc.

Manufacturer: Walworth, Homestead, WKM.

N. Safety Relief Valves:

SRV-1: Combination temperature and pressure relief type. CSA approved. Set to open at 125 psi pressure.

Manufacturer: Apollo Valves: 18C, Watts: 40L, Cash-Acme: NCLX-1.

SRV-2: Same as SRV-1, except provide on storage type water heater with anode in dip tube.

Manufacturer: Apollo Valves: 18C, Watts: 100XL, Cash-Acme: NCLX-1.

SRV-3 Spring type, ASME and NB stamped and certified with manual lifting device for air or gas.

Manufacturer: Apollo Valves, Bailey, Cash-Acme, Watts, Keckley.

O. Strainers:

STR-1 Description: Wye type with monel or stainless steel strainer cylinder (manufacturer's standard mesh), and gasketed machine strainer cap. Where indicated on Drawings, provide with valved (globe valve) blowout piping, same size as blowout plug.

1. 2-inch and smaller:
   C.M. Bailey No.100-A, 250 lb., cast iron body, threaded, Keckley: Style B, Spirax Sarco Y-type.

2. 2 ½-inch and larger:
   C.M. Bailey No.100-A, 125 lb., cast iron body, flanged, or Victaulic style 732, 300 psi, ductile iron body, grooved, fusion bonded epoxy coated.

   Manufacturer: C.M.Bailey, Armstrong, Muessco, Keckley 'A'.

STR-2 Y pattern cast iron bodies, 125 psi, monel screen. Open area at least twice the cross-sectional area of IPS pipe in which strainer is installed and may be woven wire or perforated type. Screwed ends for sizes up to 2 inches, flanged ends fusion bonded epoxy coated for 2 ½-inch and larger perforations, in accordance with the following:

1. Steam service - 40 square mesh.

2. Other services - 16 square mesh.

Bailey No.100, Armstrong, RP&C, Keckley.

STR-3 Flanged, bucket type, semi-steel body, 125 psi, stainless steel screen with 1/8 inch diameter perforations, all sizes.

Manufacturer: Bailey No.1, Zurn 150 Series, RP&C, Keckley GF.

STR-4 Grooved, T-pattern, ductile iron body, 300 psi, stainless steel frame and mesh basket, grooved ends.

P. Vent Caps:

VC-1 Vandal-proof hood type, for plumbing vent lines.

Manufacturer: Stoneman Engineering and Mfg., Semco 1550.

Q. Flanges: Flanges shall be furnished and installed at each flanged connection of each type of equipment, tanks, and valves. Faces of flanges being connected shall be furnished alike. Connection of a raised face flange to a flat-faced flange is not permitted. Flanges shall conform to following schedules:

TYPE OF PIPE	FLANGE
Screwed black or galvanized grooved steel pipelines.	125-pound black cast iron screwed flange, flat faced or grooved flange adapters, Victaulic Style 741, Tyco-Grinnell Fig. 71, Gruvlok Fig. 7401.
Welded or grooved steel pipe, except high pressure steam lines.	150-pound black forged steel welding flanges, 1/16 inch raised face ASTM A 105, Grade II or grooved flange adapters, Apollo Shurjoint 7041, Victaulic Style 741, Tyco-Grinnell Fig. 71, Gruvlok Fig. 7401.
Copper and brass pipe or tubing.	150 pound cast bronze, flat-faced flange with solder end or grooved flange adapters, Apollo Shurjoint C341, Victaulic Style 641, Tyco-Grinnell Fig. 61, Gruvlok Fig. 6084.

1. Gasket material for flanged connections shall be full faced or ring type to suit facing on flanges and shall be furnished in accordance with following schedule:

SERVICE	TYPE
Cold water	1/16-inch-thick neoprene

Grooved end flange adapters supplied with pressure responsive elastomeric Gaskets supplied with grooved flange adapters shall be pre-lubricated by the manufacturer. Grade of gasket to suit intended service.

R. Unions:

1. Unions shall be furnished and installed in accordance with the following requirements (unless flanges are furnished):

a. At each threaded or soldered connection to equipment and tanks, except in Freon or fuel gas, piping systems, whether indicated or not.

b. Immediately downstream of any threaded connection to each manually operated threaded valve or cock, and each threaded check valve, yard box or access box except those in Freon piping systems, whether indicated or not.

c. At each threaded connection to threaded automatic valves (except those in Freon piping systems) such as reducing valves and temperature control valves, whether indicated or not.

d. If grooved piping is used, couplings shall serve as unions. Additional unions are not required

2. Unions shall be located so that piping can be easily disconnected for removal of equipment, tank, or valve.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions under which Work of this Section shall be performed. Correct conditions detrimental to proper and timely completion of Work. Do not proceed until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Provide all materials and equipment for the Work. Furnish and install necessary apparatus, parts, materials, and accessories.

B. Pipe Installation:

1. Install piping parallel to wall and provide an orderly grouping of proper materials and execution.

2. Piping shall clear obstructions, preserve headroom, provide openings and passageways clear, whether indicated or not. Verify the Work of other Divisions to avoid interference.

3. If obstructions or the Work of other Divisions prevent installation of piping or equipment as indicated by the Drawings, perform minor deviations as required by the ARCHITECT.

4. Install piping after excavation or cutting has been performed. Piping shall not be permanently enclosed, furred in, or covered before required inspection and testing is performed.

5. Exposed polished or enameled connections from fixtures or equipment shall be installed with no resulting tool marks or threads at fittings. Residue or exposed pipe compound shall be removed from exterior of pipe.

6. Piping shall be concealed in chases, partitions, walls, and between floors, unless otherwise directed or specifically noted on Drawings. When penetrating wood studs,

joists, and other wood members, provide such members with reinforcement steel straps of Continental Steel & Tube Co., ULINE, Independent Metal Strap.

7. Reduce fitting where any change in pipe size occurs. Bushings shall not be furnished unless specifically reviewed by the ARCHITECT, or indicated on Drawings.

8. Piping subject to expansion or contraction shall be anchored in a manner, which permits strains to be evenly distributed. Swing joints or expansion loops shall be installed. Seismic restraints shall be installed so as not to interfere with expansion and contraction of piping. Seismic loops required at all building separations.

9. Immediately after lines have been installed, openings shall be capped or plugged to prevent entrance of foreign materials. Caps shall be left in place until removal is necessary for completion of installation.

10. Couplings shall not be installed except where required pipe runs between other fittings are longer than standard length of type of pipe being installed and except where their installation is specifically reviewed by the ARCHITECT.

11. Water piping shall be installed generally level, free of traps, unnecessary offset, arranged to conform to building requirements, clear of ducts, flues, conduits, and other Work. Piping shall be arranged with valves installed to provide for complete drainage and control of system. Piping shall not be installed which causes an objectionable noise from flow of water therein under normal conditions. Refer to Section 23 0500: Common Work Results for Plumbing.

12. Water lines may be installed in same trench with sewer lines, provided bottom of water line is 12 inches minimum above top and to the side of sewer line.

13. Changes in pipe sizes shall be furnished with eccentric reducers, flat on top. Offsets to clear obstruction shall not be installed so as to produce air pockets.

C. Pipe Sleeves and Plates:

1. Provide pipe sleeves of Schedule 40 black steel pipe or Schedule 40 PVC plastic pipe in concrete or masonry walls, footings, and concrete floors below grade. Provide adjustable submerged deck type sleeves at locations where pipes pass through concrete floors, except concrete slab floors on grade, and at locations where soil pipe for floor type water closets passes through concrete floors.

2. Sleeves shall provide ½ inch clearance around pipes, except plastic pipe shall have 1 inch clearance. Caps of deck type sleeves shall be removed just prior to installation of pipe. Area around sleeves shall be smooth and without high or low spots. Sleeves in walls shall not extend beyond exposed surface of wall. Sleeves in concrete floors and walls shall be securely fastened to forms to prevent movement while concrete is being placed.

3. Piping installed on a roof shall clear the roof surface by 10 inches minimum, with or without insulation. Bottom of individual fittings may infringe on 10 inches clear space but not groups of fittings or fittings located within 27 inches of each other.

4. Stiles shall be provided to facilitate crossing of piping when parallel piping runs are laterally greater than 12 inches out-to-out, or any pipe is higher than 18 inches, and more than 40 feet long or runs between two or more major pieces of equipment or housings greater than 20 feet apart. Stiles shall be not less than 20 inches wide with a

minimum tread depth of 10 inches. Where stiles are required, they shall be located so greatest obstructed distance is 30 feet.

5. Where pipes pass through waterproofed walls, floors, or floors on grade, sealant with Link-Seal Modular Seals, between pipe and sleeve to provide a waterproof joint. Where earth is in contact with pipe on both sides of a wall or foundation, the waterproof joint is not required. Commercial rubber compression units may be furnished instead of sealed sleeves if reviewed by the ARCHITECT.

6. A swing joint, or other required device, shall be furnished and installed in hot water lines with 10 feet of sealant or compression joint to allow for expansion.

7. Provide polished, chrome-plated flanges when plumbing pipes pass through walls at plumbing fixtures, etcetera as specified in Section 22 10 00 Plumbing. Provide polished steel, chromium-plated split floor and ceiling plates at locations where pipes pass through walls, floors, ceilings, and partitions in finished portion that neatly conceals pipe insert.

8. Pipe sleeves shall be provided where pipes intersect footings or foundation walls and sleeve clearances shall provide for footing settlement, but not less than one inch all around pipe.

D. Welding of Pipe and Qualifications of Welder:

1. Joints above grade or accessible conduit or tunnels in steel piping may be either welded or screwed unless specifically indicated otherwise on Drawings or specified. Joints in below grade steel piping, whether in insulation or not, shall not be welded, unless otherwise indicated.

2. Welded joints in pipe shall be continuous around pipe and shall comply with ASME B31: Code for Pressure Piping, unless otherwise specified.

3. Each pipe weld shall be stamped with welder's identification mark. Welding shall be performed by welders possessing a valid certificate of qualification for welding carbon steel welding pipe in horizontal position (2G) and horizontal fixed position (5G) in accordance with the requirements of Section IX of the ASME Boiler and Pressure Vessel Code, by an OWNER-recognized, DSA approved testing laboratory.

4. Before any welder performs welding on the Work, furnish the INSPECTOR with a copy of welder's valid qualification papers and obtain verification. Welder qualification is not valid unless it has been issued while welder was performing work for current employer, and has performed type of work described by qualification in the preceding 3 months.

REFERENCE: ASME BOILER AND PRESSURE VESSEL CODE, SECTION VIII, UW-29 TESTS OF WELDERS AND WELDING OPERATORS.

5. Welding performed under these Specifications is subject to special tests and inspections including rigid Ultra Sonic Testing (UT) and radiographic inspection at random, in accordance with Technique for Radiographic Examination of Welded Joints by an OWNER recognized, DSA approved testing laboratory.

ASME BOILER AND PRESSURE VESSEL CODE, SECTION VIII, UW-51 RADIOGRAPHIC EXAMINATION OF WELDED JOINTS.

E. Unacceptable Welds and Repairs to Welding:

1. Welds containing any of the following types of imperfections shall be deemed defective Work:

   a. Cracks of any type.

   b. Zones of incomplete (in excess of 1/32 inch) fusion or penetration.

   c. Elongated slab inclusions longer than 1/4 inch.

   d. Groups of slag inclusions in welds having an aggregate length greater than thickness of parent metal in a length 12 times the thickness of the parent metal.

   e. Undercuts greater than 1/32 inch.

   f. Overlaps, abrupt ridges or valleys.

3. When a defective weld is detected by examination as outlined above, two additional welds shall be radiographed at locations selected by the Project Inspector. If the two selected welds demonstrate compliant welding, then the two tested welds shall be deemed to be in compliance. Welding revealed by radiographs to be defective Work shall be removed, repaired, and tested by radiograph.

4. If either of the two selected welds demonstrates welding deemed to be defective Work, all welding in that portion of the Work shall be deemed defective Work and either: all welds shall be cutout, prepare new ends for welding and weld to comply with this Specification, or radiograph all welds, removing and repairing only such welding deemed to be defective Work.

5. Repair welding shall be performed in a manner in full compliance with ASME B31. The welded joints or repairs shall be spot examined with UT or radiographic tests in accordance with foregoing requirements.

   REFERENCE, ASME BOILER AND PRESSURE VESSEL CODE, SECTION VIII, UW-52.

6. OWNER shall cause to be performed additional random UT and radiographic examinations of welds. OWNER shall be responsible for the costs of any UT and radiographic examinations found to be in compliance with specified requirements.

7. Installer shall be responsible for the costs of UT and radiographic re-examinations of welds deemed defective Work and not in compliance with this Specification, and shall repair or replace said welds in accordance with specified requirements.

F. Welding Rods: Submit a written list of materials and proposed type of welding rods.

G. Backing Rings: Backing rings may be submitted for installation provided the Product Data is submitted with the material list.

H. Qualification Tests for Low-pressure Welding:

1. Tests shall be performed on 3-inch standard weight pipe ASTM A53, Grade A, and shall be welded by acetylene and electric arc. Each sample shall consist of 2 pieces, each 10 inches long, with 30-degree bevel at point weld.

2. Two 20-inch samples shall be performed in the 2G and two 20-inch samples in the 5G positions, with positions defined in Section IX, ASME Boiler and Pressure Vessel Code. Welds shall have the reinforcement ground or machined flush to the surface of the pipe before testing. Samples shall be tested as full section tensile.

3. Weld shall develop a load of 90 percent of 50,000 psi, i.e., 45,000 psi or shall develop a fracture in parent metal.

4. Each qualified welder shall carry an identification card listing welder's name, date of test, and type of welding tests passed; signed by the welder and the laboratory.

5. A valid certificate of qualification issued in compliance with requirements of the ASME Boiler Pressure Vessel Code Section IX shall qualify a welder for issuance of a certificate for low-pressure pipe welding.

I. Certificates of Qualification for Welding of Unfired Pressure Vessels:

1. Certificates of qualification shall be issued by a laboratory recognized by the OWNER in compliance with the requirements of the ASME Boiler Pressure Vessel Code Section IX. Qualifications shall be for both acetylene and arc welding of Schedule 40 ASTM A53, Type B, steel welded or seamless pipe in the Horizontal Position (2G) and the Horizontal Fixed Position (5G) as defined by said code.

2. Certificate described above is not valid unless it has been issued while welder was working for his current employer, and unless welder has performed type of work described by certificate in the preceding three months. Requirements for possession of a valid certificate shall not be waived for welders fabricating unfired pressure vessels when the Specifications require compliance with ASME code or when welding pipe carries working pressures greater than 75 psi and temperatures greater than 250 degrees F.

J. Pipe Joints and Connections:

1. Pipe and tubing shall be cut per IAPMO Installation Standards. Pipe shall have rough edges or burrs removed so that a smooth and unobstructed flow shall be provided.

2. Hot tapping of gas lines is strictly prohibited.

3. Threaded Pipe: Joints in piping shall be installed according to the following service schedule:

   a. Soap Piping: Litharge and glycerine, or Expando, Gasoila.

   b. Plastic Piping: Teflon pipe joint compound tape.

   c. Oxygen Piping: Wash treads with S.P., rinse, blow-dry and apply litharge and glycerine.

d. Cleanout Plugs: No compound shall be used. After inspection and test, plugs shall be removed, cleaned, greased, and replaced.

e. Other services furnish sealant, suitable and as reviewed by the ARCHITECT.

4. Threads on pipe shall be cut with sharp, clean, unblemished dies and shall conform to ANSI/ASME B2.1 for tapered pipe threads.

5. Joint compounds shall be smoothly placed on male thread and not in fittings. Threaded joints shall be installed tight with tongs or wrenches and sealant of any kind is not permitted. Failed joints shall be replaced with new materials. Installation of thread cement or sealant to repair a leaking joint is not permitted.

6. Sharp-toothed Stillson, or similar wrenches, is not permitted for the installation of brass pipe or other piping with similar finished surfaces.

K. Copper Tubing and Brass Pipe with Threadless Fittings:

1. Silver brazed joints shall be used for attaching fittings to non-ferrous metallic refrigerant piping.

2. Non-pressure gravity fed condensate lines may be soldered with 95/5 solder.

3. Silver brazing alloy, Class BCUP-5. Surfaces to be joined shall be free of oil, grease, and oxides. Socket of fitting and end of pipe shall be thoroughly cleaned with emery cloth and wiped to remove oxides. After cleaning and before assembly or heating, flux shall be installed to each joint surface and spread evenly. Heat shall be applied in accordance with instructions in the Copper Tube Handbook issued by Copper Development Associates. Joints constructed of rough bronze fittings shall be provided as recommended by manufacturer.

4. Do not overheat piping and fittings when installing silver brazing.

5. Joints in non-ferrous piping for services not covered above shall be installed with solder composed of 95/5 tin/antimony, ASTM B32, Grade 5A. Surfaces to be jointed shall be free of oil, grease, and oxides. Sockets of fitting and end of pipe shall be cleaned with emery cloth to remove oxides. Solder flux shall be sparingly installed and solder added until joint is completely filled. Do not overheat. Excess solder, while plastic, shall be removed with a small brush in order to provide an uninterrupted fillet completely around joint. Random inspection of joints shall be conducted by Project Inspector to ensure joints are lead-free.

6. Grooved end joints for copper piping shall be assembled in accordance with the latest manufacturer recommendations. Pipe ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove for proper gasket sealing. Grooving tools shall be as manufactured by Victaulic, RIDGID, MAG Tool.

7. Pressed fittings for copper or copper alloy pipe or tubing shall have an elastomeric O-ring that forms the joint. The pipe or tubing shall be fully inserted into the fitting, and the pipe or tubing marked at the shoulder of the fitting. Pipe or tubing shall be cut square, mechanically cleaned and reamed prior to joining to remove all burrs (interior and exterior) and restore full inside diameter and a smooth, chamfered exterior surface. The fitting alignment shall be checked against the mark on the pipe or tubing to ensure the pipe or tubing is inserted into the fitting. The joint shall be pressed using the tool recommended by the manufacturer.

a. Press Installation Training Requirement: Installation training shall be provided on site by manufacturer personnel and documented with Engineer. Installation procedures, depth guides, and tool inspection shall be provided by manufacturer for all product types (steel or copper) for reference and safety assurance.

L. Ring-Type Pipe: Joints shall be installed in accordance with manufacturer's instructions with grooved couplings, fittings and rubber rings. Couplings and pipe shall be compatible and of the same manufacturer. Rings shall be accurately located and installed by grooves in coupling. Pipe shall be installed with zero deflection unless otherwise specified. Pressure pipe shall be furnished with thrust blocks at each offset point.

M. Welded Pipe Joints:

1. Joints in welded steel pipelines shall be installed by oxyacetylene or electric arc process. Welding shall be continuous around pipe and provided as specified.

2. Butt welds shall be of the single V-type, with ends of pipe and fittings beveled approximately 37 ½ degrees. Piping shall be aligned before welding is started with the alignment maintained during welding.

3. Welds for flanges and socket fittings shall be of the fillet type with a throat dimension not less than pipe wall thickness.

N. Grooved End Pipe Joints: Grooved end joints for carbon steel piping shall be assembled in accordance with the latest manufacturer recommendations. Pipe ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to grove for proper gasket sealing. Grooving tools shall be as manufactured by Victaulic, RIDGID, MAG Tool.

O. Stainless steel press joints: Joints shall be Vic-Press 304TM, made with Victaulic Series ‘PFT’ tools and the appropriate sized jaw. Pipe shall be certified for use with Vic-Press 304TM system, and shall be square cut, properly deburred and cleaned, and marked at the required location to insure full insertion into the fittings and/or couplings.

P. Polyethylene (Plastic) Pipe:

1. Joints shall be installed by the heat fusion method, in accordance with manufacturer's recommendations and IAPMO installation standard IS 12, for natural gas.

2. Pipe Riser at Meter, Regulator and Building Wall: Prefabricated, anodeless type, utilizing a grade level transition between underground polyethylene pipe and gas supply steel pipe of riser outlet, GF Piping Systems. Below grade to above grade transition shall be installed in a welded, epoxy coated, steel casing.

3. Connections to Existing Pipe Line or Branch:

a. Steel-to-plastic (PE): Provide manufacturer’s prefabricated standard transition fitting, transition from epoxy-coated steel pipe to plastic, R. W. Lyall Co..

b. Plastic-to-plastic, PVC to PE: Provide manufacturer’s prefabricated standard transition fitting, transition from PVC to epoxy-coated steel pipe to PE; R.W. Lyall Co..

c. Plastic-to-plastic, PE to PE: Provide manufacturer’s standard fused tapping tee assembly with shut-off feature.

4. Provide PE reinforcing sleeves where PE pipe is fused to multi-saddles, service punch tee, reducing tees, transition fittings and anodeless risers.

Q. Valves: Valves shall conform to the following:

1. Piping systems shall be furnished with valves at points indicated on Drawings and specified, arranged to provide complete regulating control of piping system throughout building and the Project site.

2. Valves shall be installed in a neat grouping, so that parts are easily accessible and maintained.

3. Valves shall be full size of line in which they are installed, unless otherwise indicated on Drawings or otherwise specified, and shall be one of types specified.

4. Provide chain operators on valves 2-inch and larger located 7 feet or more above the servicing floor level.

5. Valves for similar service shall be of one manufacturer.

6. Except where otherwise specified, valves shall be Apollo, Belimo, Victaulic, Stockham, Crane, Jenkins, Milwaukee, Hammond, American, NIBCO, Hoffman.

7. Ball valves below grade in yard boxes shall have stainless steel handles.

8. Hose bibs in dense garden areas shall be ¾ inch in size with one hose bib in the lunch pavilion 1 inch in size. Other hose bibs shall be ¾ inch lock shield type. Bibs shall be furnished with vacuum breaker protection.

9. Safety valves and pressure relief valves shall have stamp of approval as required by ASME and shall be provided with annual test lever. Where a hot water storage tank is heated by means of a coil, pressure relief valve shall have a steam BTU discharge rating of the coil. Discharge pipe from safety or pressure relief valves shall be not less than one pipe size larger than inlet pipe size of valve. Discharge pipe shall terminate as indicated and shall be free of traps. In addition to locations specified, pressure relief valves shall be installed in the following locations:

   a. On discharge side of each pressure-reducing valve.

   b. On each water heater connected to a hot water storage tank and other pressure vessels.

   c. On cold water line to each water heater or hot water storage tank when there is a check valve, backflow prevention valve or similar device between water heater or hot water storage tank and meter or relief valve at the pressure reducing valve assembly.

   d. On discharge side of each air compressor.

   e. On each air receiver connected to an air compressor.

10. Temperature relief valves and combination temperature and pressure relief valves shall be as specified and furnished as set forth in this Section. Discharge pipe from relief valves shall be not less than discharge area of valve or valves it connects,

based on discharge area of valves, and shall terminate as indicated and free of any traps. Valves shall be installed at following locations:

11. A combination temperature and pressure relief valve or combination of valves on each heating hot water storage tank. Temperature sending element shall extend into water inside tank.

12. Manual air vent valve assemblies shall be installed at each high point of hot water space heating and chilled water piping systems. Valves shall discharge through 1/4 inch diameter copper tubing and drain to nearest floor sink. Automatic type air vent valve shall only be installed where specifically indicated. Radiator, convectors, and finned pipe convectors shall be fitted with packless radiator valves, angle or straight pattern. Each convector or radiator installed as part of a space hot water heating system shall be furnished with a manual-type air vent valve.

R. Strainers: Strainers shall be installed on each water main (except for fire line) downstream of the meter, above grade, when a pressure regulator assembly is not installed. Main strainer shall be of Y-flange or groove type. On closed loop chilled and heating hot water systems pump systems, a strainer shall be installed at each pump inlet and upstream of each flow control valve assembly. The control valve assembly may include a modulating temperature control valve and a flow-limiting valve, manufactured by Griswold, AutoFlow, Flow Control Industries, Inc..

S. Hangers and Supports:

1. Piping shall be securely fastened to building structure by approved iron hangers, supports, guides, anchors, and sway braces to maintain pipe alignment to prevent sagging and to prevent noise or excessive strain on piping due to uncontrolled or seismic movement under operating conditions. Hangers and supports shall conform to Manufacturer’s Standardization Society Specification SP-69. Hangers shall be relocated as required to correct unsatisfactory conditions that may become evident when system is placed into operation. Appliances, heat exchangers, storage tanks, and similar equipment shall be securely fastened to structure in accordance with seismic requirements. Outdoor metal hangers and supports shall be hot-dipped galvanized steel, unless otherwise specified.

2. Hose faucets, compressed air outlets, and similar items at ends of pipe branches shall be rigidly fastened to building construction near point of connection.

3. Piping shall not be supported by wire, rope, wood, plumbers' tape, or other non-recognized devices.

4. Hangers and supports shall be designed to support weight of pipe, fittings, weight of fluid and weight of pipe insulation, and shall have a minimum factor of safety of five, based on ultimate tensile strength of material installed.

5. Burning or welding of any structural member under load is not permitted. Field welding not specified on Drawings or reviewed Shop Drawings is not permitted without review by ARCHITECT and DSA.

6. Burning holes in beam flanges or other structural members is not permitted without review by the ARCHITECT and DSA.

7. Pipe hangers on piping covered with low temperature insulation shall be installed on outside of insulation and not in contact with pipe unless otherwise detailed on

Drawings. Insulation shall be protected by 18 gage galvanized steel shield, with a minimum length of 10 inches, installed completely around pipe covering between covering and hanger. Installing hangers directly on pipe and butting adjoining sections of insulation against hanger is permitted provided void and hanger rod are properly insulated and sealed so that no sweating occurs at hangers.

8. Hanger rods shall be fastened to structural steel members with suitable beam clamps. Clamps shall be Tolco, Carpenter & Patterson, Fee and Mason, as follows:

   a. Tolco I beam, Fig.62 for maximum 1000 pounds.

   b. Tolco I or WF beam, Fig. 329, for maximum of 1290 pounds.

9. Hanger rods shall be fastened to concrete inserts in concrete slabs or beams. Inserts shall be Tolco, Carpenter & Patterson, Fee and Mason, as follows:

   a. Tolco Fig.310 for maximum of 600 pounds.

   b. Tolco Fig. 309 for maximum of 1140 pounds.

10. For fastening to wood ceilings, beams, or joists, furnish Grinnell Fig. 128R, Grinnell Fig. 153, Tolco 78, pipe hanger flange fastened with drive screws. Under wood floors, 3/8 inch hanger rods shall be hung from 2-inch by 2-inch by 1/4 inch angle clips 3 inches long, with 2, staggered 10d nails, clinched over joist.

11. Pipe hanger rod sizes: 3/8-inch for pipe sizes ½-inch through 4-inch, ½-inch for pipe sizes 5-inch through 8-inch, and 5/8-inch for pipe size 10-inch through 12-inch.

12. Where rod hangers are used with a diameter greater than 3/8-inch, they shall be equipped with swivels or eye nuts to prevent bending in the rod.

13. Turnbuckles, if furnished, shall provide a load carrying capacity to that of the pipe hanger with which they are being installed.

14. Pipe hangers shall be of same size, or nearest larger manufactured size available, as pipe or tubing on which they are being installed.

15. Hangers, clamps, and guides furnished for support of non-metallic pipe shall be padded with 1/8 inch thick rubber, neoprene, or soft resilient cloth.

16. Where special pipe-supporting requirements in the Specifications conflict with any standard requirements specified herein, the Specification requirements shall govern.

17. Vertical Piping:

   a. Vertical pipe risers shall be securely supported with riser clamps of recognized type. Risers in reinforced concrete buildings shall be furnished with extension clamps fastened to pipe above each concrete floor slab with extended arms of clamp to rest on slab. Clamps shall be provided with lead or Teflon liners when installed on copper tubing. Clamps shall be plastic-coated when installed on non-ferrous pipe or tubing.

   b. Copper tubing in sizes 1 ½-inches and larger and steel pipelines passing up through building shall be supported at each floor of building or every 15 feet whichever is less.

c. Copper tubing sizes 1 ¼-inches and smaller shall be supported at not intervals not more than 6 feet on center. Special provisions shall be installed for vertical lines subject to expansion and contraction caused by operating temperature differences.

d. Vertical cast iron pipelines shall be supported from each floor and at its base. Malleable iron or steel pipe clamps with minimum thickness of 1/4 inch shall be furnished and fastened around pipe for support.

18. Horizontal Piping:

a. Roof Mounted Piping: Pressure and non-pressure piping shall be supported from channels, stands, clamps, trapezes, rollers, or structures mounted on 100% rubber, UV resistant rooftop supports with reflective strips, Dura-Block,. Roller type supports shall be provided below and above pipe to prevent its dislodgement. Bottom of pipes shall clear the roof surface by 10 inches.

b. Insulated steam and space heating hot water insulated condensate lines, insulated domestic hot water supply and return piping shall be supported with Tolco Figure 4, B-Line Figure B3140, Grinnell Figure 212, steel hangers with welded eye rods to permit hinge movement at point of attachment of hangers. Hinge movement at point of support shall be provided by welded eye linked rods Tolco Figure 101L, B-Line Figure B3211X, Grinnell Figure 278.

c. Domestic cold water piping, water supply and return piping, condenser water piping, insulated refrigerant piping gas piping, compressed air piping, cast iron soil piping, galvanized steel vents, waste and downspout piping and glass to be supported with Tolco Figure 1, B-Line Figure B3100, Grinnell Figure 260, hangers with rods, turnbuckles and inserts suitable for above hangers.

d. Maximum hanger and support spacing shall conform to CPC schedule for horizontal piping installed above grade.

19. A hanger or support shall be installed close to the point of change in direction of a pipe run, in either a horizontal or vertical plane.

20. When practicable, supports and hangers for cast iron soil pipe shall be installed as close as possible to joints and when hangers or supports are not located within one foot of a branch line fitting, an additional hanger or support shall be installed at fitting.

21. In systems where grooved piping is used, couplings shall be provided with angle pattern bolt pads to comply with support and hanging requirements of ANSI/ASME B31.1, ANSI/ASME B31.9, and NFPA Pamphlet 13.

T. Flashings:

1. Each pipe, duct, or gas-fired equipment vent passing through roof shall be installed with waterproof flashing.

2. Flashing or flanges on pipes, vents, and ducts passing through a tile or slate roof shall be constructed of sheet lead. Flashing for pipes and heater vents passing through a roof shall be 4 pound soft sheet lead. Flashing and flanges for ducts and heater vents passing through exterior walls shall be 22 gage sheet metal. Install caps on top of heater pipes. Flanges and flashing shall be installed waterproof at point of connection

with pipe or duct by welding. No soldered joints on roof flashings will be allowed. No Stoneman lead roof flashings will be allowed.

3. Lead flashing and flanges shall be constructed of 4 pound sheet lead with burned joints. Flange of lead flashing or lead flange on a duct shall extend out onto roof a minimum of 12 inches from pipe or duct. Lead flashing shall extend up the pipe or duct not less than 8 inches.

4. Sheet metal flashing shall be constructed of 24 gage galvanized sheet steel. Flanges on these flashings shall extend out onto roof a minimum of 10 inches from pipe or duct. Flanges on ducts through exterior walls shall extend out from duct a minimum of 2 ½ inches. Flanges on gas-fired equipment single-wall vents shall be of ventilated type. Type B gas vents through a roof shall be furnished with non-ventilated flashing as per NFPA Pamphlet 211.

5. Cast iron, steel, brass, and copper pipe, which terminates less than 18 inches above roof, shall be furnished with a combination counter-flashing and vandal-proof hood for protection against water, birds and foreign matter. Cast iron, steel, brass and copper pipe, which does not terminate within 18 inches of roof, shall be furnished with a counter-flashing sleeve. Pipe, which terminates more than 18 inches above roof, shall be furnished with protection against entrance of water, birds, and foreign matter.

6. Counter-flashing and combination counter-flashing sleeves and vandal-proof hoods shall be cast iron, vandal-proof, threaded, sealed or approved gas-heated sleeve type. Counter-flashing sleeves on each of these items shall extend down over flashing a minimum of ¾ inch.

7. Storm collars shall be securely screwed and installed waterproof around appliance vent pipe immediately above flashing.

8. Vent piping above roof shall be furnished with a combination counter-flashing sleeve and vandal-proof hood.

U. Equipment Installation: Install roof or floor mounted equipment on level platforms, housekeeping pads or curbs and provide sound, vibration and seismic control measures per Section 23 0548 even if not indicated on Drawings.

END OF SECTION

SECTION 22 05 53 - PLUMBING IDENTIFICATION

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes: Marking and identification on mechanical piping systems, ducts, controls, valves, and apparatus.

B. Related Requirements:

1. Division 01: General Requirements
2. Section 21 13 13: Fire Suppression Sprinkler Systems.
3. Section 22 05 13: Plumbing Materials and Methods.
4. Section 22 10 00: Plumbing.

1.02 SUBMITTALS

A. Submit in accordance with Division 01 and Section 22 05 00: Plumbing Common Work.

B. Submit product data and installation instructions for each item specified.

C. Submit Samples of materials.

1.03 QUALITY ASSURANCE

A. Comply with provisions of:

1. Section 22 05 00: Plumbing Common Work.
2. ANSI/ASME A13.1: Scheme for the Identification of Piping Systems.
3. APWA: Uniform Color Code.
4. IAPMO: Uniform Plumbing Code (UPC)

PART 2 – PRODUCTS

2.01 MATERIALS

A. General: Piping systems, controls, valves, apparatus, etc., except those that are installed in inaccessible locations in partitions, walls, and floors, shall be permanently identified.

2.02 VALVES

A. Furnish prepared chart or diagram for each piping system, indicating by identifying letter or model number of each valve in the system, its location, and function.

B. Install charts in aluminum frame with clear glass front and secure on wall where designated by the Project Inspector.

C. Bind copies of each chart in operating instructions manual.

D. Provide each valve with a brass, aluminum, or plastic disc, not less than 1-1/4 inches diameter bearing engraved numbers corresponding to those indicated on chart. Fasten discs to valve with No. 14 brass wire.

E. Provide an additional tag for safety valves and other valves that could be hazardous to safety and health of occupants. Distinguish these tags from regular valve tags by color (such as yellow with black letters and marked "Danger"); submit Sample tag to the Architect for review.

2.03 INSTRUMENTS AND CONTROLS

A. Identify panel-mounted instruments and controls with engraved bakelite nameplates permanently affixed to panel boards.

B. Identify alarm indicating devices and alarm reset devices by nameplates.

C. Identify automatic valves, flow switches, and pressure switches, with embossed aluminum or plastic tape affixed to controller, indicating service and setting.

2.04 EQUIPMENT

A. Identify each major piece of equipment with engraved bakelite nameplates permanently affixed to the equipment, indicating the room numbers it services, Equipment identification designation shall be the same to its designation indicated on the “As-Built Drawings”. Room numbers in the nameplates shall correspond to the final room numbers.

2.05 ABOVE GRADE PIPE IDENTIFICATION

A. Identify pipes by means of colored labels with directional flow arrows and identification of the pipe content, in conformance to ANSI/ASME A13.1 or the UPC.

B. Materials: Precoiled acrylic plastic with clear polyester coating, all-temperature, self-adhering, as manufactured by Brady, Brimar Industries, Seton, Stranco, Inc., or equal.

C. Size:

Outside Diameter of Pipe or Insulation (in inches)	Length of Color Field (in inches)	Size of Letter (in inches)
¾ to 1 ¼	8	½
1 ½ to 2	8	¾
2 ½ to 6	12	1 ¼
8 to 10	24	2 ½
over 10	32	3 ½

D. Locations:

1. On accessible piping, whether insulated or not (including mechanical rooms, attic and ceiling spaces); except that labels shall be omitted from piping where contained material is obvious due to its connection to fixtures (such as faucets, water closets, etcetera.).

2. Near each valve and branch connection in such accessible piping.

3. At each pipe passage through wall or floor.

4. At not more than 20 feet spacing on straight pipe run between bands required in 2 and 3 above.

5. At each change in direction.

E. Application: Install on clean surfaces free of dust, grease, oil, or any material that will prevent proper adhesion. Replace non-adhering or curling labels with new labels.

F. Color Schedule:

Content of Pipe	Legend	Background Color	Lettering Color
Domestic cold water	Domestic. C.W.	Green	White
Non-potable cold water	Caution: Non-potable Water Do Not Drink (1)(2)	Purple	Black
Domestic hot-water 140ºF	Domestic H.W. 140ºF	Blue	Black
Sanitary waste	San waste	Green	White
Sanitary vent	San vent	Green	White
Storm drain or downspout	Storm drain	Green	White
Indirect drain	Ind drain	Green	White
Sump pump discharge	Pump discharge	Green	White
Fire sprinkler supply	Fire Sprinkler supply	Red	White
Fire sprinkler drain	Sprinkler drain	Red	White
Fuel oil	Diesel oil	Yellow	Black
Gas	Gas	Yellow	White
Reclaimed Water	Caution: Reclaimed Water Do Not Drink (1)(3)	Purple	Black

H. Notes on Schedule:

1. Note (1) indicates 2 ¼ inch by 1 inch yellow label with ½ inch letters reading UNSAFE WATER at one end of primary label.

   Note (2) words should read “CAUTION: NONPOTABLE WATER DO NOT DRINK.” with international *do not drink* symbol.

Note (3) words should read “CAUTION: RECLAIMED WATER DO NOT DRINK.” with international *do not drink* symbol.

2.06 UNDERGROUND PIPE

A. Detectable Marking Tape:

1. Provide and install detectable marking tape along buried piping. Tape shall be specifically manufactured for marking and locating underground utilities with electronic equipment. Tape shall be acid and alkali resistant, and manufactured with integral wires or foil backing, encased with protective cladding. Tape shall be a minimum of two inches in width.

2. Manufacturer: Reef Industries, Inc., Advantage Brands, Inc., Northtown Company, Mutual Industries, Inc., or equal.

3. Detectable marking tape shall be color-coded per APWA Color Code:

a. Yellow: Oil and gas.

b. Blue: Water, irrigation and slurry lines.

c. Green: Sewer and drain lines.

B. Tracer Wire:

1. Solid copper wire type THWN, 12 AWG gauge, with heat and moisture resistant insulation.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Correct detrimental conditions prior to commencing the Work of this Section. Install markers and identification tags as specified with materials and installation procedures recommended by manufacturer.

B. Place tracer wire on top of non-metal utility lines allowing some slack. Do not wrap tracer wire around pipe. Fasten tracer wire in place at approximately 10 feet on centers with non-metal ties.

C. Install underground detectable pipe marking tape continuously buried 8 to 10 inches above the buried utility pipe. Wrap tape on pipe risers up to a height of 12 inches above grade.

3.02 CLEANUP

A. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

END OF SECTION

SECTION 22 07 00 - PLUMBING INSULATION

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Insulation for plumbing piping.

B. Related Requirements:

1. Division 01: General Requirements.
2. Section 22 05 00: Plumbing Common Work
3. Section 22 05 13: Plumbing Materials and Methods.
4. Section 22 05 53: Plumbing Identification.
5. Section 22 10 00: Plumbing.

1.02 REFERENCES

A. American Society for Testing and Materials International (ASTM):

1. ASTM C302 - Standard Test Method for Density and Dimensions of Preformed Pipe-Covering-Type Thermal Insulation.
2. ASTM C411 - Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
3. ASTM C423 - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
4. ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.
5. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation.
6. ASTM C1104 - Standard Test Method for Determining the Water Vapor Sorption of Unfaced Mineral Fiber Insulation.
7. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
8. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.

B. Underwriters Laboratories, Inc.

1. UL 723 - Test for Surface Burning Characteristics of Building Materials.

C. National Fire Protection Association:

1. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.

D. California Code of Regulation Title 24.

1. California Green Building Standards Code.

1.03 SUBMITTALS

A. Submit in accordance with Division 01 and Section 22 05 00: Plumbing Common Work.

1. Complete material list of items to be furnished and installed under this Section.

2. Manufacturer's specifications and other data required demonstrating compliance with the specified requirements.

3. Shop Drawings, catalog cuts and manufacturer's data indicating insulation, jacketing, adhesives, and coating. Insulating materials shall be certified by manufacturer to comply with the California quality standards for insulating materials.

4. Display sample cutaway sections.

5. Manufacturer's recommended method of installation procedures, which will become part of this Section.

1.04 QUALITY ASSURANCE

A. Qualifications of Manufacturer and Installer, Materials, Fabrication, Execution, and Standard of Quality: Comply with provisions stated under Section 22 0500: Common Work Results for Plumbing and Section 22 0513: Basic Plumbing Materials and Methods.

B. Insulation Work shall be in accordance with the California Building Energy Efficiency Standards, CBC, and Uniform Mechanical Code and the California Green Building Standards Code.

C. Test Ratings:

1. Comply with provisions stated under Section 22 0500 and 22 0513 with emphasis on ASTM E84, NFPA 255, or UL 723. ASTM C167, ASTM C302, UL label or listing of satisfactory test results from the National Institute of Standards and Technology, or a satisfactory certified test report from an acceptable testing laboratory. Approval by the State Fire Marshal is required.

2. Furnish labels, legibly printed with the name of the manufacturer or listings indicate that fire hazard ratings do not exceed those specified for materials proposed for installation. Flame spread index of not more than 25 and smoke developed rating not exceeding 50.

3. Tests shall be performed on each item individually when insulation, vapor barrier covering, wrapping materials, or adhesives are installed separately at the Project site.

4. Test insulation, vapor barrier covering, wrapping materials and adhesives as an assembly when they are factory composite systems.

D. Regulatory Requirements: Insulation furnished and installed under this Section shall meet minimum legal requirements of the Building Energy Efficiency Standards adopted and incorporated in the California Energy Commission, Title 24, Part 2, Chapters 2 through 53 and the California Green Building Standards Code unless otherwise noted, for the piping,

E. Chemically based products such as sealers, primers, fillers, adhesives, etcetera must meet the California air quality regulations.

1.05 PRODUCT HANDLING

A. Protection, Replacement, Delivery and Storage: Comply with provisions stated under Sections 22 0500: Common Work Results for Plumbing and 22 0513: Basic Plumbing Materials and Methods.

PART 2 – PRODUCTS

2.01 MATERIALS

A. General:

1. Insulating material shall be fire resistant, non-corrosive, shall not break, settle, sag, pack or disintegrate under vibration, nor absorb more than 1 percent moisture by weight.

2. Insulating material shall be furnished with thickness indicated in Table 1, and shall furnish thermal resistance in the range of R-4.0 to 4.6 in accordance with inch at 75 degrees F. For any other value of R, insulation thickness shall be calculated accordingly and submitted for review.

3. Asbestos in any quantity in insulating material is not permitted.

4. Provide insulation materials, adhesives, coatings, sealants, fitting covers, and other accessories with a fire hazard rating not to exceed 25 for flame spread, 25 for fuel contributed and 50 for smoke developed, except for materials listed as follows:

   a. Nylon anchors for installing insulation to equipment.

   b. Treated wood blocks.

5. Flame-proofing treatments subject to moisture damage are not permitted.

TABLE 1 - MINIMUM PIPING INSULATION THICKNESS (1)

Insulation Thickness Required (in inches)

Piping System Type	Temp. Range (degrees F)	Runouts up to 2 (2)	1 and less	1.25 to 2	2.5 to 4	5 to 6	8 and larger
Service Water Heating Systems (recirculating, piping supply and return)							
Hot Water	Up to 180	0.5	1.0	1.0	1.5	1.5	1.5
Condensate Drain	½ inch minimum insulation thickness.	0.5	0.5	0.5	0.5	0.5	0.5
From A/C Equipment:	Insulate condensate drain lines within building, in room, inside walls and above ceilings.	0.5	0.5	0.5	0.5	0.5	0.5

NOTES: (1) For piping exposed to ambient temperatures, increase thickness by 0.5 inch.

(2) Runouts to individual terminal units, not exceeding 12 feet in length.

B. Lagging Adhesives: Shall be nonflammable and fire-resistant and shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E84. Insulation finished with canvas shall be provided with laps adhered in accordance to manufacturer's recommendation. A finish coat of same material shall be applied to entire outer surface of lagging cloth at coverage specified by manufacturer.

C. Canvas Jackets: Provide 6 ounce, in accordance with square foot minimum, 48 by 48 thread count canvas jacketing.

D. Insulation Jackets:

1. Exterior insulation exposed to weather shall be weatherproofed with Childers aluminum jacketing as basis of design, or Pabco, RPR, or equal. Jacketing shall be manufactured from 1100, 3105 or 5010 aluminum alloy with 3/16 inch corrugations. Smooth or embossed jackets may be permitted in special situations to match an existing installation. Jacketing shall be furnished with an integrally bonded moisture barrier over entire surface in contact with insulation. A minimum thickness of 0.016 aluminum jacketing is to be provided on ducts and piping. A minimum thickness of 0.020 shall be provided on tanks, equipment, and heat exchangers.

2. Insulated elbows, of 90 degrees and 45 degrees, with a nominal iron pipe size of ½ inch to 8-inch shall be provided with Childers aluminum Ell-Jacs insulation covers as basis of design, or Pabco, RPR, or equal, manufactured from 1100 aluminum alloy of 0.024 inch thickness. Insulated elbows with a nominal pipe size of 10-inch to 18-inch shall be provided with Childers 4-piece aluminum Ell-Jacs as basis of design, or Pabco, RPR, or equal.

3. Tees, Flanges, and Valve Insulation in Conjunction with Aluminum Jacketing: Furnish Childers Aluminum Special Fabrications Insulation Covers as manufactured by Childers Products Company, Pabco, RPR, or equal.

E. Adhesives: Adhesives shall be water based, UL Classified, meet the requirements of NFPA 90A and NFPA 90B, have been tested according to relevant ASTM requirements, and be acceptable to the State Fire Marshal. Name, type and method of installation shall be submitted for review.

F. Valve and Fitting Cover: When installed in conjunction with PVC jacketing, furnish Zeston 25/50 rated polyvinyl chloride fitting covers as manufactured by Johns Manville, Knauf Insulation, Speedline, or equal.

2.02 DOMESTIC HOT WATER PIPING SYSTEM INSULATION

A. General: Insulate domestic hot water supply and return piping, including valves, strainers and fittings with insulation thickness as indicated on Table 1.

B. Materials:

1. Classes of Insulation:

a. Class A: Glass fiber molded pipe insulation suitable for service temperatures up to 850 degrees F. Pipe insulation shall be one piece, preformed, and provide a minimum R factor of 4.0 at 75 degrees F mean temperature. Insulation shall be faced with all-purpose fire retardant vapor barrier jacket. Pipe insulation shall be Johns Manville Micro-Lok, Knauf Redi-Klad 1000, Owens Corning FIBERGLAS Pipe Insulation SSL II-ASJ, or equal.

b. Class B: Flexible open-cell melamine (foam insulation) suitable for service temperature -150 degrees F to 400 degrees F. Thermal conductivity at 75 degrees F, K= 0.26. Pipe insulation, one-piece pre-formed, laminated to heavy non-reinforced PVC jacket, with locking track, factory installed to jacket, to snap insulation and jacket onto pipe. Similar to TechLite 079 Series as manufactured by Accessible Products Co., or equal. Installation shall comply with manufacturers recommendations.

c. Class C: Mineral fiber pipe insulation suitable for service temperatures up to 1200 degrees F. Pipe insulation shall be one-piece, preformed up to 3 inches thick, and provide a minimum R factor of 4.0 at 75 degrees F mean temperature. Insulation shall be faced with all-purpose fire-retardant vapor barrier jacket. Pipe insulation shall be 8 pounds in accordance with cubic foot density by Roxul Techton 1200, Fibrex COREPLUS 1200, Industrial Insulation Group, LLC (IIG) MinWool-1200, or equal.

2. Locations and Class of Insulation Required:

TABLE 2 – LOCATIONS AND CLASS OF INSULATION REQUIRED

LOCATION	CLASS OF INSULATION
Equipment Room	A, B or C
Other Locations	A, B or C

3. Fittings on indoor piping shall be covered with flush, hand-wrapped Class A, B, or C insulation, to match the adjoining pipe insulation and covered with polyvinyl chloride fitting covers: Zeston 2000 25/50 by Johns Manville, Knauf Insulation Proto PVC Fitting Cover, Speedline Polyco Smoke Safe, or equal.

4. Adhesive: Fibrous Adhesive to bond calcium silicate to itself and non-porous surfaces.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Except as specified herein, install material in accordance with recommendations of manufacturer. Do not install insulation materials until tests specified in other sections are completed. Remove foreign material such as rust, scale, or dirt. Surfaces shall be clean and dry. Maintain insulation clean and dry at all times.

B. On cold surfaces where a vapor barrier must be provided and maintained, insulation shall be installed with a continuous, unbroken moisture and vapor seal. Hangers, supports, anchors, or other projections that are fastened to cold surfaces shall be insulated and vapor sealed to prevent condensation.

C. Surface finishes shall be extended in such a manner as to protect raw edges, ends, and surfaces of insulation.

D. Pipe insulation shall be continuous through walls, ceiling or floor openings, or sleeves; except where firestop or firesafing materials are required.

E. Metal shields shall be installed between hangers or supports and the piping insulation. Rigid insulation inserts shall be installed between the pipe and the insulation shields. Inserts shall be of equal thickness to adjacent insulation and shall be vapor sealed accordingly.

F. Insulation shall not be installed in the following locations unless otherwise noted:

1. On unions, flanged connections or valve handles.

2 Over edges of any manhole, clean-out hole, clean-out plug, and to restrict opening or identification of access.

3. Over any label or stamp indicating make, approval, rating, inspection, or similar data, unless provision is made for identification and access to label or stamp.

3.02 INSTALLATION OF DOMESTIC HOT WATER PIPING SYSTEM INSULATION

A. General: Domestic hot water, tempered water supply and return piping and condensate return piping, after having been tested, shall be cleaned and insulated.

B. Application: Insulate condensate return piping, domestic hot water supply and return, including tempered supply and return piping in accordance with manufacturer's instructions and as specified herein.

1. Install insulation on valve bodies up to valve bonnet. Fill void in saddles, in accordance with Section 22 0513: Basic Plumbing Materials and Methods, with insulation and seal joints.

2. Install insulating material to fittings, valves, and strainers and smooth to thickness of adjacent covering. Leave strainer clean-out plugs accessible. Covers fabricated from polyvinyl chloride shall be furnished.

C. Insulation Jackets in Exposed Indoor Locations:

1. Cover completed insulation with canvas jacket tightly pasted to covering with lagging adhesive. Lap jacket seams 1 1/2-inch minimum. Finish entire jacket with coating of undiluted adhesive.

2. Equivalent factory applied pre-sized, glass fiber reinforced, or glass fiber jackets may be furnished. Seal jacket seams with adhesive in accordance with manufacturer's instructions.

3. Johns Manville Zeston 2000, Knauf Insulation Proto PVC Fitting Cover, Speedline Polyco Smoke Safe, or equal, fitting covers may be furnished, with molded or segmented insulation equal to specified insulation applied to fittings. Secure covers in accordance with manufacturer's instructions.

4. In addition to above requirements, cover exposed insulated piping within a distance of 8 feet above floors with 26 gage galvanized steel jacket. Omit jacket in areas accessible only to maintenance personnel, such as mechanical equipment rooms, utility corridors, accessible pipe tunnels and manholes.

D. Concealed Indoor Locations: Cover insulation over fittings, valves, and strainers with canvas. Provide pipe insulation with factory or field applied standard jacket of 4 ounce minimum canvas, fiberglass cloth, or glass fiber reinforced jacket. Seal jacket laps with adhesive in accordance with manufacturer's instructions.

E. Exposed Outdoors: In addition to canvas or fiberglass cloth cover, pipe insulation exposed to weather shall be provided with an additional 0.016 inches thick aluminum jacket with 2-inch lap connected with one inch hem overlap joint located on side of pipe and turned down to shed water. Jacket shall be strapped 12 inches on center with ½-inch wide stainless steel strapping and wing seals. Aluminum jacket shall be mitered to fit fittings.

3.03 CLEANUP

A. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

3.04 PROTECTION

A. Protect the Work of this Section until Substantial Completion.

END OF SECTION

SECTION 22 10 00 - PLUMBING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Labor, materials, tools, and equipment to install plumbing systems as indicated.

B. Related Sections:

1. Division 01 - General Requirements.
2. Section 22 05 00: Plumbing Common Work.
3. Section 22 05 13: Plumbing Materials and Methods.
4. Section 22 05 53: Plumbing Identification.
5. Section 22 07 00: Plumbing Insulation.

1.02 SUBMITTALS

A. Provide in accordance with Division 01 and Section 22 05 00: Plumbing Common Work.

B. Provide necessary documentation to Owner for processing rebates for water efficient fixtures.

1.03 QUALITY ASSURANCE

A. Unless otherwise noted, the California Plumbing Code is hereby made part of this section.

B. Conform to provisions of Section 22 05 00: Plumbing Common Work.

C. Manufacturer of plumbing products must be third-party certified to ANSI/NSF Standard 61, Section 9 certification, and ANSI/NSF 372 to demonstrate compliance with the federal requirements for lead contribution to drinking water, the Safe Drinking Water Act SDWA, and the California Health and Safety Code Section 116875.

1.04 PRODUCT HANDLING

A. Conform to provisions of Section 22 05 13: Plumbing Materials and Methods.

PART 2 - PRODUCTS

2.01 PIPING SYSTEMS

A. Materials: Refer to Section 22 05 13: Plumbing Materials and Methods.

B. Insulation for Piping: Refer to Section 23 07 00: Plumbing Insulation.

2.02 FIXTURES AND DRAINS

A. General: Fixtures specified shall be furnished complete with trim and fittings. Cast iron plumbing fixtures shall be acid resistant enamel, and identified by casting letters "AR" or words "acid-resistant" into metal. Fixtures shall be white unless otherwise specified. Cast iron fixtures shall be white enamel inside and on back, rim and apron, with exposed unfinished surfaces painted white. Fixtures of same general classifications shall be of same make.

B. Finished Brass:

1. Unless otherwise specified, finished brass of a similar type shall be of same manufacturer and model throughout buildings.

2. Finished and exposed brass plumbing, except floor, shower and urinal drains shall be chromium-plated and polished. Floor, shower and urinal drains, unless otherwise specified, shall be nickel-bronze metal.

C. Traps, Trap Arms and Tailpieces:

1. Fixture Traps shall be all L.A. Code Cast Brass Chromium-plated and polished. Exceptions as follows:

a. Traps that are an integral part of a fixture.

b. Traps concealed in floors, walls and furring.

c. Traps standard for service sinks and Industrial Shop equipment.

d. Laboratory traps and tailpieces shall be as specified in section 22 05 13 “Plumbing Materials and Methods”.

2. Trap Arms shall be all IPS Threaded Brass Nipples into Female IPS Threaded Drainage Tee.

3. Tailpieces, Extension Tailpieces, 2-part wastes and any other tubular products shall be minimum 17 gage polished chromium-plated brass, except as otherwise specified.

4. Furnish polished chromium-plated brass wall flanges with setscrews and polished chromium-plated brass cover casing on discharge side of each trap.

D. Faucet and Shower Valve Handles: Faucet and shower valve handles shall be solid brass, chromium-plated and polished, and fastened to their stems by Allen type hollow head stainless steel set screws through the side of the handle extending into the stem. Handles with sharp edges or projections shall not be furnished. At accessible fixtures: handles shall be operable with one hand and shall not require tight grasping, pinching, or twisting of the wrist. The force required to activate handles shall be 5 pounds maximum.

E. Fixture Supplies:

1. Supplies for water heaters shall be unplated rigid copper water tube with threaded adaptors for connections to valves and other threaded connections. All other supplies shall be chromium-plated brass with hospital threads or shall be furnished with fittings and valves, which completely cover threads.

2. Exposed supplies for showers shall be chromium-plated brass pipe up to header with hospital threads or shall be furnished with fittings and valves, which completely cover threads.

3. Supplies to water closet tanks, lavatories, and drinking fountains shall be furnished with a NSF 372/61 threaded brass nipple. Exposed unfinished piping shall be sleeved with chrome plated brass or copper cover casing and have an appropriate escutcheon for a clean finished appearance. Angle/straight valve stops shall be female 1/2 IPS (inlet) by 3/8 compression (outlet). Fixture supplies shall be polished chrome-plated, solid supply bulbed end risers with size compatible supply nut connection to fixture and 3/8 O.D. compression nut and ferrule connection to angle stop outlet. Stainless steel flexible braided connectors with re-enforced PVC inner hose are not allowed.

4. Hot and cold water fitting supply outlet piping serving water closets, urinals, lavatories, drinking fountains, sinks, faucets, hose bibs, and sillcocks shall be iron pipe size (IPS) brass nipple, and piped in such a manner that through wall water supply outlet piping be removable, size appropriate, and lead free. The use of copper, copper MIP sweat adapters or similar fittings, in lieu of brass nipples is not allowed. The IPS brass nipple shall be directly connected to the fixture as follows:

   a. Control stops for water closet and urinal flush valves.

   b. Angle stop for lavatories, sinks and drinking fountains.

   c. Shank/arm adapters for wall mounted sink faucets.

   d. Iron pipe size (IPS) brass nipple connection for hose bibs, sillcocks, and other plumbing related fixture and/or plumbing fitting water supply outlets.

5. Water supply pipe that penetrates a finished surface, wall, countertop or part of a cabinet shall be appropriately sized polished chromium-plated cover casing and wall flange/escutcheon fitting tight to the brass through wall nipple and securely affixed to the finished wall surface.

6. Water supplies of plumbing fixtures shall be protected against back-siphonage in event of a vacuum in piping system. Toilet and urinal flush valves shall be furnished with recognized atmospheric vacuum breakers, installed a minimum of 6 inches above fixture.

7. Discharge outlets of supply faucets for lavatories and sinks shall clear top of overflow rim by at least one inch.

2.03 ACCESS PLATES (To cleanouts, valves, water hammer arrestors and hose faucets)

A. Schedule Numbers:

AP-1: Square, unless otherwise noted, steel, prime coated; frame, 18 gage minimum. Door shall be 16 gage minimum with concealed hinge or be removable, with vandal-proof lock operated by Allen wrench. (Specify for painted and stucco walls.)

SMITH	ZURN	ELMDOR	MILKOR	WATTS	MIFAB	JOSAM
Fig 4760 AK	Z-1462-VP	DW-AKL	MOR DW AK1	CO-300-S-6	UA-A	58650-VP

AP-2: Round type, stainless steel, vandal-proof, 5/16 inch No. 18 or 1/4 inch No. 20 flat-head machine screw into cleanout plug. Plate shall be prime coated minimum 18 gage steel or polished chrome-plated brass, 18-8 No. 302 stainless steel, or polished nickel bronze. (To be specified for painted walls, screwed into cleanout plug.)

SMITH	ZURN	JOSAM	WADE	WATTS	MIFAB
4710U	Z-1469-VP	58600	8480R	CO-480-RD-6	C1400-RD-6

AP-3: Square, polished face chrome-plated bronze, aluminum alloy or brass chrome-plated brass frame with 14 gage polished 18-8 No. 302 stainless steel or brass chrome-plated secured cover with vandal-proof screws. (To be specified for tile walls.)

SMITH	ZURN	WADE	WATTS	MIFAB	JOSAM
4735U	Z-1460-VP	58630	CO-300-S-6	C1400-S-3-6	58640-VP

2.04 BACKFLOW PREVENTION ASSEMBLIES

A. Schedule Numbers:

BPV-1: Reduced pressure or pressure differential type, City of Compton approved. Sizes ½ inch to 6-inch.

WILKINS	WATTS	FEBCO
375 and 975 XL (for	LF009-QT; LF909-NRS	LF860

uninterrupted service)		

BPV-2: Pressure vacuum breakers with 3/4 inch hose bib. Install 6 feet above finished floor.

WILKINS	WATTS	FEBCO
420XL	LF008PCQT	LF765

2.05 CLEANOUT ASSEMBLIES

A. Cleanout plug shall be line size.

B. Schedule Numbers:

CO-1: Iron body cleanout tee full line size up to 4 inches and round access plate, plugs shall be brass, countersunk with tapped boss for 5/16 inch No. 18 or ¼ inch No. 20 screws. (Specify for finished walls at base of waste stack, above urinal and service sink.) AB&I and TYLER may be used as iron body cleanouts. Trim and accessories shall be Smith or Zurn.

SMITH	ZURN	WATTS	MIFAB	JOSAM
4532-U	Z-1446-BP	CO-460-RD-34B	C1460-RD-6	58600-CO

CO-2: Iron body with approved UPC plug, top and adjustable sleeve, cut-off ferrule, polished scoriated brass nickel bronze secured cover. AB&I and TYLER may be used as iron body cleanouts. Trim and accessories shall be Smith or Zurn(To be specified for finished floors inside buildings, in covered areas, and in concrete paving.)

Square:

SMITH	ZURN	WATTS	MIFAB	JOSAM
4053L-U-NB	ZN-1400-T	CO-200-S	C1220-S-1-6	55000-1-SQ

Round:

SMITH	ZURN	WATTS	MIFAB	JOSAM
4033-L-U-NB	ZN-1400	CO-200-R	C1220-1-6	55000-1

CO-3: Secured cover, extra heavy-duty, adjustable sleeve, cut-off ferule, UPC. Brass approved type plug, scoriated tractor type cover.

(To be specified for areas outside building on concrete paving.)

SMITH	ZURN	WATTS	MIFAB	JOSAM
4233-U	ZN-1400-HD	CO-200-RX-4	C1220-4-6	55000-22

CO-4: Tapped soil tee with brass plug, full line size.

(Specify for above grade, outside building at base of exposed downspout.)

SMITH	ZURN	WATTS	MIFAB	JOSAM
4512	Z-1445-BP	CO-460-34A	C1460	58910

CO-5: Raised threaded head brass plug.

(To be specified for yard box YB-3.)

ZURN	WATTS	SMITH	JOSAM
Z-1470-A	CO-590	4285	58540-20

2.06 CIRCULATING PUMPS, HOT WATER HEATING SYSTEM

A. Schedule Numbers:

CPH-1: Centrifugal, single stage, close coupled with adjustable cast iron base, bronze enclosed impeller, lead-free mechanical shaft seal suitable for water temperature range from 20 degrees to 300 degrees F. Screwed or flanged connections. GPM and TDH capacities as indicated.

BELL & GOSSETT	WEIMAN	PACIFIC	TACO

CPH-2: In-line mounted. Close coupled, centrifugal type with an all bronze water chamber, bronze sleeve bearings, bronze impellers, water tight shaft seal suitable for water temperature range from 20-300 degrees F. Forged steel shaft. It must be provided with bracket support to damper vibrations. GPM and TDH capacities as indicated.

BELL & GOSSETT All Bronze	GRUNDFOS	TACO

2.07 DIELECTRIC UNIONS

A. Schedule Numbers:

1. Dielectric style Unions using ferrous and no-ferrous metals are prohibited. Dielectric flanges are admitted for use – see DU-2.

DU-1: Lead Free Brass union with 6-inch Lead Free Brass nipple.

DU-2: Lead Free Brass union or Lead Free Brass flanged fittings are to be used in between pipes made of dissimilar metals to prevent accelerated corrosion and deterioration in the piping systems due to galvanic and stray current.

WATTS	NIBCO
LF3100M3	733-LF

2.08 EMERGENCY EYE WASH / EMERGENCY SHOWER

A. Schedule Numbers:

EEW-1: Access compliant combination emergency shower and fold-away eyewash mounted in a flush mounted recessed stainless steel cabinet with concealed piping: Eyewash: eye/face wash in a stainless steel door/water tray assembly folds up flush into stainless cabinet. Shower: access compliant shower activation by pull lever handle mounted 42 to 45 inches above the finished floor, located inside of stainless steel cabinet, supplying an exposed 20 gpm flow regulated stainless steel shower head, mounted between 82 and 96 inches above finished floor. Unit is access compliant when eye/face wash spray outlet is mounted at a height of 36 inches above finished floor. Provide 30 inches wide by 48 inches deep clear floor space for access compliance.

HAWS	GUARDIAN	ACORN SAFETY	BRADLEY
8356WCC	GBF2150-FC20	S2260-BF-PAN-RA	S19345JXB

2.09 ELECTRIC WATER COOLERS

A. Water Coolers shall be provided with brass free waterways and lead mitigating water filtering systems (DFWF).

B. Provide as indicated on Plumbing Fixture Schedule: Call out of the schedule is the basis of design. Acceptable manufacturers are Haws, Murdoc and Elkay

2.10 FAUCETS

A. Access compliant faucets: Force to activate controls shall be no greater than 5 pounds. Self-closing metering, where specified, to remain open 10 seconds minimum when activated. Handles shall be operable with one hand and shall not require tight grasping, pinching, or twisting of the wrist.

C. Provide as indicated on Plumbing Fixture Schedule: Call out of the schedule is the basis of design, Acceptable manufacturers are Chicago, T&S and American Standard.

2.11 FLOOR DRAINS

A. Schedule Numbers:

FD-1: Cast iron body, no hub with seepage pan and flat, round nickel bronze strainers not less than 5-inch diameter for 2-inch outlet bodies, 7-inch for 3-inch outlet bodies and 8-inch for 4-inch outlet bodies, with maximum of ½ inch square holes or slots not larger than ¼ inch by 1 ¼-inch.

(To be specified for use in locations other than tile floors.)

SMITH	ZURN	WATTS	MIFAB	JOSAM

2005Y-A	ZN-415-B	FD-100-A	F1100-C-1	30000-A

FD-2: Same as specified for FD-1, except with square tops.

(To be specified for use in tile floors.)

SMITH	ZURN	WATTS	MIFAB	JOSAM
2005Y-B	ZN-415-S	FD-100-M	F1100-C-S-1	30000-S

FD-3: Area type, with 8-inch diameter minimum cast iron top grates (no hub). Drain shall be vandal-proofed by securing grate to body with stainless steel Allen flat-head screws.

SMITH	ZURN	WATTS	MIFAB	JOSAM
2110-Y-U	Z-550-VP	FD-320-Y-6	F1320-4-6	32100-VP-Z

FD-4: Gang shower, cast iron body with 5-inch diameter nickel-bronze vandal-proof strainer. No hub.

SMITH	ZURN	WATTS	MIFAB	JOSAM
2005-Y-NB-U-(A)	ZN-415-B-VP	FD-100-A-6	F1100-C-1-6	30000-A-VP

FD-5: For indirect waste. Cast iron body, with vandal-proof nickel-bronze top and funnel. No hub.

SMITH	ZURN	WATTS	MIFAB	JOSAM
3510-F11-NB5	ZN-415-E	FD-100-EF-1	F1100-C-EF-1	30000-E2-VP

FD-6: Area drain, cast iron body, round pedestrian grate set in square frame.

SMITH	ZURN	WATTS	MIFAB	JOSAM
1470Y-U-NB	ZN-158-VP	RD-200-CP-L-1	F1100-C-S8-1-6	23730-VP

FD-7: Trash Drain Wash down Area Drain: Waste water diversion valve drain acts as an area drain for sanitary and rain drainage. When the hose Bibb is activated, the drain automatically diverts run offs to sanitary drain.

FOX Waste Water Diversion Valve System:
DD 600

2.12 FLEXIBLE HOSES

A. Schedule Numbers:

FLH-1: Braided stainless steel metal hose (for gas use). US Flex, Metraflex, Nelson Dunn.

FLH-2: Braided bronze metal hose (for non-pressure condensate connection use). US Flex, Metraflex, Nelson Dunn.

2.13 FLUSH VALVE ASSEMBLY

A. Valves shall be furnished so that flush remains constant and will not require any adjustment.

1. Each flush valve shall be provided with a loose key, square shank, lock shield angle service stop connected to flush valve with a union connection.

2. Provide l7 gage pressed brass escutcheons for wall and fixture. Escutcheons shall be fastened to not turn or rattle.

3. Each flush valve shall be furnished with a vacuum breaker providing one inch opening to atmosphere, which will not leak under any degree of back pressure and will not restrict rate of flow more than 10% at 10 PSI, and will operate noiselessly.

4. Tailpiece shall not be lighter than 17 gage and shall be part of flush valve assembly.

5. Exposed metal parts of flush valve assembly shall be nickel or chromium-plated on a brass or copper base.

6. Controls for water closet flush valves shall be mounted on the wide side of toilet areas.

B. Schedule Numbers:

FLV-1: Manual Flush Valve for Water Closet: Shall deliver 1.28 gallon of water at each operation.

SLOAN	ZURN
Royal 111-1.28	Z6000AV-HET

FLV-2: Manual Flush Valve for Urinals: shall deliver 1/8 gallon of water per flush.

SLOAN	ZURN
Royal 186-0.125-DBP	Z6003AV-ULF

2.14 FLOOR SINKS

A. Schedule Numbers:

FS-1: 6 inches to 8 inches deep, square cast iron acid-resistant enamel, bottom aluminum dome strainer with nickel bronze rim and grate top.

SMITH	ZURN	WATTS	MIFAB	JOSAM

3140Y 3150Y	Z-1901 ZN-1900	FS-740-1 or FS-730-1	FS1720-1, FS1730-1	49320A-NB, 49340A-NB

2.15 HOSE BIBBS

A. Schedule Numbers:

HB-1: For plaster or stucco wall, furnished with box and stop, exposed trim chrome-plated, with or without door and with vacuum breaker.

ACORN	WOODFORD	PRIER
8141, 8151	B75	C-633NFC

HB-2: For brick, CMU and poured in place concrete walls, furnished with box and stop, exposed trim chrome-plated, with or without door and with vacuum breaker.

ACORN	WOODFORD	PRIER
8141, 8104, 8151	B75	C-633NFC

HB-3: ASTM B 62 bronze body, rubber composition disc or renewable seat, bent nose with brass die cast or enamel iron hand wheel and with vacuum breaker. (To be specified for use at roof top AC Unit. Mechanical Equipment Room, Boiler Rooms, etc.)

ACORN	ZURN	CHAMPION	PRIER
8126-LK-RBVB	Z-1343-VB-LK	B-401 LK	C-255NP

HB-4: Recessed hose box furnished with wall flange and built-in drip lip. Box shall be one piece construction; door shall have a recessed cam lock. Door shall remain up and out of the way when in fully opened position. Valve shall be replaceable loose key wheel handle and screwdriver stop. Install within 2 feet above finished floor. Provide vacuum breaker.

(To be specified for use in Toilet Rooms.)

ACORN	WOODFORD	PRIER
Hose box 8104 or 8151	B75	C-634BX1

2.16 LAVATORIES

A. Access compliant faucets for Lavatories: Force to activate controls shall be no greater than 5 pounds. Self-closing metering, when specified, to remain open 10 seconds minimum when activated.

B. Cast Iron Lavatories shall be acid resistant enamel and shall conform to Commercial Standards CS 77.63. Unites furnished in conjunction with strainer installation or faucet installation shall be brass. Exposed brass nuts shall be chrome plated.

C. Exposed trim shall be free from sharp edges or points. Fixture shall be furnished with other listed manufacturer specified trim. Instead of solid supply pipe, polished chrome-plated risers, 3/8 inch outside diameter with ferrule stop end and metal nosepiece may be furnished.

D. Insulate cold water, hot water and drain lines under all access compliant lavatories with approved type insulation.

PLUMBEREX	LAV-GUARD

E. Provide as indicated on Plumbing Fixture Schedule: Call out of the schedule is the basis of design. Acceptable manufacturers are Kohler, Sloan and American Standard.

	BRASS CRAFT	CHICAGO	ZURN
Drain		327 XCP	Z8743
Supply	HSTR 1720 A-CB-C	1017	ZH-8822-CE-LK

Note: Provide cast iron hangers for sinks.

2.21 PIPE HANGERS

A. Refer to Section 22 0513: Basic Plumbing Materials and Methods.

B. Schedule Numbers:

1. PH-1: Complete with clamps, inserts, etc.

2.22 P-TRAPS

A. Schedule Numbers:

PT-1: Cast brass complete, chrome-plated.

AB&A
107

2.23 PRESSURE REGULATING VALVE ASSEMBLIES

A. Schedule Numbers:

PRV-1: Furnish for sizes ½-inch to 2-inch water service, all bronze body, stainless steel seat, bronze strainer, calibrated springs, and corrosion resistant, adjustable control.

WILKINS	WATTS

500XL- YSBR-HLR	LF223S-B-HP

PRV-2: Furnish for sizes 2 ½-inch and larger: Automatic (pressure) control valve-pilot controlled and diaphragm actuated pressure control valve, straight or angle pattern, flanged inlet and outlet connection, fusion bonded epoxy coated inside and out with stainless steel cover, stainless steel pilot, stainless steel bolts and nuts, and stainless steel flexible tubing in a compact configuration, vandal resistant bolt-on pilot controller, ¼ ball valve on all pilot control lines, and stainless steel internal parts.

WATTS	CLA-VAL
LFM115	90-01

PRV-3: Furnish for gas service, spring-loaded model, Buna N rubber composition or leather valve seat disc and diaphragm, inlet pressure 125 pound maximum.

REPLANCE	FISHER	SENSUS
1813C	S-100. 166-1, S-201, 166-2	121

PRV-4: Furnish for gas service for (unit heaters, boilers, and similar installations). Spring-loaded model, Buna N rubber composition, or leather valve seat and diaphragm suitable for temperatures to 150 degrees F.; maximum inlet pressure one pound. Outlet pressure 4 inches to 10 inches adjustable; orifice to suit. For pilot lines and main burners.

REPLIANCE	MAXITROL	HONEYWELL
A3000 Series	RV	V5172 Series

2.24 ROOF DRAINS

A. Schedule Numbers:

RD-1: Low profile dura-coat cast iron body dome strainer type.

SMITH	ZURN	WATTS	MIFAB	JOSAM
1010Y-ERC-CID	Z-100-ERC-M	RD-300-F-D-K40	R1200-EU-M	21500-22
Jay R. Smith MFG Co. 1775 Downspout with hinged cover. Type 304 Stainless Steel over flow drain covers				

RD-1A:

SMITH	ZURN	WATTS	MIFAB	JOSAM
1010Y-R-C-CID	Z100-89-RC-M	RD-300-D-K40	R1200-M-B-U	21500-17-22

RD-2: Cast iron body with standpipe. (Specify for use as overflow.)

SMITH	ZURN	WATTS	MIFAB	JOSAM
1080Y-ERC-CID	Z-100-89-ERC-M	RD-300-R-F-B-D-M	R1200-R-EU-M	21500-3-16-22

SC-1:

SMITH	ZURN	WATTS	MIFAB	JOSAM
	Z161			

2.25 SHOWER ASSEMBLIES

A. General Requirements:

1. All shower and diverter valves and related components shall be concealed within the wall, along with all required supply and outlet piping.
2. Hand held shower slide bars have been omitted.
3. Hand held shower wall brackets shall be used in place of prior specified slide bars
4. Shower heads and hand-held showers shall have maximum flow rate of 1.8 GPM.
5. All showers and diverter valves internal working components shall be constructed of brass or stainless steel. Ceramic disk and/or plastic cartridges of any type are not accepted.
6. Reference Plumbing Standard Technical Drawings P-032 thru P-035 for placement of all ADA shower components.
7. All finish trim components, to include trim plates, flanges, handles, etc., shall be polished chrome of metal material. Plastic components of any type shall not be accepted.

D. Provide as indicated on Plumbing Fixture Schedule: Call out of the schedule is the basis of design. Acceptable manufacturers are Haws, Murdoc and Elkay

2.26 SERVICE SINKS and TRIM

A. Provide as indicated on Plumbing Fixture Schedule: Call out of the schedule is the basis of design. Acceptable manufacturers are American Standard, Chicago, and Sloan.

SS-1: Cast Iron corner service sink, conforming to Commercial Standard CS 77.63 for acid-resistant enamel, 28-inch by 28-inch, coated wire rim guard, 2-inch flat strainer and rough-

plated double faucet with top brace mounted above sink back, furnished with vacuum breaker and hose end.

	CECO	KOHLER	ZURN
Strainer	B-71-2	K-9142	D-2

2.27 SINKS and TRIM

A. Provide as indicated on Plumbing Fixture Schedule: Call out of the schedule is the basis of design. Acceptable manufacturers are American Standard, Chicago, and Sloan.

B. Access compliant faucets for sinks: Force to activate controls shall be no greater than 5 pounds. where specified self closing metering to remain open 10 seconds minimum when activated.

C. Cast iron sinks shall be acid resistant enamel, and shall conform to Commercial Standards CS 77.63. Units furnished in conjunction with strainer installation or faucet installation shall be brass. Exposed brass nuts shall be chrome-plated. Refer to the Fixture Supplies paragraph of this section.

D. Exposed trim shall be free from sharp edges or points. Fixture shall be furnished with other listed manufacturer specified trim. Instead of solid supply pipe, polished chrome-plated risers, 3/8-inches outside diameter with ferrule stop end and metal nosepiece may be furnished.

E. For access compliant sinks: Insulate cold water, hot water and drain pipes under sinks with district approved type insulation.

PLUMBEREX	LAV GUARD

2.28 SERVICE STOP GAS VALVES

A. Schedule Numbers:

SGV-1: Bronze/Brass, ¾-inches to 2-inch IPS (WOG) water, oil, or gas – full port ball valve. CSA approved.

(To be specified for larger water heaters, small boilers, pool heaters, and A/C units on roofs.)

WATTS	NIBCO	WILKINS
LFFBV-4	F-510-CS-R-66-FS	Model 850

SGV-2: Cast iron, 2-inch to 4-inch flanged ball valves (WOG) water, oil, or gas. CSA approved.

(To be specified for larger heating equipment.)

WILKINS	NIBCO	WATTS

Model 850	F-510-CS-R-66-FS	G4000M1

SGV-3: Lubricated plug gas valve, 3/4-inch to 2-inch IPS valve.

To be specified for use after gas meter headers, gas regulators, and isolation valves for building isolation, individual floor level isolation, and boiler rooms.)

NORDSTROM	WALWORTH	RESUN
142	1786	1430

SGV-4: Lubricated plug gas valve flanged type 2 ½-inch and larger valve.

(To be specified for use after gas meter headers, gas regulators, isolation valves for buildings isolation, individual floor level isolation and boiler rooms.)

NORDSTROM	WALWORTH	RESUN
142	1786-F	1431

SGV-5: Bronze/Brass ½ inch to 2-inch IPS X Flare Appliance ball valves with Tee handle. Flares to be used in conjunction with corrugated flex lines.

(To be specified for clothes dryer, water heaters, unit heaters, and wall heaters up to 100,000 BTU.)

BRASSCRAFT	NIBCO
TBV 10-12 TBV 8-8 TBV 6-8	GBV 12 GBV 1516

2.29 STOP VALVES

A. Stops shall be loose key type, ½-inches IPS inlet and outlet chrome-plated brass casting, except as noted.

B. Schedule Numbers:

STV-1: Angle:

CHICAGO,	NIBCO
442-LKABCP	77

STV-2: Partition:

CHICAGO	T& S BRASS
1771-ABCP	B-1028

STV-3: Straight Type, with Loose Key:

CHICAGO	T&S BRASS
45-LKABCP (1/2 inch)	B-O418

2.30 TRAP PRIMERS

A. Schedule Numbers:

ATP-1: Automatic, multi-trap primer, cast bronze with access panel. Pressure drop of three p.s.i. shall activate trap seal primers. Manufactured by MIFAB. (Installed in accessible location.)

MIFAB
MR-500-NPB

2.31 URINALS

A. Provide as indicated on Plumbing Fixture Schedule: Call out of the schedule is the basis of design. Acceptable manufacturers are American Standard, Kohler, and Sloan.

B. Manual-flush valve: FLV-2.

2.32 WATER CLOSETS

A. General: Water closets shall be vitreous china with Polyvinyl chloride bolt caps. Fixtures with auto-flush valves shall be provided with manual override button.

B. Provide as indicated on Plumbing Fixture Schedule: Call out of the schedule is the basis of design. Acceptable manufacturers are American Standard, Kohler, and Sloan.

2.33 WATER HEATERS / DOMESTIC BOILERS

A. Provide as indicated on Plumbing Fixture Schedule: Call out of the schedule is the basis of design. Acceptable manufacturers are Ajax, Rheem and Raypak.

2.34 WATER HAMMER ARRESTORS

WHA-1: Lead Free Water Hammer Arrestor provided for Headers for Lavatories, Wash Sinks, Wash Fountains, Kitchen Sinks, Service Sinks, Urinals and Water Closets. For sizing purposes size according to manufacturer's recommendations.

SIOUX CHIEF	PPP	JR SMITH	WATTS	JOSAM
655 and 656 SERIES	SC SERIES	5005 TO 5050 SERIES	Series LF05 and LF15M2	75000

2.35 WATER TANKS, HOT – UNFIRED

A. Schedule Numbers: Provide as indicated on Plumbing Equipment Schedule: Call out on the schedule is the basis of design. .

B. Unfired Hot Water Storage Tanks: All welded 1/2 inch thick hot rolled carbon steel plate construction conforming to requirements of ASME Code for Unfired Pressure Vessels (Section VIII of ASME Boiler and Pressure Vessel Code). Tank designed for a working pressure of 125 psig and temperature of 150 degrees F.; tested and coded stamped. Connections shall be 3,000 psi welded extra heavy couplings. Flanged coupling may be furnished on 3 inches or larger connections.

RAYPAK	A.O. SMITH
LOCHINVAR	BRADFORD/WHITE

2.36 YARD BOXES

A. Schedule Numbers:

YB-1 Yard Boxes: 14 3/4-inch by 20-inch by 12-inch, cast concrete, with cast iron hinged locking traffic cover marked "GAS"

(For use over gas stops for portable buildings only, on addition to accessible emergency shutoff valve on building.)

BROOKS No. 36-HFL Assembly with cast iron hinged locking cover

YB-2: Same as YB-1, marked "WATER" (For use over water valves).

BROOKS No. 36-HFL Assembly with cast iron hinged locking cover

YB-3: Same as YB-1, marked "SEWER"

BROOKS No. 36-HFL Assembly with cast iron hinged locking cover

2.37 HEIGHT OF FIXTURES

A. Heights for standard fixtures.

Fixture	Adults and Students (Inches)
Toilets, height to top of seat	15 to 17

Lavatories, sink top height	32
Wash Sinks	30
Urinals, lip height	24
Shower Heads From tip of shower head to finish floor	72
Shower valves	48

B. Heights for access compliant fixtures.

Fixture	Adults and Students (Inches)
Toilets, center line from wall/partition	17-1/2
Toilets Seat Height	18
Lavatories, sink top height	34 maximum
Lavatories, sink knee clearance	27 minimum
Urinals, lip height	16
Urinals, flush handle height	43
Drinking fountains, bubbler height.	36 maximum
Drinking fountains, knee clearance	27 minimum
Wash Sink	Per Drawings
Shower Valves	Per CBC
Shower Seat	Per CBC
Shower Head (adjustable) Bar	Per CBC

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions under which Work of this section will be performed. Correct conditions detrimental to proper and timely completion of Work. Do not proceed until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. General:

1. Unless otherwise specified, plumbing fixtures, equipment and appliances that require connections to plumbing line shall be connected. This shall include fixtures specified or indicated as furnished by others, furnished by Owner, or specified in other related sections. Install supplies, stops, valves, traps, wall flanges, or pipe casing for connection of this equipment.

2. Install equipment as indicated on reviewed and accepted Shop Drawings.

3. Avoid interference with Work of other trades. Do not deviate from Drawings without review of the Architect.

B. Examination: Check each piece of equipment in system for defects verifying that parts are properly furnished and installed.

C. For piping Work, refer to Section 22 0513: Basic Plumbing Materials and Methods.

D. Plumbing Fixture and Equipment Installation:

1. Unless otherwise indicated, fixtures shall be installed with 5/16 inch brass bolts or screws of sufficient length to securely fasten fixture to backing, wall, or closet ring.

2. Fixtures installed against concrete or masonry walls shall have their hangers fastened with 5/16 inch brass bolts, Philip Shield type anchors, or 2 unit cinch anchors. Wood or plastic plugs are not permitted.

3. Fixtures installed against wood or metal stud walls shall have their hangers fastened to metal backing plates with 5/16 inch brass bolts screwed into plate. Fixture hangers for urinals shall be fastened centered vertically on metal backing plate with three 5/16 brass bolts each for small individual hangers and six, for larger one piece hangers. Lavatories shall be hung with not less than four 5/16 inch brass bolts or not less than five 1/4 inch brass bolts. Each sink hanger shall be hung with not less than four 5/16 inch brass bolt or not less than five 1/4 inch brass bolts.

4. Pan type drinking fountains shall be hung with 5/16 inch cadmium plated bolts with a bolt in each bolt opening in hanger. Hangers for pan type drinking fountains shall provide 2 inches (plus or minus 1/4 inch) between pan and wall. Spaces due to

irregularities between fixtures and tile walls shall be neatly filled with white cement or silicone filler.

5. Backing for hanging of plumbing fixtures and equipment shall be installed in supporting wall at time rough piping is installed. Backing for stud walls shall be steel plate 1/4 inch thick, not less than 4 inches wide. Backing for urinals shall be ¼-inches thick by 6-inch wide steel plate. Steel plate shall be attached to stud at each end of plate and to each stud it crosses. Plate shall be attached to metal studs by bolting with two ¼ inch U-bolts per stud with bolts through plate and around stud flange or by welding with a 1/8 inch fillet weld full width of stud flange, top and bottom of plate. At wood studs, plate shall be carefully recessed flush with face of stud and attached to each stud with 2 No. 14 flat-head wood screws, 2 inches in length into pre-drilled 1/8 inch holes. Backing for stud walls supporting wall-hung closets shall be as detailed.

6. Rough-in for fixtures, equipment and appliances shall be as indicated on Drawings and as specified, including those items indicated as furnished by others, furnished by Owner, or future capacity. When connections to equipment from capped or plugged lines are required, caps or plugs shall be removed at time equipment is set and stops or valves installed and connections provided as specified.

7. Piping shall be stubbed out to exact location of fixtures and stubs shall be installed symmetrical with fixtures. Hot and cold water supplies for center set faucets on lavatories shall be installed on 8-inch centers, unless otherwise specified or required.

8. Kitchen equipment requiring backflow protection with hot and cold water connections shall be installed with approved backflow prevention assemblies; BPV-3 and drain into floor sink with air gap.

E. Cleanouts in Drain, Waste, Vent and Sewer Lines:

1. Cleanouts shall be installed at locations stated in the California Plumbing Code and accessible at following locations:

   a. At locations above first floor as stated on construction documents and 5 feet outside of the building.

   b. Install an accessible main line upper terminal cleanout in all restrooms above water closet overflow. (Install above upper terminal water closet where there are more than one water closets in a restroom).

   c. Above faucets of each sink with brass plug.

   d. Above service sink with brass plug.

   e. At each Drinking Fountain with brass plug.

   f. At each urinal and locate above urinal with brass plug.

g. Above overflow level of pot sinks with brass plug.

h. In vertical line at base of each downspout connected to an underground storm drain system extend cleanout to exterior of building.

i. At upper end of a horizontal vent line when any part of horizontal line is below overflow level of fixture it serves.

j. Not to exceed 100-foot intervals in sewer and waste lines exterior of building.

k. At property line connection.

l. Where indicated on Drawings.

2. Cleanouts shall be extended to grade as follows:

a. Not to exceed 100-foot intervals in straight runs of pipe outside buildings.

b. At horizontal changes of direction in aggregate greater than 135 degrees (underground).

c. At property lines.

d. Where cleanouts occur under concrete.

e. Where marked for future connections.

3. Cleanouts in building shall be extended to floor level or above floor level or above floor level in walls or furring when cleanouts are not accessible or where clearance is less than 18 inches.

4. Cleanouts in finished areas in building shall be concealed except that cleanouts above service sinks in janitor's rooms or closet, and cleanouts above service sinks or in exposed piping in boiler or heater equipment rooms, may be exposed. Cleanouts for urinals shall be installed above urinal and shall terminate behind an access plate.

5. Cleanouts in floors of covered areas and those extended to grade in concrete areas shall be floor level type with extensions body brass plugs and detachable nickel-bronze or aluminum alloy scoriated.

6. Concealed cleanouts in vertical lines shall be service weight soil cleanout tees with brass plugs and round cover plates unless otherwise specified or indicated. A snug fitting sleeve of galvanized sheet metal shall be placed around hub of tee and shall extend to flush with finished soil, or cleanout shall be extended to finished wall.

7. Cleanouts extended from below floor to a wall or furring or on horizontal lines above floor that terminate at a wall or furring shall be iron body type with brass plugs and round cover plates.

8. Cover plates over cleanouts in painted walls shall be steel, bonderized and prime coated. Cover plates cover cleanouts in tile walls shall be chromium-plated brass or nickel bronze. Plates shall be attached to cleanout plugs with 5/16 inch No. 18 or 1/4 inch No. 20 stainless steel vandal-proof type screws. Plates shall be one inch larger in diameter than fitting opening.

9. Cleanouts at bases of downspouts shall be tapped soil tees with brass plugs as hereinafter specified, full size of line.

10. Cleanouts extended to grade in exterior sewer lines other than floors or concrete areas shall be a cleanout assembly with secured top, extra heavy-duty, adjustable sleeve, cut-off ferrule, countersunk threaded brass plug and scoriated tractor type cover.

11. Other cleanouts shall be iron body type.

12. Cleanout extensions shall be no-hub cast iron soil pipe. Exterior cleanouts, those in concrete excepted, shall terminate in a 14-inch by 6-inch thick concrete block with cleanout assembly and top of block flush with finish grade.

13. Fittings in lines utilized as cleanouts shall be approved soil fittings including no-hub pipe. Tees and crosses in vent headers excepted.

14. Pipe joint compound shall not be installed on cleanout plug. After lines are tested and approved, each cleanout plug shall be removed, greased, and replaced.

3.03 EXCAVATION, TRENCHING AND BACKFILLING

A. Perform trenching, excavation, and backfilling required for Work of this section as specified herein and in Section 31 2323: Excavating, Backfilling, and Compacting for Utilities.

3.04 SERVICE CONNECTIONS

A. Determine exact location of required water, drain, and sewer connections and provide proper connections.

B. Potable water lines shall be purged completely before connecting to sources of water for the Project. Determine quality of water supply before connection.

3.05 WATER HAMMER ARRESTORS

A. Install water hammer arrestors indicated on Drawings and in following locations (only non-ferrous arrestors may be installed in copper water system):

1. Water lines to lavatory headers, water closet and urinal headers, service sinks, kitchen sinks, wash fountains, drinking fountains, laboratories with medical type faucets and on wash sinks having three or more stations and all other quick closing fixture such as clothes washers, as close to fixture as possible.

2. Between last two fixtures when three or more fixtures, other than those listed in Number 1 above, are served by a common header.

B. When possible, arrestor shall be installed in wall or furring. When arrestor is installed in wall or furring, furnish an access plate large enough to permit removal of arrestor. Access plate shall be a minimum of 2 inches larger in each direction than the arrestor.

C. Fixture water lines shall be provided with mechanical water arrestor hammer dampening devices. Air chambers are not approved.

3.06 CONDENSATE DRAINS - FROM AIR CONDITIONING UNITS

A. Connect drain piping from drain pan of air conditioning unit to condensate disposal location indicated. When coil or unit housing is shock or vibration isolated, connection shall be furnished through a flexible connector not less than 10 inches long. Drain line shall pitch to flow out at not less than one inch in 8 feet. Drain line shall not be reduced smaller than unit outlet connection.

B. Condensate drain piping installed within building whether in air conditioned space or not shall be insulated. Refer to Section 22 0700: Plumbing Insulation, for type of material required.

C. Condensate Trap:

1. A condensate trap shall be installed for each air conditioning coil. Trap shall be assembled from 2 brass unions: one between A/C unit and inlet of trap, and one at outlet of trap that connects to main drain.

2. Trap configuration shall be per manufacturer's recommendations based on total unit casting static pressure (simulated plugged filter condition), but not less than 3 inch water seal.

3. Running trap design is not permitted.

4. Secondary drain shall not be trapped.

D. Condensate trap shall be checked at equipment operational tests for proper water drainage flow from air conditioning unit. Cooling condensate pan shall be filled with water, filters covered with plastic (plugged filter simulated), unit panels replaced, and unit motor running at design condition. Pan shall drain without hesitation to bottom of inlet connection. Tests are made prior to installation of ceiling.

E. Secondary Overflow Drain:

1. Drain pan installed underneath air conditioning units in concealed ceiling space or units that incorporate dam fitting shall be furnished with secondary drain piped to outside planter area with outflow location clearly visible.

2. If outside building location is not available or feasible, secondary drains shall be piped to a classroom sink, if sink is not available pipe to a room corner away from cabinets, computers, desks, door ways/entrances or stairs.

3. Secondary vertical pipe that penetrates through suspended ceiling shall be furnished with a coupling or threaded adapter so ceiling tile can be removed without damage.

3.07 CONDENSATE DRAINS - FROM WINDOW TYPE HEAT PUMP AND EXTERIOR WALL MOUNT HEAT PUMP UNITS

A. Whether indicated on Drawings or not, window units and wall mount units without built in bottom drain pan for evaporator and condenser coils shall be provided with galvanized steel condensate pan at bottom of unit with drain line that drains into approved drywell. Install copper 1/2 inch diameter pipe for window type air conditioners and 3/4 inch diameter pipe for exterior wall-mounted heat pump units.

3.08 MAKE-UP WATER SYSTEMS

A. Provide and connect make-up water systems for equipment in other sections.

3.09 GAS SERVICE

A. Above Grade Service: Pipe shall be steel, hammered, free of dirt and scale, and blown out with oil-free air or nitrogen to a clean, dry condition. Piping shall not be installed in or through a ventilation duct or plenum.

B. Underground Service, Gas approved (yellow) Polyethylene Plastic Pipe: Refer to Section 22 0513: “Basic Plumbing Materials and Methods”.

1. Pipes shall be joined with polyethylene fitting and joined together by thermal fusion in accordance with procedures recommended by Polyethylene plastic pipe and fitting manufacturer.

2. Plastic pipe shall be installed not less than 30 inches below grade.

3. Underground Warning Tape shall be installed 12 inches above buried gas piping. Warning tape shall be yellow with caution statement as follows: “CAUTION – BURIED GAS LINE BELOW”.

4. Plastic pipe shall not be installed in or under a building or structure. Pipe shall be installed under bituminous surfacing or compacted soil area, free from large stones. Pipe may be installed under sidewalks or driveways, as long as no joint occurs. Pipe installed under paved covered areas wider than 40 feet shall be installed in ventilated conduits extending 2 feet past paving.

5. Pipe shall be installed on a 6 inches deep sand bed. After required pressure-leak test, pipe shall be covered with sand not less than 6 inches thick.

6. Piping shall not support weight of valves, metal fittings or other items. Pipe shall be installed strain free.

7. Plastic pipe fittings shall not be stored or left exposed to sunlight. Pipe in open trenches shall be shielded. A sand envelope of 6 inches minimum shall be placed around pipe, with exception of joints, until inspection by IOR is completed. Protection for pipe shall be provided when necessary to leave pipe exposed overnight.

8. Installer of piping is required to have training and to have attained a certification. Non-trained/Non-certified installer must contact the manufacturer or manufacturer's representative to provide on-site fusion training and certification, prior to work commencement

9. Polyethylene plastic pipe shall connect to a steel epoxy coated anodeless type riser to minimum of 6 inches above grade, when exiting the underground installation and transitioning to steel pipe connection.

10. Where a steel pipe riser passes into a structure or building, a double swing or double-offset joint shall be furnished. Pipe shall pass into structure 6-inches above grade and through a sleeve with a minimum one inch clearance. An isolation valve is required before pipe entering the building.

3.10 CLEANING - PLUMBING PIPING SYSTEMS AND FIXTURES

A. Plumbing lines and fixtures shall be flushed to remove dirt and foreign material until water runs clear and no foreign substance or odor is present. Strainers and screens on faucets shall be removed during this cleaning operation.

B. After satisfactory cleaning of strainer and screen replacements has been witnessed by the Project Inspector, post and maintain signs stating: "CAUTION - Water at this construction project has not yet been certified for human consumption." Signs shall be furnished with letters at least 1/2 inch in height and shall be conspicuously posted at entrances to the Project site. Signs shall be paneled, black and yellow, in conformance with OSHA Section 1910.1455.

3.11 DISINFECTING DOMESTIC WATER PIPING SYSTEMS

A. Newly installed or replaced piping and/or fixtures dispensing potable water, and any additional piping and/or equipment impacting the integrity of this system shall be disinfected and undergo an approved bacteriological analysis before water system is allowed for public use.

B. Disinfection shall commence upon complete installation of all related domestic water systems including fixtures, valves, faucets, water heating systems, etc.

C. Work shall be performed by Technicians Certified by the American Water Works Association (AWWA) and/or the State of California Department Health Services, Grade II

Water Treatment Operator Certification or higher issued by the Department of Health Services (DHS) for the State of California. Comply with Title 22, Code of Regulations Division 4, Chapter 13, and Article 2 Operator Certification Grades.

D. Method:

1. A Physical Separation of minimum 6" or Reduced Pressure Backflow assembly shall be installed to protect from cross contamination of the local water purveyor's meter service supply when at any time there is any type of water connection with the piping to be disinfected (Chlorinated) and the water meter service supply.

2. Install a Chlorination Port including a T fitting and a shut off valve to the proximity of the point of connection at the new piping system.

3. System is to be flushed to remove any materials that may have entered the system.

4. Using a chemical feed metering pump and a chlorine tank, the chlorine solution is injected into the water system.

E. Disinfection and De-chlorination procedure (24 or 3 Hour Contact Time):

1. 24-hour Test Method:

a. Prior to disinfection, post signs on all water outlets of the system to be disinfected. Sign or tags shall read, "Water System Being Chlorinated- "Danger Do Not Drink Water" or similar warning.

b. Piping system shall then be adequately flushed with water to remove any particles and eliminate air pockets.

c. Using the continuous feed method, sodium hypochlorite conforming to ANSI/ AWWA B300 will be injected into the water system at a minimum of 50 PPM. A water flow meter provided by the water treatment technician will be used to determine the rate of injection and a chlorine test kit, Hach or equivalent, will be used to monitor the residual.

d. Chlorine residual test will be taken at all appropriate points and outlets to verify 50 PPM residual levels.

e. The chlorinated system shall be shut down for any use and the chlorinated water shall remain in the water system for retention of 24 hours.

f. After 24 hours, chlorine residual levels will again be tested at various points throughout the system to insure a minimum of 25 PPM residual. If the system has not met the minimum of a 25 PPM residual, the above disinfection process shall be repeated.

g. After satisfactory completion of the residual testing, flush out system until Hach or equivalent test reveal the water outlets have a free chlorine residual concentration less than 0.5 PPM. The procedure shall be in accordance with the AWWA standard C651-05.

h. The OAR may allow temporary use of the water system for construction purposes pending results of the bacteriological test analysis. Sign or Tags shall be left on all outlets stating water system is not safe for consumption until laboratory results are complete and meet these specifications.

2. 3 Hour Test Method:

a. If the water systems must be turned on for use as soon as possible, a 3 hours chlorine contact time to allow for disinfection is permitted with the OAR's approval.

b. Prior to disinfection, post signs on all water outlets of the system to be disinfected. Sign or tags shall read, "Water System Being Chlorinated-"Danger Do Not Drink Water" or similar warning.

c. Piping system shall be then adequately flushed with water to remove any particles and eliminate air pockets. Using the continuous feed method, sodium hypochlorite conforming to ANSI/ AWWA B300 will be injected into the water system at a minimum of 200 PPM. A water flow meter provided by the water treatment technician will be used to determine the rate of injection and a chlorine test kit, Hach or equivalent, will be used to monitor the residual.

d. Chlorine residual test will be taken at all appropriate points and outlets to verify 200 PPM levels. The chlorinated system shall be shut down for any use and the chlorinated water shall remain in the water system for retention of 3 hours.

e. After satisfactory completion of a 3 hour disinfection period, flush out system until Hach or equivalent test reveal the water outlets have a free chlorine residual concentration less than 0.5 PPM. The procedure shall be in accordance with the AWWA standard C651-05.

f. The OAR may allow temporary use of the water system for construction purposes pending results of the bacteriological test analysis. Sign or Tags shall be left on all outlets stating water system is not safe for consumption until laboratory results are complete and meet these specifications.

F. Bacteriological Test:

1. After final flushing and satisfactory results from the residual free chlorine concentration test, Bacteriological test samples shall be collected. The intent of the following is to provide insurance for an accurate representation to a complete

Bacteriological test of the water system. At least two samples shall be taken from each floor of each building.

2. Bacteriological test samples shall be delivered to a State of California Department of Health Services Certified Laboratory to perform qualitative and quantitative bacterial analyses on the water samples for the presence of any Total Coliform bacteria and Plate Count. This count must be less than 500 cfu/mL.

3. The procedure shall be repeated if it shown by bacteriological examination made by an approved agency that the level of Disinfection does not meet these specifications.

4. After satisfactory results for the bacteriological test are provided to the OAR, the physical barrier or temporary reduce pressure back flow devise shall be removed, and the new piping shall be connected to the point of connection. All the connecting piping and fittings shall be disinfected prior to installation. Chlorination Port shall be capped water tight. Warning sign or tags shall be removed.

G. Drinking Fountain and Bottle Filler Lead Test: After installation of Drinking Fountain or Bottle Filler, and successful Bacteriological Test, shut off domestic water supply line feeding the fixture, and inform OAR. OAR will coordinate with the Drinking Water Quality Program (DWQP) Supervisor in local Project Unit and M&O's Plumbing Technical Unit Supervisor to conduct lead detection test and mitigate as necessary. Do not remove related construction warning sign and tags.

3.12 VALVES ON PLUMBING SYSTEM

A. Furnish and install gates, ball, globes, angles, and check valves on plumbing Work at following locations whether indicated on drawings or not.

B. Hot and cold valves shall be:

1. Lead free complying with AB1953.

2. Above the ground copper water system, 2-inch and larger, may utilize Victaulic butterfly valves and fittings for their connections. A 2-inch or larger Victaulic valve may be in a wall if an adequately sized access panel is provided for maintenance or removal.

C. Valves shall be accessible and installed within an access panel approximately 3 feet above floor and no more than 7 feet above floor, or in a marked yard box to prevent tampering.

1. Immediately after each water meter, in addition to any valve furnished by utility company, there shall be an accessible valve on the inlet side for a strainer assembly, dual backflow device assembly and/or possibly a dual pressure reducing valve assembly.

2. A gate or ball valve on each water supply before it enters building. Valves shall be accessible from outside building and shall be installed in a marked yard box, unless

otherwise indicated on drawings. Ball valves 2 ½-inch size or larger shall omit gate valve handle and furnish 2-inch square operating nut.

3. At multi story buildings, provide an isolation-valve or multiple valves for both hot and cold water in access panel to isolate and control each floor level.

4. For classrooms, shops, offices and boiler or mechanical room, install a gate or ball valve to control hot and cold water lines to each group of fixtures, a group of fixtures shall be considered to be 2 or more fixtures in the same room. When practical, valves shall be installed on the same wall as group of fixtures. Valves shall control only fixtures in rooms in which they are installed.

5. For restrooms, a gate or ball valve shall be installed in each restroom to isolate the hot and cold water supply into a restroom regardless of the number of fixtures. These valves shall control and be accessible only from within the restroom in which fixtures are installed. Valves shall be installed on the same wall as the group of fixtures it serves. Valves shall control only fixtures in restroom in which they are installed. Back to back restrooms shall be isolated separately and individually.

6. Install a gate or ball valve on each building branch line, which serves two or more fixtures, when these fixtures are not provided with a group isolation valve as specified above. These valves shall be located approximately 3 feet but not more than 7 feet above finish floor.

7. Install a gate, ball valve or partition stop for a drinking fountain or a group of drinking fountains.

8. Install a gate, ball valve or partition stop for hot and cold water supply to plumbing fixtures with no accessible supply stops, such as wall mounted faucets.

9. Install a gate, ball valve or partition stop for stops adjacent to, and controlling water flow to each sill cock and hose bib except as follows:

   a. A sill cock immediately below an exterior drinking fountain may be controlled by the same gate, ball valve or partition stop as drinking fountain.

   b. Valves or stops will not be required for individual hose bibs when these hose bibs are on a branch line serving only hose bibs and branch line is furnished with a shut-off valve.

10. Install a lose key angle stop, on each exposed fixture supply, and for each flush valve unless otherwise specified,

11. Install gate or ball valve at each location where a water line is connected to a piece of equipment other than items mentioned above.

12. Install a check valve on each hot water return line where it connects to a hot water storage tank or a water heater.

13. Handles, hand wheels (including dishwasher fill valve handles) and operating nuts shall be furnished of steel, brass, or cast iron and shall be removable. Unless specified to be loose key type, handles shall be securely fastened to their stems. On exposed outdoor valves, omit operating handles and provide operating nuts.

14. Provide a handle or a key for each five, or fraction thereof, loose key valves, bibs, or stops and deliver them to the project OAR.

3.13 VALVES - GAS SERVICE

A. A gas readily accessible shut-off stop shall be installed on each gas line entering a building immediately prior to the point it enters the building. Unless otherwise specified or indicated, shut-off valves for lines entering a permanent structure, buildings or portable buildings, shall be installed in a vertical riser above grade.

1. Gas shut off valve for portable buildings – In addition to the gas readily accessible shut-off stop specified above, a dedicated Gas shut off valve shall be provided in a marked Yard Box, for each portable building to facilitate relocation/removal of building without the need to shut off gas to entire campus.

B. Gas Shut off valve within a building – A gas shut off valve with handles shall be accessible and serviceable within an access panel. Install valve minimum 3 feet above floor but less than 7 feet above floor.

C. In addition to locations specified, gas shut off valve shall be installed at following locations:

1. Install a lubricated plug gas shut off valve on any line connected to gas main or header at master assembly.

2. Install a lubricated plug gas shut off valve before entering any building or structure.

3. Install a gas valve on each outlet, in addition to any gas stop furnished with equipment.

4. Service to laboratory gas cocks shall be furnished with a special precision check valve, located downstream from gas stop servicing room outlet at each laboratory cock. Unless otherwise specified, 1/8-inches bore shall be provided for each outlet cock.

5. Install a gas shut-off valve on each gas line serving 2 or more gas outlets in same room. Service stop shall be installed not more than 7 feet above floor, and shall be in the room it serves.

6. Install a gas shut-off valve on inlet side of each gas pressure regulating valve.

7. Gas shut-off valves to be furnished with equipment.

8. Install gas shut-off valve at not more than 1,000 foot intervals on each gas main.

9. At multi-story buildings, provide gas-shut off valve(s) to isolate and control each floor or level. Install valves in a concealed manner in walls with access panels.

10. Gas shut-off valves in classrooms and locations subject to tampering shall be protected while remaining accessible.

D. When a gas-shut off valve adjacent to gas-fired equipment is indicated in Contract Documents it shall be furnished and installed as part of Work of this section.

E. When electrical wall switches with emergency push button are specified for controlling gas outlets at Laboratory Classrooms, provide main shut-off gas valve with normally closed electric solenoid valve within an accessible access panel.

3.14 ELECTROLYSIS PREVENTION

A. Brass nipples, 6 inches, with recognized brass unions; flanges shall be furnished and installed at locations described herein. Flanges shall be installed with complete insulating component consisting of gasket bolt sleeves and bolt washers. Dielectric insulators shall be installed at following locations:

1. Where special applications indicated on Drawings require an insulation flange or brass union, with 6-inch brass nipple to be installed in a condensate line, or steam line, flange insulation shall be of a high temperature type, suitable for continuous operation at temperatures up to 220 degrees F. for condensate and 400 degrees F. for steam.

2. Where steel or cast iron in ground connects to copper or brass piping above ground, transition from steel or cast iron pipe to copper or brass pipe shall be provided in an accessible location.

3. Underground dielectric connections shall be furnished in accessible yard boxes.

4. Above ground dielectric connections shall be exposed; or if in finished rooms shall be located in accessible access boxes.

3.15 UNDERGROUND PIPE MARKERS

A. Pipe markers shall be furnished according to Section 22 0553: “Plumbing Identification”

B. Underground Caution Tape shall be placed 12 to 18 inches above the utility line. The Caution Tape shall be a designated color and marked with the appropriate name for the specific type of utility pipe as follows:

1. Yellow – with the words: CAUTION GAS LINE BELOW

2. Blue – with the words: CAUTION WATER LINE BELOW

3.16 HOT WATER CIRCULATING PUMPS

A. Floor-mounted pumps shall be provided with a 4-inch high concrete base with ½ inch reinforcing bars at 12-inch centers each way and doweled into concrete floor.

B. Piping shall be supported from building structure so as to prevent any strain on pump casing.

C. In-line pumps, unless otherwise specified, shall be centrifugal type with non-overloading characteristics and shall not overload motor above its horsepower rating under operating conditions with ratings based on continuous operation.

D. Centrifugal water pumps shall be rated according to Hydraulic Institute Test Code for Centrifugal Pumps. Pumps shall be furnished with bronze water chamber, bronze impeller and mechanical seal. Rotating parts shall be statically and dynamically balanced.

E. Flanged connections shall be provided on pumps with discharge connections larger than 2 inches. Smaller sizes may be threaded connections.

F. Hot water circulating pump shall be arranged so that pump can be automatically turned off when hot water system is not in operation.

3.17 WATER TEMPERATURE CONTROLLERS

A. Furnish and install a water temperature controller in hot water line adjacent to, and for control of, circulating pumps on hot water return lines when said pump is indicated on Drawings or herein specified. Bulb of temperature controller shall be installed so as to be directly in path of flowing water and so as not to obstruct flow of water.

B. Furnish and install a water temperature controller in hot water storage tanks for control of circulating pump on hot water circulating line when said pump is indicated on Drawings or specified herein.

3.18 DEPTH OF SEWER LINES

A. Minimum depth of below grade sewer lines shall be 24 inches to centerline of pipe. Sewer lines shall slope ¼ inch per foot minimum, unless otherwise indicated. Minimum depth at Owner property line shall be 6 feet, unless otherwise required.

3.19 BACKFLOW PREVENTION DEVICES

A. Backflow Devices: Installation of backflow devices shall be tested and certified by Los Angeles County backflow device tester before Substantial Completion. Tests shall be performed in presence of Project Inspector. Test reports shall be turned over to Project Inspector for mailing to proper agency.

3.20 CLEANUP

A. Remove rubbish, debris, and waste materials and legally dispose off Project site.

3.21 PROTECTION

A. Protect Work of this section until Substantial Completion.

END OF SECTION

DIVISION 23

HEATING, VENTILATING, AND AIR-CONDITIONING (HVAC)

SECTION 23 05 00 - MODULAR CENTRAL PLANT

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. General description.
2. Manufacturers.
3. Qualifications.
4. Performance testing.
5. Mechanical equipment.
6. Electrical and controls equipment.
7. Project execution.

B. Related Sections:

1. [Section 23 05 13 “Common Motor Requirements for HVAC Equipment.”]
2. [Section 23 05 19 “Meters and Gages for HVAC Piping.”]
3. [Section 23 05 23 “General-Duty Valves for HVAC Piping.”]
4. [Section 23 05 53 “Identification for HVAC Piping and Equipment.”]
5. [Section 23 07 16 “HVAC Equipment Insulation.”]
6. [Section 23 07 19 “HVAC Piping Insulation.”]
7. [Section 23 09 00 “Instrumentation and Control for HVAC.”]
8. [Section 23 09 93 “Sequence of Operations for HVAC Controls.”]
9. [Section 23 21 13 “Hydronic Piping.”]
10. [Section 232123 “Hydronic Pumps.”]
11. [Section 23 52 00 “Heating Boilers.”]
12. [Section 23 57 00 “Heat Exchangers for HVAC.”]
13. [Section 26 05 19 “Low-Voltage Electrical Power Conductors and Cables.”]
14. [Section 26 05 23 “Control-Voltage Electrical Power Cables.”]
15. [Section 26 05 26 “Grounding and Bonding for Electrical Systems.”]
16. [Section 26 05 33 “Raceways and Boxes for Electrical Systems.”]
17. [Section 26 05 53 “Identification for Electrical Systems.”]
18. [Section 26 24 19 “Motor-Control Centers.”]
19. [Section 26 29 23 “Variable-Frequency Motor Controllers.”]

C. References:

1. AHRI – Air-Conditioning, Heating, and Refrigeration Institute.
2. AISC – American Institute of Steel Construction.
3. ANSI – American National Standards Institute.
4. ASCE – American Society of Civil Engineers.
5. ASHRAE – American Society of Heating, Refrigerating, and Air-Conditioning Engineers.
6. ASME – American Society of Mechanical Engineers.
7. ASTM – American Society for Testing and Materials.
8. ETL – Electrical Testing Laboratories.

9. Hydraulic Institute.
10. IBC – International Building Code.
11. IEEE – Institute of Electrical and Electronics Engineers.
12. NEC – National Electrical Code.
13. NEMA – National Electrical Manufacturers Association.
14. NIST – National Institute of Standards and Technology.
15. OSHA – Occupational Safety and Health Administration.

1.3 GENERAL DESCRIPTION

A. Provide a factory assembled modular central plant as specified herein and according to plan drawings. The modular central plant shall be no smaller than specified on plan drawings.

B. The modular central plant after assembly shall require only the following connections for the hot water portion:
   1. Hot water suction and discharge pipe connections.
   2. One (1) make-up water connection.
   3. <Insert number> electrical power connection(s).
   4. Terminal contacts to field mounted devices and building automation system (BAS).

1.4 MODULAR CENTRAL PLANT COMPONENTS

A. The modular central plant's hot water portion shall consist of the following components: structural base, boiler(s), domestic water skid, hot water pump(s)/motor(s), power distribution, controls, valves, and all necessary piping and components as listed in the specification for a complete system.

1.5 MODULAR CENTRAL PLANT DESIGN CONDITIONS

A. Boiler Plant:
   1. Total heating load at present: 4,000 MBH, two boiler(s) at 2,000 MBH each.
   2. Hot water system: Two 100 GPM HHW Variable Primary Pumps with 110' TDH. One 35 GPM HHW Pump for Domestic Water Skid with 25' TDH.
   3. Instantaneous Domestic Water: 18.6 GPM Capacity with 70 Degree temperature rise and 379 MBH.

1.6 MANUFACTURER

A. Subject to compliance with the specification, provide a complete modular central plant by one of the following manufacturers:

   Base Bid: Systecon Inc. (www.systecon.com).
   Alternates: Stellar Energy (www.stellar-energy.net).
   TAS Energy (www.tas.com).

   Alternate manufacturers not listed above must submit 2 weeks before the bid date following data for the engineer's review. Failure to provide the information below will result in a disqualification:

   1. Preliminary 3D layout & P&ID for this project
   2. Complete control sequence.
   3. Pumping energy analysis.
   4. System performance data.
   5. Documentation of proposed equipment with flow diagrams.
   6. At least five successful variable primary flow jobs with contact name and phone number.
   7. Itemized list of any exceptions taken to the base bid specification.

8. Provide a letter from an officer of the packaged plant manufacturer stating that the exceptions listed are the only deviations from the specifications.

1.7 QUALIFICATIONS

A. The modular central plant manufacturer shall be listed by ETL or UL as an approved manufacturer of factory assembled modular central plants. The equipment shall bear the listing and label before shipment from the factory.
   a. The listing must cover the entire modular central plant as assembled.
   b. An individual listing for components is unacceptable.
   c. If the manufacturer does not carry a listing, they must pay UL or ETL to field label the entire modular central plant system.

B. The modular central plant manufacturer must be the manufacturer of the controls and control panel used for the system.
   a. The control panel shall be listed by UL as an approved manufacturer of industrial control panels.
   b. Upon request from the engineer, the manufacturer shall furnish proof of listing.
   c. Use of commercial grade controllers from the building automation contractor is not acceptable.

C. Boiler Plant Controls:

   i. Skid Controller to provide PLC start stop of major equipment and pump control.

D. The modular central plant manufacturer shall have a quality assurance program.
   a. The manufacturer shall provide documentation of this program in the submittal.
   b. The manufacturer shall provide a description of the performance test procedure.
   c. The manufacturer shall provide current (within last 9 months) independent testing certifying the performance test stand instrumentation is NIST traceable.

E. The modular central plant manufacturer shall of a minimum of fifteen (15) years of manufacturing and application experience.

F. The modular central plant manufacturer shall provide all mechanical drawings in a three-dimensional format. These drawings shall be reviewed utilizing a 3D viewer with the owner and engineer. The use of 3D design software is required to ensure the design adequately provides for maintenance and angle clearance.

1.8 PERFORMANCE TESTING

A. Factory Performance Test Standards

1. Field performance testing of the modular central plant is not acceptable.
2. Factory performance tests to be witnessed by the owner, consulting engineer, commissioning agent, installing contractor and equipment representative.
3. The entire testing facility shall be independently certified and traceable to NIST or ASME PTC 18.1 calibration procedures. Certification shall be kept on file for inspection. Hydraulic Institute standards shall be followed for the calibration procedures of all testing instrumentation.

4. Prior to factory assembly of the modular central plant, each pump or pumping system shall be performance tested as per 1.8B.
5. After factory assembly of the modular central plant, the entire system shall be hydrostatically tested with water to 150 PSIG for ANSI class 150 for a minimum of thirty (30) minutes.
6. The performance test stand must have a tank that will limit the water temperature rise from the beginning to the end of the test to 10 degrees F. Flow test data must be provided showing the tank temperature.
7. As a minimum requirement, the following test equipment must be utilized and shall be within the following accuracies:

    a. Flow meter: ±4% of rated flow, 0 to full range.
    b. Pressure gauges and sensors: ±2% based upon independent dead weight test.
    c. Tachometer: ±1% of rated speed, 0 to full range.
    d. Multimeter: for readings of supply voltage, input amperage, input kilowatts, and power factor ±1% of selected reading, 0 to full range.

1.9 SUBMITTALS

A. Submittals shall include the following as a minimum:

1. Title page with job name, location, and equipment title.
2. Table of contents with document index.
3. System design information sheet.
4. Description of system operation.
5. Modular central plant general arrangement and dimensioned drawing(s).
6. Modular central plant schematic showing all pipe sizes, location of reducers, components, specialties, and instrumentation.
7. Structural base drawings showing number and size of members.
8. Structural base deflection calculations.
9. Electrical power and control wiring drawings.
10. Pump(s) material and construction drawing(s).
11. Pump(s) performance curve showing design point.
12. A predictive pumping energy analysis showing system efficiency and kW.
13. [Complete boiler submittal.]
14. Complete variable frequency drive(s) submittal.
15. Catalog information on valves, strainers, and control components.
16. Name and address of factory trained service company.
17. Performance test procedure and performance test stand drawing.

B. Provide electronic download of submittal for approval.

C. Submittals that are generic and not specifically designed to meet the requirements of this specification section will be immediately rejected and are not acceptable.

D. Submittal shall be assembled in an organized manner with proper index.

E. If the submittal is rejected more than once, upon the third submission the manufacturer shall pay the engineer $5,000.00 for each instance for their service before the third or subsequent submittal is reviewed.

1.10 OPERATION AND MAINTENANCE MANUALS

A. Operation and Maintenance (O&M) Manuals shall include the following as a minimum:

1. Title page with job name, location, and equipment title.
2. Table of contents with document index.
3. System design information sheet.
4. Description of system operation.
5. Modular central plant general arrangement and dimensioned drawing(s).
6. Modular central plant schematic showing all pipe sizes, location of reducers, components, specialties, and instrumentation.
7. Electrical power and control wiring drawings.
8. Bill of material.
9. Modular central plant component's operation and maintenance instructions.

B. Provide electronic download of operation and maintenance manual.

C. Operation and maintenance manuals that are generic and not specifically designed to meet the requirements of this section are not acceptable.

D. Operation and maintenance manuals shall be assembled in an organized manner with proper index.

PART 2 – PRODUCTS

2.1 MECHANICAL

A. Structural Base

1. A pre-engineered structural steel base shall be provided by the modular central plant manufacturer to support all equipment and facilitate lifting, shipping, and the proper installation of the plant. All major equipment, including chiller(s), boiler(s), pump(s), and heat exchanger(s), shall be supported directly with full height structural steel members underneath the floor. All equipment shall be welded to the floor. Bolting equipment is not acceptable.

2. Structural base shall be supported on a maximum of 24" centers to the structural intermediate support channels. Structural base shall be lifted with a maximum of 4 lifting lugs. Structural base shall not deflect more than the allowable strain at the allowable design stress or 1/360th of the length of the base, whichever is less. Floor decking shall be provided and be made from solid welded ¼" hot rolled steel diamond plate sheets. Floor decking shall be 1" stitch welded, every 12" from the bottom and continuously welded from above. Floor decking shall be turned upward at the perimeter a minimum of 2" to provide for proper containment. Module sections shall be provided with clips used to pull sections together, as well as base bolts to fasten modules together. Jacking bolts shall also be present on either side of base bolts on each module section.

B. Condensing Boiler(s)

1. Boiler(s) shall be provided by the modular central plant manufacturer.
Required Equipment:
Qty (2) Aerco Benchmark Platinum 2000
Outdoor Covers

C. Instantaneous Domestic Water Heater

Qty(1) Aerco Smartplate EV

D. Pump(s) and Motor(s)

1. Hot water pump(s) and motors(s) shall be provided by the modular central plant manufacturer.
   Required Equipment:
   Qty (2) HHW Pumps 100 GPM @ 110' TDH
   Qty (1) HHW Pump: 35 GPM @ 25' TDH

E. Pipe, Manual Valves, Fittings, and Hydronic Specialties
1. All pipe, manual valves, fittings, and hydronic specialties as shown on the bid drawings within the boundaries of the plant enclosure shall be provided by the modular central plant manufacturer.
2. Refer to Section 230516 "Expansion Fittings and Loops for HVAC Piping."
3. Refer to Section 230523 "General-Duty Valves for HVAC Piping."
4. Refer to Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
5. Refer to Section 232113 "Hydronic Piping."
6. Refer to Section <Insert number> "Hydronic Specialties."
7. Pipe shall be fabricated welded steel headers using manufactured fittings conforming to ASME Section 9 Code B.31.1, 150# ANSI class. Pipe shall be sized for a maximum velocity of 10 feet/second and maximum head loss of 8.5 feet per 100 feet of pipe. Branch piping shall be sized for the design capacity of each component.
8. Grooved couplings shall be limited to connections between modules, chiller evaporator and condenser connections, and connections through enclosure walls. A modular central plant assembled entirely of grooved couplings is unacceptable.
9. All pipe on the plant skid shall be supported from the structural base and be independent of component connections. Pipe shall be isolated from supports using a non-metallic spacer. Pipe welded directly to supports is unacceptable.
10. When copper pipe is used, it shall be Type L and Pro Press fittings shall be used.

F. Actuated Control Valves

1. The modular central plant manufacturer shall provide automatic, two-way, two-position, control valves with electric actuator for the following functions, at a minimum:
   a. Boiler inlet isolation.

2. All valves indicated above shall be provided as an integral part of the modular central plant. All valves shall be designed for quarter turn operation. Three-way assemblies shall consist of two butterfly valves with integral linkage and tee. All butterfly valve shall be constructed with a ductile iron lug body, EPDM seat, stainless steel disc, 416 stainless steel shaft, and copper and brass bushings. The actuator shall be mounted on a bracket, which is coupled to the valve shaft. The actuators for two position operation shall have a split phase capacitor AC reversing motor with 25% duty. The actuators for modulating operation shall have a split phase capacitor AC reversing motor with 100% duty. Actuators shall be housed in an aluminum NEMA 4 enclosure with integral 115 VAC condensate heater. Two-position valve actuators shall have end switches. All valves shall be provided with position indication displays on HMI. All electric actuated control valves shall be provided with manual override clutch and wheel hand operator. Brass isolation valves shall be present at headers for equipment tie-in

G. Piping Insulation

1. The modular central plant manufacturer shall provide and install piping insulation with service jacket for all hot water system components which are included within the interior of the plant enclosure. Components include pumps, piping, valves, fittings, and air separators.
2. Expansion tanks/associated piping and water make-up pipes shall be uninsulated
3. Refer to Section 230716 “HVAC Equipment Insulation.”
4. Refer to Section 230719 “HVAC Piping Insulation.”
5. All piping insulation required for piping that will be installed exterior to the plant enclosure shall be provided and installed by the installing contractor.

H. Fit and Finish

1. Paint: All exposed steel components shall be cleaned, degreased and painted with a rust preventive primer, and shall be painted the same color as the base. Base and pipe components shall be mechanically cleaned per SSPC – surface preparation specification No. 2. The structural base, exposed steel, pipe, pump(s), motor(s), and valves shall be painted with a consistent color and two-part epoxy. All other major equipment shall be in original condition and not painted. Provide touch up paint as part of the shipment.
2. Tagging: All mechanical components, electrical devices (including switches and receptacles), transmitters, and control devices shall be tagged. Provide phenolic name tags with chains for all control valves and transmitters. Provide type tagging in circuit breaker panels. Tagging to be the same as shown on the submitted flow diagram. Refer to Section 230553 “Identification for HVAC Piping and Equipment.
3. Pipe marking: All pipe shall be marked with pipe markers to indicate type of fluid and flow direction. Markers to have 2 inch letters with colored background. Locate marker before and after major components. Use different colors for each system.
4. Caution markers: Provide caution markers for all hazards. Markers to include hoist ratings, shock hazards and burn hazards. Provide tagging on exterior doors for refrigerant and hearing protection.
5. Conduit and Pipe: All horizontal conduit and pipe shall be installed level. All vertical conduit and pipe shall be installed vertical. Pipe and conduit shall be arranged not to impede access. Pipe and conduit to be arranged so that it does not become a trip hazard or hazard for bumping your head.

2.2 ELECTRICAL

A. Electrical Distribution

1. A switchboard shall be provided by the modular central plant manufacturer for distribution of power for the entire skid. This shall include power for boilers, pump(s), valve(s), and controls.
2. Power Supply: 460/3/60.
3. The switchboard shall be package mounted and wired. The switchboard shall comply with all applicable codes and braced for 65,000 AIC. Switchboard shall include the following:
   a. Main plant circuit breaker.
   b. Boiler water pump circuit breakers.
   c. Load center panel board with 480v/120v step-down transformer. Serves 120/1/60 utilities on the skid enclosure.
   d. Transient Voltage Surge protection.
   e. NEC clearance required for all electrical components.
4. Conduit shall be provided for all electrical wiring.
   a. Galvanized rigid conduit with Meyers hubs shall be required conduit for outdoor use.
   b. Connectors to be watertight where conduit crosses the floor. Where the conduit is not a trip hazard raise conduit a minimum of 1-5/8” above floor using Unistrut stand off to allow drainage.

c. Control device wiring shall be run in conduit.
d. When sensor wiring does not have a junction box, run conduit to minimize exposed wire.
e. Main power wiring to be color tagged at each end. All power wiring to be phased correctly. All 115-volt wiring to be tagged at each end. All control wiring to be tagged at each end. Control wires to be continuous except across package splits. Use shielded cable as required for transmitters.

B. Variable Frequency Drives

1. The modular central plant manufacturer shall provide an ABB ACH580 variable frequency drive for each hot water pump.
2. Refer to Section 262923 “Variable-Frequency Motor Controllers”.
3. Provide with adjustable frequency, which employ a pulse width modulated inverter.
4. Each drive shall have its own, individual disconnect
5. Drives for cooling tower fans and single pump applications shall have manual by-pass starters.
6. To ensure safety of the equipment, the VFD shall include these protective features and options:
   a. NEMA 3R enclosure.
   b. Static instantaneous over-current and over-voltage trip.
   c. Static over-speed (over-frequency) protection.
   d. Line or fuse loss and under-voltage protection.
   e. Power unit over-temperature protection.
   f. Motor inverse time overload protection.
   g. Input line reactor or DC choke. AC or DC sized for a minimum of 1-½% impedance.
   h. Ammeter.
   i. Speed meter.
   j. Automatic restart after power failure or minor drive fault. The drive shall attempt a minimum of two restarts before a complete drive shut-down.
   k. Power on light.
   l. Manual speed potentiometer or control capability through the keypad.
   m. Hand/Off/Automatic Switch or Manual/Automatic Switch with start/stop pushbutton.
   n. VFD fault light and reset.
   o. The drive shall include built in diagnostics. Diagnostics shall be annunciated through the alpha numeric keypad. The drive shall be listed UL, ETL and/or CSA.
   p. All drive information shall be transmitted to the BAS through an interface with the master control panel. Multiple BAS connections are not acceptable.

2.3 CONTROLS

A. Hardware

1. All controls hardware required for the operation of the boiler/domestic water plant to be provided by the modular boiler skid manufacturer.
2. The control enclosure to conform to NEMA 3R type construction.
3. Control panel to be UL 508A listed under cULus.
4. The modular boiler plant control panel to include:
   a. Disconnect switch.
   b. Control circuit transformer 480/120 with primary and secondary fuses.
   c. System Local-Off-Remote selection.
   d. System Initialized indication.
   e. Run indication for each pump
   f. Pump failure alarm indication and reset.
   g. Lead selector for manual alternation of each pump set.

h. Lead selector for manual alternation of chillers.
i. Open-close-auto switch for each control valve.
j. Position indication for each control valve.
k. Failure alarm indication for each control valve.
l. Programmable Logic Controller (PLC).
m. Human Machine Interface (HMI).
n. Interface controls for variable frequency drives.

5. Programmable Logic Controller (PLC).
   a. Industrial PLC based control system shall be used.
   b. Manufacturer: Allen-Bradley
   c. Memory: Expandable to 64K.
   d. PLC to have built in communication for peer-to-peer, DH 485, device net or RS232.
   e. I/O points: 4096.
   f. Provide built in security with multiple levels of passwords.
   g. PLC is to be mounted in the cabinet to avoid accidental damage. Damage to the HMI shall not affect the operation of the PLC.
   h. Individual remote I/O panels to be provided for each equipment module.
   i. Commercial grade DDC systems are not acceptable.
6. All analog and digital inputs and outputs to be supplied with compatible programmable logic controller interface (either individually or in clustered groups).
7. Human Machine Interface (HMI)
   a. The operator display is to be provided in a single integrated graphic display screen with a separate processor for the controls.
   b. The HMI to be suitable for mounting in the door of a NEMA 1 enclosure so that it will maintain the enclosure's NEMA 1 rating.
   c. Mount at a suitable height to assure proper visibility and easy access by the operator.
   d. Display shall be a 15" color STN display and a resistive touch screen rated for at least 5,000,000 touches.
   e. The HMI includes the following:
      1. CPU: Minimum 5x86/133 MHz.
      2. System memory: Minimum 8 MB.
      3. Storage Memory: Compact FLASH Cartridge (minimum 8 MB). Rotating media devices and mechanical hard drives are not acceptable.
      4. Serial ports: Total 2, with at least one (1) port configurable for RS232/422/486.
      5. Ethernet port: NE 2000 compatible, 10 MBPS / 10 Base-T with RJ45 connector.
      6. Expansion Slots: Minimum one (1) PC/104 slot
   f. The HMI will be provided with a full color graphic display. A separate screen shot will be provided for the following:
      1. Master screen.
      2. Hot water schematic.
      3. Hot water pump(s).
      4. Boilers(s).
      5. Heat exchanger(s).
   g. Each screen will have a touch button to relocate the screen to any of the main screens. On each screen the touching of the individual component will take you to a component screen. The component screens to consist of:
      1. Boiler(s).
      2. Pump(s).
      3. Valve(s).
   h. The master screen will display the active tons, kW, flow and kW/ton.
   i. All screens' shots to be provided digitally to the building automation for their use in monitoring the controls.

8. Transmitters
   a. Differential Pressure Transmitters
      1. Provide One complete, self-contained, variable capacitance type differential pressure transmitters. DPT's shall be hard wired back to the control system for pump monitoring and failure sequencing.
      2. The following are to be remote mounted by others:
         Hot water system zones (at load) - ONE
      3. Manufacturer: Rosemount "Smart Transmitter" No. 2051 or equal.
      4. Wiring terminals and electronics to be in separate compartments, so the electronics remain sealed during installation.
      5. Provide reverse polarity protection to keep wiring mishaps from damaging the transmitter.
      6. Wiring Manufacturer: Belden 9320, two wire, shielded twisted cable between the control system and the transmitters, and installed separate from any conduit containing AC circuit wiring.
      7. Design range shall be as required by system. External zero and span adjustments, over-pressure to 2,000 PSI, and no humidity effects.
      8. Minimum accuracy: 0.25% of calibrated span. Includes combined effects of linearity, hysteresis and repeatability.
      9. Stability: 0.25% of upper range limit for six months.
      10. Internal mechanical linkages are not allowed in the transmitter(s).
   b. Turbine Type Flow Meters
      1. Provide ONE dual turbine, insertion type flow meter(s) for the hot water system.
      2. Manufacturer: Onicon SF1210 or equal.
      3. Wiring Manufacturer: Belden 9320, two wire, shielded twisted cable between the control system and the transmitters, and installed separate from any conduit containing AC circuit wiring.
      4. Provide 15 straight pipe diameters for installation. Provide additional straight pipe diameters as necessary.
      5. Provide hot tap installation, in order to be both insertable and removable through a ball valve when the pipe is under pressure.
   c. HOT Water Temperature Transmitters
      1. Provide TWO self-contained RTD type temperature transmitters.
      2. Manufacturer: Rosemount 248 or equal.
      3. Provide for supply and return temperatures of chilled water and hot water systems.
      4. Provide for inlet and outlet temperatures on each chiller evaporator and condenser.
      5. Provide for inlet and outlet temperatures on each heat exchanger.
      6. Power input and current output (4-20mA) through the same pair of low voltage wires.
      7. Each transmitter head to be explosion proof.
      8. Temperature Probe: Provide a platinum, wire wound, sensing element in a 316SS sheath, spring loaded, and inserted into a ¾" NPT stainless steel thermowell with explosion proof process fittings and connection head. The thermowell to penetrate one-half the pipe diameter.
      9. Temperature Range: 32-122ºF (0-50ºC) for chilled or condenser water. For applications measuring the supply and return temperatures for a loop type water system, the two probes to be a matched pair.
   d. Pressure Transmitters
      1. Provide across heat exchangers, boilers, pumps and suction diffusers. Pressure to be displayed after compensation for elevation.
      2. Manufacturer and Product: Dyer Model 626-12.

B. Control Sequencing

   1. All controls sequencing of pumps and boilers required for the operation of the modular central plant to be provided by the modular central plant manufacturer.

2. Refer to Section 230993 “Sequence of Operations for HVAC Controls”.

C. Communications

1. Modular central plant shall include full integration of all components to single BAS interface of the protocol BACnet MS/TP
2. The communication interface shall be native to the existing building management system. The installation of the communication cabling to the main building shall be included in another contract.

3. The communication interface shall transmit and receive the following points:
   a. Transmit:
      1. Hot Water System Request to Start/Stop (Digital)
   b. Receive:
      1. Equipment on/off status (Each pump boiler) (Digital)
      2. Equipment failure alarms (Each pump boiler) (Digital)
      3. Valve failure alarm (Each control valve) (Digital)
      4. Valve position (Each 2-way control valve) (Digital)
      5. Valve position (Each modulating control valve) (Analog)
      6. Pump speed (Each pump) (Analog)
      7. Pump suction pressure (Each pump) (Analog)
      8. Pump discharge pressure (Each pump) (Analog)
      9. Suction header pressure (Each connection) (Analog)
      10. Discharge header pressure (Each connection) (Analog)
      11. Hot water system flow (Analog)
      12. Hot water system zone differential pressure (Analog)
      13. Hot water system supply temperature (Analog)
      14. Hot water system return temperature (Analog)
      15. Boiler inlet temperature (Analog)
      16. Boiler outlet temperature (Analog)
      17. Boiler inlet pressure (Analog)
      18. Boiler outlet pressure (Analog)
      19. Hot water system KW (Analog)
      20. Hot water system KW/MBH (Analog)

PART 3 – EXECUTION

3.1 DELIVERY OF EQUIPMENT

A. Prior to Shipment:

Manufacturer is required to disassemble modular central plant into subassembly form. Subassemblies shall be authorized by the engineer. Manufacturer is required to weatherize subassemblies for shipment. This shall include exterior equipment and exposed sections of the subassemblies. Manufacturer is required to completely drain system of water and remove drain plugs where the possibility of freeze damage may exist.

B. Upon Delivery at Jobsite:

Reassembly of the modular central plant is the responsibility of the installing contractor. Reassembly of the subassemblies shall be coordinated between the manufacturer and installation contractor, with the manufacturer providing a technician for supervision. Installation contractor shall comply with the manufacturer’s instructions for rigging, unloading, and transporting equipment.

3.2 INSTALLATION

A. Responsibilities of the Manufacturer:

1. Provide detailed instruction manual on the reassembly of the modular central plant.
2. Provide two (2) visits for the supervision of the installation of the modular central plant.
3. Inspect installed modular central plant including field assembled components and connections.

B. Responsibilities of the Installation Contractor:

1. Install the modular central plant in accordance with the manufacturer's instructions.
2. Receive and inspect the interior and exterior of the modular central plant and report damage accordingly.
3. Provide temporary protection of individual enclosure and equipment sections from the elements before roofing and final section connections can be finalized.
4. Hoist and rig all subassemblies into final locations.
5. Reassemble equipment sections including reconnections at the section spits for the base, house enclosure, and piping. Caulking and sealing as required.
6. Level and shim structural base as needed per manufacturer's recommendations.
7. Supply and install all roof finishing materials including caulking and sundry items needed to complete modular central plant installation.
8. Realign and level all equipment within recommended tolerances including pumps and motors.
9. Check and tighten all mechanical connections that may have vibrated loose during shipment.
10. Reconnect all internal electrical power and control conduit between subassemblies as required.
11. Install equipment accessories that are shipped loose from the manufacturer.
12. Install control instrumentation that is shipped loose from the manufacturer. This may include pressure transmitters, temperature transmitters, flow meters, and the associated wiring for each device.
13. Install all field connections to the modular central plant. This shall include all system, electric, domestic water, drainage, and control connections.
14. Reassemble and install all boiler exhaust stacks.
15. Touch-up and paint scratches and minor dents that may occur during hoisting and rigging.
16. Flush and fill each system.
17. Obtain all pertinent inspections and permits required to start-up modular central plant.

3.3 DEMONSTRATION

A. Commissioning and Start-up: Manufacturer to provide two (2) visits for commissioning and start-up. Each visit will require a minimum of three (3) days on-site. Installation contractor to complete and sign off on all items listed on the start-up request form. Commissioning shall include final checkout, adjustment, and start-up of the complete system.

B. Training: Manufacturer or representative will provide a minimum of eight (8) hours of training for the owner's personnel on the operation and maintenance of the modular central plant.

3.4 WARRANTY

A. Manufacturer shall provide parts and labor warranty coverage for all components for a period of 12 months from start-up or 18 months from installation, whichever occurs first.

END OF SECTION

SECTION 23 05 13

MECHANICAL MATERIALS AND METHODS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. This Section prescribes basic materials and methods generally common to the Work of Division 23.

B. Related Requirements:

1. Division 01: General Requirements.

2. Division 07: Thermal and Moisture Protection: Polyvinyl-Chloride Roofing.

3. Division 23: Heating, Ventilating, and Air-Conditioning.

4. Division 26: Electrical.

5. Section 31 23 23: Excavation and Fill for Utilities.

1.02 SUBMITTALS

A. Provide in accordance with Division 01, Section 23 05 00 and specific requirements of each section of Division 23.

1.03 QUALITY ASSURANCE

A. Standards: Comply with applicable national, state, and local codes and standards: ASTM, ASME, and ANSI. Federal Specifications, AWWA, CISPI, NFPA, FM Global, UL, CPC (California Plumbing Code), CMC (California Mechanical Code), CSA.

B. Qualifications of Manufacturer: Products used in the Work of this Section shall be produced by manufacturers regularly engaged in manufacture of similar items and with a history of successful production as reviewed by the Architect.

1.04 COORDINATION

A. Coordinate related Work in accordance with provisions of Section 01 31 13: Project Coordination.

PART 2 – PRODUCTS

2.01 GENERAL

A. Provide the following products if they are indicated in the Contract Documents or if they are required for the proper installation, function or operation of equipment, systems or components indicated in the Contract Document.

B. Provide the following products as a complete assembly with required accessories for a complete and functioning entity in compliance with governing codes and applicable standards as specified in Section 23 05 00, manufacturer's instructions or as required.

1. Omission of minor details in the Contract Documents does not waive and/or otherwise relinquish compliance with the above requirements.

2.02 MANUFACTURERS AND MATERIALS

A. Air and Dirt Separators:

AS-1 Furnish Spirotherm, Bell and Gossett, or Wessels air and dirt separation fitting on the hot water heating system, chilled water system, and closed loop fluid cooler system. Fittings shall be fabricated steel, rated for 150 psig design pressure and selected for less than one foot of water pressure drop and entering velocity not to exceed 4 feet per second at specified GPM. Performance curves from the unit manufacturer shall be furnished as part of the submittal for each unit. Units shall be furnished with internal copper coalescing medium to facilitate maximum air and dirt separation and suppress turbulence. Units shall be furnished with galvanized steel strainer and stainless steel collector tube. Provide integral high capacity float actuated air vent at top fitting of tank. Furnish cast iron float actuated air vent rated at 150 psig, threaded to the top of the fitting. Unit shall be furnished with the bottom of the vessel extended for dirt separation with the system connection nozzles equidistant from the top and bottom of the vessel and shall include a blowdown connection and valve.

Bell and Gossett, Spirotherm, Wessels, or equal.

B. Balancing Valves:

BBV-1 Dual purpose, balancing and shut-off:

1. Direct operated Pressure Regulator: Class 200# SAG duct iron body, silicone chrome spring, stainless steel 316L Bellows/push rod.

2. Pilot operated Pressure Regulator Class 250# SAG cast iron body, cast iron cover, stainless steel valve stem, valve seat.

Sarco Type BRV 2, 71, 25P Armstrong GD 45 GP 28
Hoffman series 754

C. Boiler Blow-Off Valve:

BOV-1 Boiler blow-off (drain): Refer to Section 23 50 00.

D. Ball Valves: Bronze, 2 inches and smaller:

BV-1 Class 150, 600 psi, CWP, 2 piece construction reinforced Teflon seats, full port, adjustable packing gland, stainless ball and stem, threaded ends.

Hammond UP-8303A/UP-8305/UP-8513, NIBCO T-685-80-LF/TS-685-66-LF, Milwaukee UPBA400S/450S.

BV-2 Class 150, 600 psi CWP, 2-piece construction, bronze body, reinforced Teflon seats, adjustable packing gland, (no threaded stem designs allowed), threaded ends.

Hammond UP8301A, NIBCO T-585-70, Milwaukee BA-400.

Ball Valves in Insulated Piping: Use extended operating handle of non-thermal conducive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation and memory stops that are fully adjustable after insulation is applied. NIBCO Nib-Seal Handle.

E. Butterfly Valves:

BFV-1 Centerline Series A, 200 psi CWP tight shut-off.

1. Body: Lug type ductile iron. Suitable for bi-directional dead-end service at rated pressure without use of downstream flange.

2. Disc: Bronze, or aluminum bronze.

3. Stem: One or two-piece, 400 series stainless steel.

4. Seat and O-Rings: EPDM.

5. Upper and Lower Stem Bearings: Copper alloy or non-metallic material.

6. Operators: Valves 6 inches and smaller, with lever handle. Valves 8-inch and larger, with manual gear operator and disc position indicator.

7. Manufacturers:

   a) Valves 2.5 to 6-inch: NIBCO, Milwaukee ML-233E, Hammond 6411-03.

   b) Valves 8-inch and larger: Milwaukee ML 333E, Hammond 6411-03, NIBCO LD 2000.

8. Grooved ends: Valves 6 inches and smaller, Victaulic No. 700 or NIBCO No. GD-4765-3 with lever handles. Valves 8 inches and larger, Victaulic VIC-300 Masterseal Series 761, NIBCO No. GD-4765-5, Gruvlok Fig. 7700 Series, with manual gear operator and disc position indicator.

F. Check Valves:

1. Bronze, 2-inch and smaller:

   CHV-1 Class 125, 200 CWP swing check, Teflon disc, threaded ends.

   NIBCO T-413-Y, Milwaukee 509-T, Hammond IB-940.

CHV-2 Class 150, 300 psi, CWP, swing check, bronze, Teflon disc, threaded ends:

Stockham B-321; Crane 11TF, NIBCO T-433, Milwaukee 510-T, Hammond IB-946..

2. Cast Iron 2-1/2 and larger:

CHV-3 Class 125, 200 psi, CWP, IBBM, renewable seat and disc, bolted cap, threaded ends:

Crane 372, Stockham G-927, NIBCO T-918-B.

CHV-4 Class 125, 200 psi, CWP, IBBM, renewable seat, bronze or cast iron disc, bolted cap, flanged ends:

Stockham G-931, Crane 373, NIBCO F-918 B, Milwaukee F-2974-M, Hammond IR-1124-HI.

CHV-5 On pump discharge, Class 250, 400 psi, CWP, wafer check, center guided disc, spring actuated:

NIBCO W-960B, Keckley Co. Style CW, Val-Matic 1400

G. Expansion Tank:

ET-1 Pressurized, vertical, steel expansion tank for non-potable water systems with a replaceable, heavy duty, Butyl rubber bladder, 1 inch or 1 ½-inch NPT system connection, 3/4 inch drain, 0.302 inch-32 standard automobile tire valve type charging connection, lifting rings and a floor mounting skirt for vertical installation. The tank must be constructed in accordance with Section VIII of the ASME Boiler and Pressure Vessel Code and stamped for 125 psi working pressure. The tank must be also rated for a continuous working temperature of 240 degrees F. Provide weather and rust resistant coating.

Bell and Gossett, Wheatley, Taco, Amtrol.

H. Flow Control Valve – Manual:

FC-1 Flow control valves: Bell and Gossett Series CB circuit setter balancing valve, line size, with integral pointer (to register degree of valve opening), differential pressure meter connections with built-in check valves and lockable memory stops. Armstrong Series CBV circuit-balancing valves, Victaulic/TA Hydronics.

I. Venturi Flow Measuring Device:

FMD-1 Preso B-plus Series, Victaulic “Style 733”, Griswold QuickSet Metering Stations, venturi type flow measuring device. Provide on the main heating hot water and chilled water lines and other locations as required for balancing, as indicated, between straight sections of pipe. Upstream pipe section shall be not less than 5 diameters in length and downstream section shall be not less than 2 diameters in length. Venturis shall be furnished complete with quick disconnect valves, safety shut-off with memory valves and attached metal identification tag.

1. 2-inch or smaller shall be furnished with threaded connections.

2. 2 ½-inch or larger shall be furnished with flanged or grooved connections.

J. Electronic Flow Readout Meter:

FM-1 Flow meter shall combine the functions and ranges of several gages into a single board range meter. Meter shall function as a compound pressure gage measuring the high side and low side pressure simultaneously and display each reading in sequence. Meter shall be furnished complete with a shut-off, bypass, and blow down valve network installed on a portable meter panel. A carrying case shall be provided with storage for accessories. Meter shall automatically select the proper range, compensate for temperature, and reset itself. Memory function shall store up to 90 sets of pressure and temperature. Pressure reading shall be accurate to plus or minus 2 percent of reading from 0.01 to 150 psi. Temperature readings shall be accurate to plus or minus 0.5 degrees F and plus or minus 1.0 degree F. from minus 65 degrees F to 250 degrees F. The flow metering device shall be Hydrodata Multimeter HDM-250 as manufactured by Shortridge Instruments Inc., and shall be furnished with pressure gage, portable meter panel and with valve network, carrying case, battery charger, instruction manual and certificate of calibration, two 6 feet long by 1/2 inch OD pressure hoses with quick disconnects, two 8 foot by 1/4 inch OD drain hoses, and a set of adapters.

K. Gate Valves:

1. Bronze, 2 inches and smaller:

GV-1 Class 125, 200 psi CWP, bronze body and bonnet non-rising stem, inside screw, screw-in bonnet, solid disc, threaded ends:

Hammond IB645, Crane 1701, Milwaukee 105, American 3F, NIBCO T-113.

GV-2 Same as GV-1, except solder ends:

NIBCO S 113, Milwaukee 115, Hammond IB 647.

GV-3 Class 125, 200 psi WOG, rising stem, inside screw, screw-in bonnet, solid disc, threaded ends:

Stockham B-100, Crane 428, NIBCO T-111, Milwaukee 148, Hammond IB-640.

GV-4 Same as GV-3 except solder ends:

NIBCO S-111, Milwaukee 149, Hammond IB-635, or equal.

GV-5 Class 125, 200 psi CWP, rising stem, union bonnet, solid disc, threaded ends:

Stockham B-105, Crane 428 UB, NIBCO T-124, Milwaukee 1152, Hammond IB-617.

GV-6 Class 150, 300 psi CWP, rising steam, union bonnet, solid wedge, threaded ends:

Crane 431 UB, Stockham B-120, NIBCO T-134, Milwaukee 1151, Hammond IB-629.

2. Iron Body Gate Valves; 2 1/2 inches and larger:

GV-7 Class 125, O S and Y, IBBM, bolted bonnet, solid disc, flanged ends:

Hammond IR1140HI, Stockham G623, Crane 465-1/2, NIBCO F-617-0, Milwaukee F 2885M.

L. Heater Vent Pipe:

1. Schedule Number:

HVP-1 Shall be UL approved for service specified. Concealed heater vent pipe, including pipe in or through attic spaces, shall be City of Compton approved double wall metal vent pipe. For recessed wall heaters, furnish B.W. type. All others may be Type B, or B.W. Clearances must comply with Compton code and conditions of UL listing.

American Metal Products Co., Inc., Simpson Dura-Vent, AmeriVent, Hart & Cooley Mfg. Co., Metalbestos.

M. Liquid Level Gage:

LLG-1 Refrigerant type, carbon steel with stainless steel trim or all forged steel construction, back-seating standard design. Upper and lower valve furnished with ball check valves; 1/2 inch diameter glass on center. Four 3/16 inch diameter gage glass guard rods or slotted steel guard.

Peneberthy, Henry, Conbraco.

N. Piping:

1. Piping shall be continuously and permanently marked with manufacturer's name, type of material, size, pressure rating, and the applicable ASTM, ANSI, UL, or NSF listing. On plastic pipe, date of extrusion must also be marked.

2. Underground non-ferrous pressure pipes shall be installed with proper color tracer wires. Refer to color code provisions in Section 23 0553: HVAC Identification.

3. Refer to HVAC Piping: Section 23 2013 for heating and chilled water piping and fittings.

O. Pipe Isolators:

PLA-1 Absorption pad shall be not less than 1/2 inch thick, unloaded. Pad shall completely encompass pipe.

Holdrite, LSP, Stoneman, Potter-Roemer, Trisolator, PR-Isolator.

PLA-2 Plastic cushion to form an insulating liner and eliminate metal to metal contact when securing copper tubes and pipes in air conditioning and refrigeration insulation preventing galvanic erosion. (Acoustical Type for Sound Absorption)

Hydra-Zorb Cushion Clamps, LSP Products Group Acousto Clamp.

P. Pressure Gage: Aluminum or steel case, minimum 4-1/4 inches dial; pressure type or combination vacuum-pressure type, with provisions for field calibration. Dial indicator to indicate pressure in psi with accuracy to within plus or minus 0.5 percent of maximum dial reading. Furnish gages with restriction screw, size 60, to eliminate vibration impulses. Black case and ring, bourdon tube of seamless copper alloy with brass tip and socket. Three way gage cock, constructed of brass with stuffing box, 1/2 inch couplings, with fixed or movable cap nut to shut off pressure gage.

PG-1 Pressure type, black drawn steel case, 4 ½-inch glass dial, range approximately twice line pressure.

Marsh Keckley, Trerice, Weksler, Weiss.

Q. Safety Relief Valves:

SRV-1 Combination temperature and pressure relief type. CSA approved. Set to open at 125 psi pressure.

Watts 40L, Cash-Acme NCLX-1, Wilkins TP220.

SRV-2 Same as SRV-1, except provide on storage type water heater with anode in dip tube.

Watts 10 x L, CashAcme NCLX-1, Wilkins TP220.

R. Strainers:

STR-1 Description: Wye type with monel or stainless steel strainer cylinder (manufacturer's standard mesh), and gasketed machine strainer cap. Where indicated on Drawings, provide with valved (globe valve) blowout piping, same size as blowout plug.

1. 2-inch and smaller:
   C.M. Bailey No.100-A, 250 lb., cast iron body, threaded, Keckley 'B', Spirax Sarco Y-type.
2. 2 ½-inch and larger:
   C.M. Bailey No.100-A, 125 lb., cast iron body, flanged, or Victaulic style 732, 300 psi, ductile iron body, grooved, fusion bonded epoxy coated.
   C.M.Bailey, Armstrong, Muessco, Keckley 'A'.

STR-2 Y pattern cast iron bodies, 125 psi, monel screen. Open area at least twice the cross-sectional area of IPS pipe in which strainer is installed and may be woven wire or perforated type. Screwed ends for sizes up to 2 inches, flanged ends fusion bonded epoxy coated for 2 1/2 inches and larger perforations, in accordance with the following:

1. Other services - 16 square mesh.

Bailey No.100, Armstrong, RP&C, Keckley.

S. Temperature Control Valves:

TCV-1 Motor-operated valve, Forged brass bodies rated at no less than 400 psi working pressure; Chrome plated brass ball and stem, female NPT union ends, dual EPDM lubricated O-rings and TEFZEL characterizing disc.

Operated by Electronic Valve Actuator, manufactured, brand labeled or distributed by Belimo, TA, Honeywell.

TCV-2 Valves, automatic, electric, 3-way control.

Nickel-plated forged brass body rated at no less than 400 psi, stainless steel ball and blowout proof stem, NPT female end fittings, with dual EPDM O-ring packing design, fiberglass reinforced Teflon flow characterizing disc. [NPS ¾ inch and Smaller for Terminal Units: Nickel plated forged brass body rated at no less than 600 psi, chrome plated brass ball and blowout proof stem, NPT female fiberglass reinforced Teflon flow charactering disc.]

Belimo, Flow Control Industries, Inc., Delta Control Products

T. Thermometers

1. Industrial:

T-1 Straight type with fixed or ratable stem, extruded or cast brass or cast aluminum case and brass separable well 6 inches minimum scale, angle or straight type range 30 degrees - 240 degrees F.

Weksler, Trerice, Weiss, Ashcroft, Marshalltown.

T-2 Round type 3 ½-inch minimum dial range of 100 between 30 degrees and 155 degrees F, color coded red above 150 degrees F. Brass chrome plated case.
Ashcroft, U.S. Gage, Marsh, Weiss.

2. Remote:

T-3 Liquid-filled capillary type with bulbs as required for remote and insertion mounting dials of 3 ½-inch minimum diameter, non-ferrous internal parts, external means for re-calibration, glass or plastic lens and steel or non-ferrous case suitable for wall, duct or panel mounting range 30 degrees to 240 degrees F.

U. Valves (Air Vent):

VAV-1 Hot or chilled water air release valves shall be cast brass rated for 150 psig design pressure and 270 F operating temperature.

Spirotherm, Bell & Gossett, Taco.

VAV-2 Hot or chilled water space heating system air valve, brass with nickel trim 1/4 inch connection, disc type for manual or automatic venting.

Hoffman 500, Spirotherm, Watts.

VAV-3 Brass petcock, 1/4 inch connection by 1/4 inch copper tube to high point of coil or line by means of a tapped cap on top of 6 inches vertical nipple. Petcock to be installed approximately 5 feet 6 inches above finish floor.

Amtrol, Watts, Dole.

V. Unions:

1. Unions shall be furnished and installed in accordance with the following requirements (unless flanges are furnished):
    a. At each threaded or soldered connection to equipment and tanks, except in Freon or fuel gas, piping systems, whether indicated or not.
    b. Immediately downstream of any threaded connection to each manually operated threaded valve or cock, and each threaded check valve, yard box or access box except those in Freon piping systems, whether indicated or not.
    c. At each threaded connection to threaded automatic valves (except those in Freon piping systems) such as reducing valves and temperature control valves, whether indicated or not.
    d. If grooved piping is used, couplings shall serve as unions. Additional unions are not required

2. Unions shall be located so that piping can be easily disconnected for removal of equipment, tank, or valve.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions under which Work of this Section shall be performed. Correct conditions detrimental to proper and timely completion of Work. Do not proceed until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Provide all materials and equipment for the Work. Furnish and install necessary apparatus, parts, materials, and accessories.

B. Pipe Installation:

1. Install piping parallel to wall and provide an orderly grouping of proper materials and execution.

2. Piping shall clear obstructions, preserve headroom, provide openings and passageways clear, whether indicated or not. Verify the Work of other Divisions to avoid interference.

3. If obstructions or the Work of other Divisions prevent installation of piping or equipment as indicated by the Drawings, perform minor deviations as required by the Architect.

4. Install piping after excavation or cutting has been performed. Piping shall not be permanently enclosed, furred in, or covered before required inspection and testing is performed.

5. Exposed polished or enameled connections from fixtures or equipment shall be installed with no resulting tool marks or threads at fittings. Residue or exposed pipe compound shall be removed from exterior of pipe.

6. Piping shall be concealed in chases, partitions, walls, and between floors, unless otherwise directed or specifically noted on Drawings. When penetrating wood studs, joists, and other wood members, provide such members with reinforcement steel straps of Continental Steel & Tube Co., ULINE, Independent Metal Strap, or equal.

7. Reduce fitting where any change in pipe size occurs. Bushings shall not be furnished unless specifically reviewed by the Architect, or indicated on Drawings.

8. Piping subject to expansion or contraction shall be anchored in a manner, which permits strains to be evenly distributed. Swing joints or expansion loops shall be installed. Seismic restraints shall be installed so as not to interfere with expansion and contraction of piping. Seismic loops required at all building separations.

9. Immediately after lines have been installed, openings shall be capped or plugged to prevent entrance of foreign materials. Caps shall be left in place until removal is necessary for completion of installation.

10. Couplings shall not be installed except where required pipe runs between other fittings are longer than standard length of type of pipe being installed and except where their installation is specifically reviewed by the Architect.

11. Water piping shall be installed generally level, free of traps, unnecessary offset, arranged to conform to building requirements, clear of ducts, flues, conduits, and other Work. Piping shall be arranged with valves installed to provide for complete drainage and control of system. Piping shall not be installed which causes an objectionable noise from flow of water therein under normal conditions. Refer to Section 23 05 00.

12. Water lines may be installed in same trench with sewer lines, provided bottom of water line is 12 inches minimum above top and to the side of sewer line.

13. Hot and chilled water circulating piping installed for space heating or cooling shall pitch up to a high point at a slope of 1/4 inch in 10 feet in the direction of flow. Where supply and return lines are exposed, both lines shall pitch in same direction. Otherwise, where possible, lines shall pitch up toward compression tank.

14. Changes in pipe sizes shall be furnished with eccentric reducers, flat on top. Offsets to clear obstruction shall not be installed so as to produce air pockets.

C. Pipe Sleeves and Plates:

1. Provide and install pipe sleeves of Schedule 40 black steel pipe or Schedule 40 PVC plastic pipe in concrete or masonry walls, footings, and concrete floors below grade. Provide and install adjustable submerged deck type sleeves at locations where pipes pass through concrete floors, except concrete slab floors on grade, and at locations where soil pipe for floor type water closets passes through concrete floors.

2. Sleeves shall provide 1/2 inch clearance around pipes, except plastic pipe shall have 1-inch clearance. Caps of deck type sleeves shall be removed just prior to installation of pipe. Area around sleeves shall be smooth and without high or low spots. Sleeves in walls shall not extend beyond exposed surface of wall. Sleeves in concrete floors and walls shall be securely fastened to forms to prevent movement while concrete is being placed.

3. Piping installed on a roof shall clear the roof surface by 10 inches minimum, with or without insulation. Bottom of individual fittings may infringe on 10 inches clear space but not groups of fittings or fittings located within 27 inches of each other.

4. Stiles shall be provided to facilitate crossing of piping when parallel piping runs are laterally greater than 12 inches out-to-out, or any pipe is higher than 18 inches, and more than 40 feet long or runs between 2 or more major pieces of equipment or housings greater than 20 feet apart. Stiles shall be not less than 20 inches wide with a minimum tread depth of 10 inches. Where stiles are required, they shall be located so greatest obstructed distance is 30 feet.

5. Where pipes pass through waterproofed walls, floors, or floors on grade, sealant with Link-Seal Modular Seals, or equal, between pipe and sleeve to provide a waterproof joint. Where earth is in contact with pipe on both sides of a wall or foundation, the waterproof joint is not required. Commercial rubber compression units may be furnished instead of sealed sleeves if reviewed by the Architect.

6. A swing joint, or other required device, shall be furnished and installed in hot water lines with 10 feet of sealant or compression joint to allow for expansion.

7. Pipe sleeves shall be provided where pipes intersect footings or foundation walls and sleeve clearances shall provide for footing settlement, but not less than one inch all around pipe.

D. Welding of Pipe and Qualifications of Welder:

1. Joints above grade or accessible conduit or tunnels in steel piping may be either welded or screwed unless specifically indicated otherwise on Drawings or specified. Joints in below grade steel piping, whether in insulation or not, shall not be welded, unless otherwise indicated.

2. Welded joints in pipe shall be continuous around pipe and shall comply with ASME B31: Code for Pressure Piping, unless otherwise specified.

3. Each pipe weld shall be stamped with welder's identification mark. Welding shall be performed by welders possessing a valid certificate of qualification for welding carbon steel welding pipe in horizontal position (2G) and horizontal fixed position (5G) in accordance with the requirements of Section IX of the ASME Boiler and Pressure Vessel Code, by an Owner-recognized, DSA approved testing laboratory.

4. Before any welder performs welding on the Work, furnish the Project Inspector with a copy of welder's valid qualification papers and obtain verification. Welder qualification is not valid unless it has been issued while welder was performing work for current employer, and has performed type of work described by qualification in the preceding 3 months.

REFERENCE: ASME BOILER AND PRESSURE VESSEL CODE, SECTION VIII, UW-29 TESTS OF WELDERS AND WELDING OPERATORS.

5. Welding performed under these Specifications is subject to special tests and inspections including rigid Ultra Sonic Testing (UT) and radiographic inspection at random, in accordance with Technique for Radiographic Examination of Welded Joints by an Owner recognized, DSA approved testing laboratory.

REFERENCE: ASME BOILER AND PRESSURE VESSEL CODE, SECTION VIII, UW-51 RADIOGRAPHIC EXAMINATION OF WELDED JOINTS.

E. Unacceptable Welds and Repairs to Welding:

1. Welds containing any of the following types of imperfections shall be deemed defective Work:

a. Cracks of any type.

b. Zones of incomplete (in excess of 1/32 inch) fusion or penetration.

c. Elongated slab inclusions longer than 1/4 inch.

d. Groups of slag inclusions in welds having an aggregate length greater than thickness of parent metal in a length 12 times the thickness of the parent metal.

e. Undercuts greater than 1/32 inch.

f. Overlaps, abrupt ridges or valleys.

2. When a defective weld is detected by examination as outlined above, two additional welds shall be radiographed at locations selected by the Project Inspector. If the two selected welds demonstrate compliant welding, then the two tested welds shall be deemed to be in compliance. Welding revealed by radiographs to be defective Work shall be removed, repaired, and tested by radiograph.

3. If either of the two selected welds demonstrates welding deemed to be defective Work, all welding in that portion of the Work shall be deemed defective Work and either: all welds shall be cutout, prepare new ends for welding and weld to comply with this Specification, or radiograph all welds, removing and repairing only such welding deemed to be defective Work.

4. Repair welding shall be performed in a manner in full compliance with ASME B31. The welded joints or repairs shall be spot examined with UT or radiographic tests in accordance with foregoing requirements.

REFERENCE, ASME BOILER AND PRESSURE VESSEL CODE, SECTION VIII, UW-52.

5. Owner shall cause to be performed additional random UT and radiographic examinations of welds. Owner shall be responsible for the costs of any UT and radiographic examinations found to be in compliance with specified requirements.

6. Installer shall be responsible for the costs of UT and radiographic re-examinations of welds deemed defective Work and not in compliance with this Specification, and shall repair or replace said welds in accordance with specified requirements.

F. Welding Rods: Submit a written list of materials and proposed type of welding rods for review by the Architect.

G. Backing Rings: Backing rings may be submitted for installation provided the Product Data is submitted with the material list.

H. Qualification Tests for Low-pressure Welding:

1. Tests shall be performed on 3-inch standard weight pipe ASTM A53, Grade A, and shall be welded by acetylene and electric arc. Each sample shall consist of two pieces, each 10 inches long, with 30-degree bevel at point weld.

2. Two 20-inch samples shall be performed in the 2G and two 20-inch samples in the 5G positions, with positions defined in Section IX, ASME Boiler and Pressure Vessel Code. Welds shall have the reinforcement ground or machined flush to the surface of the pipe before testing. Samples shall be tested as full section tensile.

3. Weld shall develop a load of 90 percent of 50,000 psi, i.e., 45,000 psi or shall develop a fracture in parent metal.

4. Each qualified welder shall carry an identification card listing welder's name, date of test, and type of welding tests passed; signed by the welder and the laboratory.

5. A valid certificate of qualification issued in compliance with requirements of the ASME Boiler Pressure Vessel Code Section IX shall qualify a welder for issuance of a certificate for low-pressure pipe welding.

I. Certificates of Qualification for Welding of Unfired Pressure Vessels:

1. Certificates of qualification shall be issued by a laboratory recognized by the Owner in compliance with the requirements of the ASME Boiler Pressure Vessel Code Section IX. Qualifications shall be for both acetylene and arc welding of Schedule 40 ASTM A53, Type B, steel welded or seamless pipe in the Horizontal Position (2G) and the Horizontal Fixed Position (5G) as defined by said code.

   NOTE: Certificate described above is not valid unless it has been issued while welder was working for his current employer, and unless welder has performed type of work described by certificate in the preceding three months. Requirements for possession of a valid certificate shall not be waived for welders fabricating unfired pressure vessels when the Specifications require compliance with ASME code or when welding pipe carries working pressures greater than 75 psi and temperatures greater than 250 degrees F.

J. Pipe Joints and Connections:

1. Pipe and tubing shall be cut per IAPMO Installation Standards. Pipe shall have rough edges or burrs removed so that a smooth and unobstructed flow shall be provided.

2. Threaded Pipe: Joints in piping shall be installed according to the following service schedule:

   a. Refrigerant and Soap Piping: Litharge and glycerine, or Expando, Gasoila, or equal.

   b. All other services Furnish sealant, suitable and as reviewed by the Architect.

3. Threads on pipe shall be cut with sharp, clean, unblemished dies and shall conform to ANSI/ASME B1.20.1 for tapered pipe threads.

4. Joint compounds shall be smoothly placed on male thread and not in fittings. Threaded joints shall be installed tight with tongs or wrenches and sealant of any kind is not permitted. Failed joints shall be replaced with new materials. Installation of thread cement or sealant to repair a leaking joint is not permitted.

5. Sharp-toothed Stillson, or similar wrenches, is not permitted for the installation of brass pipe or other piping with similar finished surfaces.

K. Copper Tubing and Brass Pipe with Threadless Fittings:

1. Silver brazed joints shall be used for attaching fittings to non-ferrous metallic refrigerant piping.

2. Non-pressure gravity fed condensate lines may be soldered with 95/5 solder.

3 Silver brazing alloy, Class BCUP-5. Surfaces to be joined shall be free of oil, grease, and oxides. Socket of fitting and end of pipe shall be thoroughly cleaned with emery cloth and wiped to remove oxides. After cleaning and before assembly or heating, flux shall be installed to each joint surface and spread evenly. Heat shall be applied in

accordance with instructions in the Copper Tube Handbook issued by Copper Development Associates. Joints constructed of rough bronze fittings shall be provided as recommended by manufacturer.

4. Do not overheat piping and fittings when installing silver brazing.

5. Joints in non-ferrous piping for services not covered above shall be installed with solder composed of 95/5 tin/antimony, ASTM B32, Grade 5A. Surfaces to be jointed shall be free of oil, grease, and oxides. Sockets of fitting and end of pipe shall be thoroughly cleaned with emery cloth to remove oxides. Solder flux shall be sparingly installed and solder added until joint is completely filled. Do not overheat. Excess solder, while plastic, shall be removed with a small brush in order to provide an uninterrupted fillet completely around joint. Random inspection of joints shall be conducted by Project Inspector to ensure joints are lead-free.

6. Grooved end joints for copper piping shall be assembled in accordance with the latest manufacturer recommendations. Pipe ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove for proper gasket sealing. Grooving tools shall be as manufactured by Victaulic, RIDGID, MAG Tool, or equal.

L. Ring-Type Pipe: Joints shall be installed in accordance with manufacturer's instructions with grooved couplings, fittings and rubber rings. Couplings and pipe shall be compatible and of the same manufacturer. Rings shall be accurately located and installed by grooves in coupling. Pipe shall be installed with zero deflection unless otherwise specified. Pressure pipe shall be furnished with thrust blocks at each offset point.

M. Welded Pipe Joints:

1. Joints in welded steel pipelines shall be installed by oxyacetylene or electric arc process. Welding shall be continuous around pipe and provided as specified.

2. Butt welds shall be of the single V-type, with ends of pipe and fittings beveled approximately 37 ½ degrees. Piping shall be aligned before welding is started with the alignment maintained during welding.

3. Welds for flanges and socket fittings shall be of the fillet type with a throat dimension not less than pipe wall thickness.

N. Grooved End Pipe Joints: Grooved end joints for carbon steel piping shall be assembled in accordance with the latest manufacturer recommendations. Pipe ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to grove for proper gasket sealing. Grooving tools shall be as manufactured by Victaulic, RIDGID, MAG Tool, or equal.

O. Joints shall be Vic-Press 304TM, or equal, made with Victaulic Series ‘PFT’ tools and the appropriate sized jaw. Pipe shall be certified for use with Vic-Press 304TM system, and shall be square cut, properly deburred and cleaned, and marked at the required location to insure full insertion into the fittings and/or couplings.

P. Valves: Valves shall conform to the following:

1. Piping systems shall be furnished with valves at points indicated on Drawings and specified, arranged to provide complete regulating control of piping system throughout building and the Project site.

2. Valves shall be installed in a neat grouping, so that parts are easily accessible and maintained.

3. Pressure Independent Characterized Control valve type shall be suitable for service on which installed.

4. Valves shall be full size of line in which they are installed, unless otherwise indicated on Drawings or otherwise specified, and shall be one of types specified.

5. Provide chain operators on valves 2-inch and larger located 7 feet or more above the servicing floor level.

6. Valves for similar service shall be of one manufacturer.

7. Except where otherwise specified, valves shall be Belimo, Victaulic, Stockham, Crane, Jenkins, Milwaukee, Hammond, American Valve, NIBCO, Hoffman, or equal.

8. Ball valves below grade in yard boxes shall have stainless steel handles.

9. Temperature relief valves and combination temperature and pressure relief valves shall be as specified and furnished as set forth in this Section. Discharge pipe from relief valves shall be not less than discharge area of valve or valves it connects, based on discharge area of valves, and shall terminate as indicated and free of any traps. Valves shall be installed at following locations:

   a. A combination temperature and pressure relief valve or combination of valves on each heating hot water boiler. Temperature sending element shall extend into water inside boiler.

10. Manual air vent valve assemblies shall be installed at each high point of hot water space heating and chilled water piping systems. Valves shall discharge through 1/4 inch diameter copper tubing and drain to nearest floor sink. Automatic type air vent valve shall only be installed where specifically indicated. Radiator, convectors, and finned pipe convectors shall be fitted with packless radiator valves, angle or straight pattern. Each convector or radiator installed as part of a space hot water heating system shall be furnished with a manual-type air vent valve.

Q. Strainers: Strainers shall be installed on each water main (except for fire line) downstream of the meter, above grade, when a pressure regulator assembly is not installed. Main strainer shall be of Y-flange or groove type. On closed loop chilled and heating hot water systems pump systems, a strainer shall be installed at each pump inlet and upstream of each flow control valve assembly. The control valve assembly may include a modulating temperature control valve and a flow-limiting valve, manufactured by Griswold, AutoFlow, Flow Control Industries, Inc., or equal.

R. Hangers and Supports:

1. Piping shall be securely fastened to building structure by approved iron hangers, supports, guides, anchors, and sway braces to maintain pipe alignment to prevent sagging and to prevent noise or excessive strain on piping due to uncontrolled or

seismic movement under operating conditions. Hangers and supports shall conform to Manufacturer's Standardization Society Specification SP-69. Hangers shall be relocated as required to correct unsatisfactory conditions that may become evident when system is placed into operation. Appliances, heat exchangers, storage tanks, and similar equipment shall be securely fastened to structure in accordance with seismic requirements. Outdoor metal hangers and supports shall be hot-dipped galvanized steel, unless otherwise specified.

2. Piping shall not be supported by wire, rope, wood, plumbers' tape, or other non-recognized devices.

3. Hangers and supports shall be designed to support weight of pipe, fittings, weight of fluid and weight of pipe insulation, and shall have a minimum factor of safety of 5, based on ultimate tensile strength of material installed.

4. Burning or welding of any structural member under load is not permitted. Field welding not specified on Drawings or reviewed Shop Drawings is not permitted without review by Architect and DSA.

5. Burning holes in beam flanges or other structural members is not permitted without review by the Architect and DSA.

6. Pipe hangers on piping covered with low temperature insulation shall be installed on outside of insulation and not in contact with pipe unless otherwise detailed on Drawings. Insulation shall be protected by 18 gage galvanized steel shield, with a minimum length of 10 inches, installed completely around pipe covering between covering and hanger. Installing hangers directly on pipe and butting adjoining sections of insulation against hanger is permitted provided void and hanger rod are properly insulated and sealed so that no sweating occurs at hangers.

7. Hanger rods shall be fastened to structural steel members with suitable beam clamps. Clamps shall be Tolco, Carpenter & Patterson, Fee and Mason, or equal, as follows:

   a. Tolco I beam, Fig.62 for maximum 1000 lbs.

   b. Tolco I or WF beam, Fig. 329, for maximum of 1290 lbs.

8. Hanger rods shall be fastened to concrete inserts in concrete slabs or beams. Inserts shall be Tolco, Carpenter & Patterson, Fee and Mason, or equal, as follows:

   a. Tolco Fig.310 for maximum of 600 lbs.

   b. Tolco Fig. 309 for maximum of 1140 lbs.

9. For fastening to wood ceilings, beams, or joists, furnish Anvil Fig. 128R, Anvil Fig. 153, Tolco 78, or equal pipe hanger flange fastened with drive screws. Under wood floors, 3/8 inch hanger rods shall be hung from 2-inch by 2-inch by 1/4 inch angle clips 3-inch long, with two staggered 10d nails, clinched over joist.

10. Hanger rod sizes for copper, iron, or steel pipe: 3/8 inch for pipe sizes 1/2 inch through 2-inch, 1/2 inch for pipe sizes 3-inch, 4-inch and 5-inch, 5/8 inch for pipe size 6-inch, and 3/4 inch for 8-inch and 10-inch pipe.

11. Turnbuckles, if furnished, shall provide a load carrying capacity equal to that of the pipe hanger with which they are being installed.

12. Pipe hangers shall be of same size, or nearest larger manufactured size available, as pipe or tubing on which they are being installed.

13. Hangers, clamps, and guides furnished for support of non-metallic pipe shall be padded with 1/8 inch thick rubber, neoprene, or soft resilient cloth.

14. Where special pipe-supporting requirements in the Specifications conflict with any standard requirements specified herein, the Specification requirements shall govern.

15. Vertical Piping:

    a. Vertical pipe risers shall be securely supported with riser clamps of recognized type. Risers in reinforced concrete buildings shall be furnished with extension clamps fastened to pipe above each concrete floor slab with extended arms of clamp to rest on slab. Clamps shall be provided with lead or Teflon liners when installed on copper tubing. Clamps shall be plastic-coated when installed on non-ferrous pipe or tubing.

    b. Copper tubing in sizes 1 ½-inches and larger and steel pipelines passing up through building shall be supported at each floor of building or every 15 feet whichever is less.

    c. Copper tubing sizes 1 ¼-inch and smaller shall be supported at not intervals not more than 6 feet on center. Special provisions shall be installed for vertical lines subject to expansion and contraction caused by operating temperature differences.

    d. Vertical cast iron pipelines shall be supported from each floor and at its base. Malleable iron or steel pipe clamps with minimum thickness of 1/4 inch shall be furnished and fastened around pipe for support.

16. Horizontal Piping:

    a. Roof Mounted Piping: Pressure and non-pressure piping shall be supported from channels, stands, clamps, trapezes, rollers, or structures mounted on 100% rubber, UV resistant rooftop supports with reflective strips, Dura-Block, or equal. Roller type supports shall be provided below and above pipe to prevent its dislodgement. Bottom of pipes shall clear the roof surface by 10 inches.

        1) At PVC roofing provide walk tread, polyester reinforced, UV resistant, with surface embossment at rooftop supports. Heat welding of walk pads shall only be done by manufacturer certified installers.

            a) Sika-Sarnafil and Carlisle: Walk tread shall be no more than one inch larger than the plan area of the pipe support blocks and adhered to the roof membrane with Sika 1A or Carlisle Universal Single-Ply sealant, as applicable.

            b) Johns Manville: Walk tread shall be installed under the pipe support blocks and adhered to the blocks, if possible, and left

loose laid on top of the PVC roof system. Walk-pad shall have a minimum of 4 inches of material past perimeter on all 4 sides of block.

2) Built-up roofing: Provide APP granulated modified torch-down at each pipe support block. Torch-down shall extend 2 to 4 inches beyond the edges of the block and adhered by torch application over existing cap sheet membrane. This work shall be performed by a certified roofer.

b. Piping Mounted to Underside of Roof and Decks and from Structure:

1. Insulated steam and space heating hot water supply and return piping shall be supported with Tolco Figure 4, B-Line Figure B3140, Anvil Figure 212, or equal, steel hangers with welded eye rods to permit hinge movement at point of attachment of hangers. Hinge movement at point of support shall be provided by welded eye linked rods Tolco Figure 101L, B-Line Figure B3211X, Anvil Figure 278X, or equal.

2. Chilled water supply and return piping, condenser water piping, insulated refrigerant piping may be supported with Tolco Figure 1, B-Line Figure B3100, Anvil Figure 260, or equal, hangers with rods, turnbuckles and inserts suitable for above hangers.

c. Maximum hanger and support spacing shall conform to CPC schedule for horizontal piping installed above grade.

17. A hanger or support shall be installed close to the point of change in direction of a pipe run, in either a horizontal or vertical plane.

18. When practicable, supports and hangers for cast iron soil pipe shall be installed as close as possible to joints and when hangers or supports are not located within one foot of a branch line fitting, an additional hanger or support shall be installed at fitting.

19. In systems where grooved piping is used, couplings shall be provided with angle pattern bolt pads to comply with support and hanging requirements of ANSI/ASME B31.1, ANSI/ASME B31.9, and NFPA Pamphlet 13.

S. Flashings:

1. Each pipe, duct, or gas-fired equipment vent passing through roof shall be installed with waterproof flashing.

2. Flashing or flanges on pipes, vents, and ducts passing through a tile or slate roof shall be constructed of sheet lead. Flashing for pipes and heater vents passing through a roof shall be 4 pound soft sheet lead. Flashing and flanges for ducts and heater vents passing through exterior walls shall be 22 gage sheet metal. Flanges and flashing shall be installed waterproof at point of connection with pipe or duct. No soldered joints on roof flashings will be allowed.

3. Lead flashing and flanges shall be constructed of 4 pound sheet lead with burned joints. Flange of lead flashing or lead flange on a duct shall extend out onto roof a minimum of 12 inches from pipe or duct. Lead flashing shall extend up the pipe or duct not less than 7 inches.

4. Sheet metal flashing shall be constructed of 24 gage galvanized sheet steel. Flanges on these flashings shall extend out onto roof a minimum of 10 inches from pipe or duct. Flanges on ducts through exterior walls shall extend out from duct a minimum of 2 ½ inches. Flanges on gas-fired equipment single-wall vents shall be of ventilated type. Type B gas vents through a roof shall be furnished with non-ventilated flashing as per NFPA Pamphlet 211.

5. Cast iron, steel, brass, and copper pipe, which terminate less than 18 inches above roof, shall be furnished with a combination counter-flashing and vandal-proof hood for protection against water, birds and foreign matter. Cast iron, steel, brass and copper pipe, which does not terminate within 18 inches of roof, shall be furnished with a counter-flashing sleeve. Pipe, which terminates more than 18 inches above roof, shall be furnished with protection against entrance of water, birds, and foreign matter.

6. Counter-flashing and combination counter-flashing sleeves and vandal-proof hoods shall be cast iron, vandal-proof, threaded, sealed or approved gas-heated sleeve type. Counter-flashing sleeves on each of these items shall extend down over flashing a minimum of 3/4 inch.

7. Flashing and flanges on ducts shall be installed waterproof at point of connection to the duct by riveting and soldering. Storm collars shall be securely screwed and installed waterproof around appliance vent pipe immediately above flashing.

8. Vent piping above roof shall be furnished with a combination counter-flashing sleeve and vandal-proof hood.

T. Equipment Installation: Install roof or floor mounted equipment on level platforms, housekeeping pads or curbs and provide sound, vibration and seismic control measures per Section 23 0548, unless indicated otherwise whether indicated on drawings or not.

END OF SECTION

SECTION 23 05 48

MECHANICAL SOUND, VIBRATION AND SEISMIC CONTROL

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes: Reduction or elimination of excessive noise or vibration within building due to operation of equipment, machinery, piping, and ductwork as specified.

1. Vibration isolators.
2. Seismic restraint devices.
3. Duct silencers.
4. Acoustic housings.
5. Lining and enclosing ductwork.
6. Acoustic louvers.
7. Sound attenuation boots at supply, return, exhaust and transfer air inlets, outlets and openings.
8. Flexible ducts, conduits and piping.

B. Related Requirements:

1. Division 01: General Requirements.
2. Section 01 45 25: Testing, Adjusting, and Balancing for HVAC.
3. Section 23 05 00: Mechanical Common Work.
4. Section 23 05 13: Mechanical Basic Materials and Methods.
5. Section 23 20 13: Mechanical Above Grade Piping.
6. Section 23 30 00: Mechanical Air Distribution.
7. Section 23 80 00: Mechanical Equipment.

1.02 GENERAL REQUIREMENTS

A. Provide vibration isolators to eliminate or reduce the transmission of vibration noise to any part of building and mitigate vibration frequency and load imposed by equipment. Vibration isolators,

base frames, inertia bases and seismic restraints shall be of sufficient size, flexibility and load distribution configuration to assure that deflection, stability and seismic restraint requirements are met without permitting excessive movement when starting. For typical units, no fewer than four isolators shall be provided. Isolators shall be provided to deflect uniformly under operating gravity and equipment thrust loadings to within plus or minus 10 percent of specified deflection values.

B. Static deflections specified are based on the anticipated equipment characteristics. In the event the equipment proposed by the Contractor has characteristics other than those indicated, particularly the rated rpm, the static deflection shall be re-evaluated and the proper mountings and other devices shall be provided.

C. Where fabricated vibration isolator units are indicated, furnish manufacturer's standard catalog products with printed loading ratings or certified submittals

D. Seismic Requirements:

1. Refer to Seismic Restraint Manual: Guidelines for Mechanical Systems, published by SMACNA and approved by DSA, for minimum seismic restraints required on mechanical components design and construction details.

2. Provide seismic restraints for mechanical equipment or components specified. Where equipment is specified with proprietary names, design for seismic restraints is for first proprietary name listed.

3. Provide restraints, bracing and anchorage as required for the mechanical equipment, electrical equipment and components specified in the Contract Documents. Restraints, bracing and anchorage shall be installed to resist the total design earthquake or wind loads in any direction in accordance with CBC and SMACNA guidelines.

4. Provide restraints, bracing, and anchorage for the mechanical equipment and components.

5. For rigidly mounted liquid filled steel pipe, comply with the following:

   a. Provisions of NFPA Pamphlet 13, section for sway bracing.

   b. Provisions of NFPA Pamphlet 13, section for earthquake protection.

   c. Hanger spacing as specified in Section 23 05 13 under Hanger Spacing Schedule.

6. For flexibly mounted liquid filled steel pipe, comply with the following:

   a. Provisions of the California Building Code for flexibly mounted equipment.

   b. Provisions of VISCMA (Vibration Isolation and Seismic Control Manufacturer’s Association) Seismic Control Device Installation, Best Practices Manuals.

1.03 SUBMITTALS

A. Provide in accordance with Division 01.

1. Catalog cuts and data sheets on specific vibration isolators, seismic restraints, and anchors demonstrating compliance with the Specifications.

2. Shop Drawings for each piece of equipment including dimensions, structural member size, support point, vibration, and seismic restraints.

3. Written approval of frame design to be furnished by the equipment manufacturer.

4. Drawings indicating methods for suspension, support, seismic restraints, guides, etc., for piping, ductwork, etcetera.

5. Drawings indicating methods for isolation of pipes, ducts etcetera, piercing slabs, beams, etcetera.

B. Vibration Test Reports: At completion of installation, submit the following documents. Submission of these documents must be complete before final acceptance of vibration isolation systems is given. Assistance from the vibration isolation equipment Manufacturer may be required.

1. Complete tabulation showing for each vibration isolator:

a. Actual static deflection measured at the project.

b. Specified minimum static deflection.

2. Report certifying:

a. Each piece of operative rotating mechanical equipment does not exceed the specified vibration displacement level.

b. Each piece of isolated equipment or equipment component (ducts, pipes, conduit, etcetera) is not short-circuited by any means.

c. Requirements of Part 2 are satisfied for equipment.

1.04 QUALITY ASSURANCE

A. Standards and Codes: Comply with applicable codes and standards having jurisdiction including, but not limited to:

1. NFPA, Pamphlet 13.

2. ASHRAE Handbook: HVAC Systems and Equipment.

3. SMACNA Seismic Restraint Manual: Guidelines for Mechanical Systems.

4. California Building Code.

5. VISCMA

a. Installing Seismic Restraints for Mechanical Equipment.

b. Installing Seismic Restraints for Duct and Pipe.

B. Qualifications of Manufacturer and Installers: Comply with provisions as set forth in Section 23 0500: Common Work Results for HVAC.

PART 2 – PRODUCTS

2.01 GENERAL

A. Furnish and install vibration dampers, sound isolation pads, flexible connections and similar equipment required to prevent sound of water flowing in pipes, vibration of motors, and motor operated equipment from being transmitted to building structure; and, in case of fans, from being transmitted along ducts. Piping shall be isolated from vibrating equipment by furnishing required flexible connectors.

B. Pumps and similar motor operated equipment shall be installed on anti-vibration units.

C. Fans, except curb-mounted roof-type exhaust fans and wall mounted propeller fans, shall be installed with anti-vibration units, whether indicated on Drawings or not. Fans built into air handling units may be furnished with independent anti-vibration mountings or whole unit may be installed on an external vibration isolation system.

D. Other equipment shall be installed on anti-vibration bases, pads, or hangers, unless specifically noted otherwise on Drawings. Package units, furnished with built in anti- vibration bases, do not require unit bases unless otherwise specified.

1. Unless specified otherwise, anti-vibration bases shall be Mason Industries, M.W. Sausse & Co., the VMC Group, or equal, of the Model Number specified or indicated on the drawings. Furnished base including sub-base, shall be manufactured by same company with fan and integral motor base. Seismic restraints may be incorporated into bases or furnished separately.

2. Inertia anti-vibration bases shall conform to requirements indicated.

3. Unless noted otherwise, furnished anti-vibration bases, including supporting units for inertia bases, shall be of the spring type.

4. Selection of bases or supporting units shall be in accordance with manufacturer's recommendations based on following installed minimum effective isolation efficiencies (where not provided with each piece of equipment):

a.	Centrifugal fans, packaged fan and coil units less than 800 RPM	80 percent
b.	Centrifugal fans over 800 RPM	90 percent
c.	Centrifugal pumps	95 percent

E. Flexible duct connections shall be provided at inlet and outlets of each fan or HVAC unit, except curb-mounted roof exhaust fans whether indicated on the drawings or not.

F. Flexible pipe or conduit connections shall be provided at piping and conduit connections to HVAC units, pumps, and other moving (reciprocating or rotating) mechanical or electrical equipment provided under this Section whether indicated on the drawings or not.

G. Flexible connections for Freon piping shall be seamless flexible metal hoses of type and length recommended by manufacturer and suitable for system operating pressure.

H. Flexible connections for all other piping shall be flexible metal hose or spool type with flanged ends, unless otherwise specified. Metal hose shall be covered with protective braiding in areas where physical abrasion may occur, or for personnel safety.

I. Spool types shall be similar to American Rubber Co., Mercer Rubber Co., PROCO Products, Inc., or equal, and hose types shall be similar to DME, Inc., U.S. Flex, Pennflex, Anaconda Flexpipe, Keflex, or equal with any required modifications to meet specified requirements. Flanges shall be furnished with steel retaining rings. Units installed on discharge side of pumps shall be furnished for a suitable working pressure of not less than 100 psig, and those on suction side for working pressures of 50 psig or 30 inches Hg vacuum.

J. Units installed in cold water lines (less than 125 degrees F) shall furnish a minimum temperature rating of 180 degrees F and those installed in hot water lines (above 125 degrees F) shall be constructed of special heat resistant materials and be furnished for a minimum temperature rating of 220 degrees F, continuous operation. Units shall be able to withstand a maximum lateral deflection of 3/8 inch. Temperature and pressure ratings shall be molded into body of each spool unit so they are easily identified. Spool types shall be for straight in flow only.

K. Spool type units shall be furnished with control units comprised of a minimum of two tie-rods and anchor plates or internal guide sleeves to prevent excessive elongation or misalignment. Rubber washers shall be provided under bolt heads and rubber grommets in bolt holes to prevent any metal to metal contact between bolts and flanges.

L. Where hose type units are furnished, restraining anchors or braces shall be provided if excessive or undesirable pipe movement occurs when system is operated.

2.02 GENERAL PROPERTIES OF VIBRATION ISOLATORS.

A. Shall be provided with markings so that, after adjustment, when carrying their load, deflection under load can be verified; thus determining that load is within proper range of device and that correct degree of vibration isolation is being provided according to the design.

B. Isolators to operate in direct proportion to their load versus deflection curve. Load versus deflection curves shall be furnished by manufacturer and must be linear over a deflection range of 50 percent above design deflection.

C. Wave motion through isolator shall be reduced to following extent: Isolation above resonant frequency shall follow theoretical prediction based upon an un-dampened single degree of freedom system with a minimum isolation of 50 decibels above 150 cycles per second.

D. Vibration isolator spring diameters shall be no less than their deflected height. Furnish spring with a 50 percent overload safety factor.

E. Unless otherwise indicated, equipment installed on vibration bases shall provide a minimum operating clearance of one inch between structural steel base and floor or support base. Provide flexible connectors in piping and flexible conduit in power wiring to minimize transmission of vibration.

F. Isolators and springs exposed to weather shall be hot-dipped galvanized or powder coated after fabrication and before installation. Hot-dipped zinc coating shall be not less than two ounces per square foot by weight complying with ASTM A123. In addition, provide limit stops to resist wind velocity.

G. Where indicated, provide structural steel bases with height saving brackets, and minimum of three points of support. Isolators shall be furnished with a method for leveling.

H. Design isolators and seismic restraints for positive anchorage against uplift and overturning.

I. Provide and install, under this Section of the Specifications, structural steel required to properly support equipment and steel required to support horizontal thrust arrestors.

2.03 ISOLATOR TYPES

A. Type A: Steel Spring Isolators: Un-housed steel spring isolators, laterally stable and unrestrained. Design springs so that ratio of horizontal to vertical spring (stiffness) constant is between 0.9 and 1.3. Natural frequency of isolator must be 1/3 to 1/4 of driving frequency that is to be controlled. Isolators to provide a minimum additional travel to solid equal to 50 percent of rated deflection. Isolators shall be furnished with built-in leveling bolts complete with sound isolation pads type B. Static deflection as specified.

B. Type B: Sound Isolation Pad: Provide under each spring isolator a sound isolation pad, utilizing high quality durable neoprene pad material, loaded to 40 psi. Build sound pad up to 2 layers of 1/4 inch thick neoprene material; separate layers with a 16 gage galvanized sheet metal plate. Top layer shall provide a hardness of 40 durometers and the bottom layer shall be 40 durometers. Cold bond sound pads together and to isolator baseplate.

C. Type C: Neoprene-in-Shear Isolators: Isolator shall be neoprene-in-shear type as recommended by manufacturer. Isolator shall provide a static deflection under rated load at 1/4 inch.

2.04 EQUIPMENT FRAMES

A. Provide mounting frames and brackets to carry load of equipment without causing mechanical distortion or stress to the equipment.

B. Type A Frame: Wide flange members, rigidized structural steel frame with brackets. Maximum allowable deflection at any point on load frame relative to unloaded frame shall be 0.005 inch. Members to be constructed of wide flange beams, with a depth of not less than 1/10 of length of span between isolators. Frame shall be M.W. Sausse & Co. type RMSB-W, as basis of design, or Mason Industries, Caldyn, or equal.

C. Type B Frame: Channel members, rigidized structural steel frame with brackets. Frame to be constructed of channel steel with section depth equal to 1/10th length of longest structural member. Frame shall be M.W. Sausse & Co. type RMSB-C, as basis of design, or Mason Industries, Caldyn, or equal.

D. Type C Frame: Steel gusset or bracket welded or bolted directly to machine frame in order to accommodate isolator. Frame shall be M.W. Sausse & Co. type RMSG, as basis of design, or Mason Industries, Caldyn, or equal.

E. Type D Frame: Fabricated of rectangular channel steel forms for floating foundations to be filled with concrete on the Project site. Channel depth to be a minimum of 1/12th of longest dimension, but in no case less than 6 inches. Form shall include 1/2 inch reinforcing bars installed each way in a layer 1 ½ inches above bottom and drilled steel members with sleeves mounted below holes to receive equipment anchor bolts. Weight of concrete and frame shall be two times or more than the weight of the unit it supports. Frame shall be M.W. Sausse & Co. type RMSBI, as basis of design, or Mason Industries, Caldyn, or equal.

2.05 MATERIALS AND CONSTRUCTION

A. Duct Silencers: Provide factory fabricated duct silencers of tubular or rectangular type, for low or medium velocity service, with arrangements, sizes, and capacities as indicated on the Drawings.

1. Construction:

a. Fabricate silencers of galvanized steel with casing seams sealed or welded to be airtight at a pressure differential of 8 inches water gage between inside and outside of unit, and stiffen or brace as necessary to prevent structural failure or deformation at same condition, or audible vibration during normal operation. Outer casings of rectangular silencer modules shall be made of 22 gage galvanized steel in accordance with ASHRAE Guide of recommended construction for high-pressure rectangular ductwork. Seams shall be lock formed and mastic filled. Outer casings of tubular silencers shall be made of galvanized steel in 18 to 22 gage. Internal acoustic elements of rectangular silencers shall incorporate integral die formed entry and exit to minimize pressure drop and self-noise. Interior partitions for rectangular silencers shall be fabricated of not less than 26 gage galvanized perforated steel. Interior construction of tubular silencers shall be compatible with the outside casings.

b. Filler material shall comply with the following:

1) Fire Safety Standards: NFPA 90A and NFPA 90B.

2) Temperature: ASTM C411.

3) Air velocity: ASTM C1071, UL 181.

4) Fire Hazard Classification: ASTM E84, UL 723-Class 1, NFPA 255.

5) Corrosion Resistance: ASTM C739, C665.

6) Fungi Resistance: ASTM G21.

7) Water Vapor Sorption: ASTM C1104, less than 1 percent by weight.

8) Formaldehyde, Phenolic Resins or other Volatile Organic Compounds: 0 percent.

c. Airtight construction shall be provided by furnishing a duct sealing compound installed on the Project site. Silencers shall not fail structurally when subjected to a differential air pressure of 8 inches w.g. inside to outside of casing.

2. Acoustic Performance: Silencer ratings shall be determined in a duct-to-reverberant room test facility, which provides for airflow in both directions through the test silencer in accordance with ASTM Standard E477. The test facility shall be accredited by the National Voluntary Laboratory Accredited Program for the ASTM E477 test standard. Data from a non-accredited laboratory is not permitted. The test set-up and procedure shall eliminate effects due to end reflection, directivity, flanking transmission, standing waves, and test chamber sound absorption. Acoustic ratings shall include dynamic insertion loss (DIL) and self-noise (SN) power levels both for forward flow (air and noise in same direction) and reverse flow (air and noise in opposite directions). Data shall be for test silencers no smaller than the following cross-sections:

Rectangular, inches - 24 by 24, 24 by 30, or 24 by 36
Tubular, inches - 12, 24, 36, and 48

a. Noise reduction values (dynamic insertion loss) in decibels reference 10-12 watts, shall not be less than (of the model, size and length) indicated on Drawings.

b. Self generated noise in decibels reference 10 to 12 watts, shall not be more than of the model, size and length indicated on Drawings.

3. Aerodynamic performance: Airflow measurements shall be performed in accordance with ASTM specification E477 and applicable portions of ASME, Air Movement and Control Association (AMCA), and Air Diffusion Council (ADC) airflow test codes. Tests shall be reported on the identical units for which acoustic data is presented. Air pressure drops shall not exceed those (of the model, size and length) indicated on Drawings.

4. Certification: With submittals, provide certified test data on dynamic insertion loss, self-noise power levels, and aerodynamic performance for reverse and forward flow

test conditions. Test data shall be for a standard product. Rating tests shall be conducted in the same facility, shall utilize the same silencer, and shall be open to inspection if required by the Architect.

5. Rectangular silencers shall be Industrial Acoustics Company of the model number indicated on the drawing, as basis of design, or Vibro-Acoustics, Dynasonics, SEMCO Silentair, TranSonics, Inc., or equal.

B. Duct Liner: As indicated in Section 23 07 00: Mechanical Insulation.

C. Flexible Ducts: As indicated in Section 23 07 00: Mechanical Insulation.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Provide isolators, flexible pipe connectors, flexible electrical conduit and flexible duct connectors at all moving mechanical system components to prevent transmission of vibration noise to any part of building whether indicated on the drawings or not.

B. Install isolators to suit imposed load and the vibration frequency to be absorbed. Isolator units shall furnish adequate strength and flexibility to exhibit proper resiliency under machine load and impact without permitting excessive movement when starting.

C. Where commercial vibration isolator and seismic restraint units are specified, furnish manufacturer's standard catalog products with printed loading ratings, or provide substantiating calculations.

D. Install vibration isolators and seismic restraints in accordance with manufacturer's printed installation instructions.

E. Where equipment is belt driven and motor is not installed on equipment, install motor and driven equipment on unitized support, and install entire support isolators. Unitized support to be provided with adjustable slide rails sized for motor weight and frequency. Support shall be Mason Industries type WF, M.W. Sausse & Co., type RMSF, Caldyn, or equal.

F. Do not install any equipment, piping, conduit, ductwork, etc., that makes rigid contact with building or its structural members, unless reviewed by the Architect.

1. Coordinate Work with other trades to avoid rigid contact with building.

2. Correct, before installation, any conflict with other Work that would result in solid contact to equipment or piping due to inadequate space.

3. Obtain inspection from the Project Inspector for concealed Work before enclosure.

4. Notify manufacturer before installation of vibration isolation devices so that manufacturer may instruct and demonstrate technique for proper installation.

G. The furnishing or installation of vibration isolators must not cause any change of position or alignment of equipment, ductwork, or piping, resulting in stresses in piping or ductwork, connections, or misalignment of shafts or bearings. Equipment, piping, and ductwork shall be maintained in a rigid position during installation. Load shall not be transferred to isolator until installation is complete and under full operational load.

H. Pumps, Boilers with Integral Combustion Fans and Miscellaneous Equipment, mounted on roof or raised floors: Install each unit with its motor on a vibration isolated base utilizing type B frames, except where a type D frame is indicated on Drawings. Install steel support frame furnished by equipment manufacturer, utilizing equipment anchor bolt templates and isolator height saving brackets. Provide springs as specified for type “A” isolator; static deflection shall be a minimum of 2 inches.

I. Fans (2000 rpm or higher) Air Compressors and Miscellaneous Equipment, mounted on grade: As specified for grade mounted boilers except furnish type C isolators.

J. Boilers mounted on grade: Install each unit on concrete housekeeping pad with sound isolation pad designed for applicable equipment loading. Unit shall be fastened to housekeeping pad to prevent any movement.

K. Air Handling, Air Conditioning Units, Floor Mounted Fans, and Cabinet-Installed Fans: Install entire casing including filters, mixing box, fan section, coil sections, etc., on a continuous, integral, structural steel base, as indicated. Furnish type A, B, or C frames, reinforced as necessary to prevent distortion of frame. Furnish isolator type A; static deflection shall be a minimum of l ½ inches.

L. Suspended Fans and Air Conditioning Unit Fan Coils and Unit Ventilators: Suspend each integral unit from overhead structure on steel spring and elastomer hanger isolators. Support deflection under rated load of 3/8 inch. Provide spring static deflection as follows:

Fan RPM	Min. Deflection
200 – 400	3 inches
400 – 700	2 inches
Above 700	1 inches

M. Pipe Isolation: Where indicated and as required, furnish and support each pipe from an isolator. Isolator for the first five support locations away from vibrating equipment shall have the same deflection as the equipment isolators. After that, isolators shall be a neoprene-in-shear type of size as recommended by manufacturer; except where indicated on Drawings, pipe hanger rod shall be furnished with a steel spring isolator and elastomeric element, with lower rod capable of 30 degrees total misalignment without contact on spring housing.

N. Seismic Restraints: Floor or pad mounted equipment that do not require vibration isolators, shall be bolted to floor or other support. Floor mounted equipment with vibration isolators shall be provided with lateral and vertical restraining devices on all sides of base to restrict displacement of equipment. On all sides of suspended equipment, provide bracing for rigid supports and provide aircraft cable restraints for resiliently supported equipment.

O. Ductwork, duct acoustical lining, manual volume dampers and flexible ducts: Do not reduce length of duct runs, duct acoustical lining, manual volume dampers and flexible ducts for economy.

P. Installation of flexible ducts at air inlets and outlets: Do not attach flexible ducts directly to air inlets and outlets unless a straight, smooth and uniform air flow can be achieved with sufficient space to make an elbow with a radius of at least three times the diameter of the duct. If sufficient space is not available to make such an elbow, provide a rigid elbow or a lined plenum.

Q. Placement of Air Devices: Do not relocate air devices without the Architect's approval.

3.02 EXAMINATION

A. Arrange for the services of a certified representative of isolation manufacturer to visit the Project site for inspecting installation of devices. In the event the isolators do not meet specified requirements perform necessary revisions. Submit a written report to the Architect, signed by above representative, indicating all devices are properly installed and are operating as specified or required by isolation manufacturer.

END OF SECTION

SECTION 23 05 53

MECHANICAL IDENTIFICATION

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes: Marking and identification required on mechanical piping systems, ducts, controls, valves, apparatus, etcetera.

B. Related Requirements:

1. Division 01: General Requirements.

2. Section 23 05 13: Mechanical Basic Materials and Methods.

4. Section 23 20 13: Mechanical Above Ground Piping.

5. Section 23 30 00: Mechanical Air Distribution.

6. Section 23 80 00: Mechanical Equipment.

1.02 SUBMITTALS

A. Submit in accordance with Division 01 and Section 23 05 00:

B. Submit product data and installation instructions for each item specified.

C. Submit Samples of materials.

1.03 QUALITY ASSURANCE

A. Comply with provisions of:

1. Section 23 05 00

2. ANSI/ASME A13.1: Scheme for the Identification of Piping Systems.

3. APWA: Uniform Color Code.

Or

4. IAPMO: Uniform Plumbing Code (UPC).

PART 2 – PRODUCTS

2.01 MATERIALS

A. General: Piping systems, controls, valves, apparatus, etc., except those that are installed in inaccessible locations in partitions, walls, and floors, shall be permanently identified.

2.02 VALVES

A. Furnish prepared chart or diagram for each piping system, indicating by identifying letter or model number of each valve in the system, its location, and function.

B. Install charts in aluminum frame with clear glass front and secure on wall where designated by the Project Inspector.

C. Bind copies of each chart in operating instructions manual.

D. Provide each valve with a brass, aluminum, or plastic disc, not less than 1-1/4 inches diameter bearing engraved numbers corresponding to those indicated on chart. Fasten discs to valve with No. 14 brass wire.

E. Provide an additional tag for safety valves and other valves that could be hazardous to safety and health of occupants. Distinguish these tags from regular valve tags by color (such as yellow with black letters, and marked "Danger"); submit Sample tag to the Architect for review.

2.03 INSTRUMENTS AND CONTROLS

A. Identify panel-mounted instruments and controls with engraved bakelite nameplates permanently affixed to panel boards.

B. Identify alarm indicating devices and alarm reset devices by nameplates.

C. Identify damper motors and automatic valves, flow switches, pressure switches, etc., with embossed aluminum or plastic tape affixed to controller, indicating service and setting.

2.04 EQUIPMENT

A. Identify each major piece of equipment with engraved bakelite nameplates permanently affixed to the equipment, indicating the room numbers it services, Equipment identification designation shall be the same to its designation indicated on the “As-Built Drawings”. Room numbers in the nameplates shall correspond to the final room numbers.

2.05 ABOVE GRADE PIPE IDENTIFICATION

A. Identify pipes by means of colored labels with directional flow arrows and identification of the pipe content, in conformance to ANSI/ASME A13.1 or the UPC.

B. Materials: Precoiled acrylic plastic with clear polyester coating, all-temperature, self-adhering, as manufactured by Brady, Brimar Industries, Seton, Stranco, Inc., or equal.

C. Size:

Outside Diameter of Pipe or Insulation	Length of Color Field	Size of Letter
¾ to 1 ¼-inch	8-inch	½-inch

1 ½ to 2-inch	8-inch	¾-inch
2 ½ to 6-inch	12-inch	1 ¼-inch”
8 to 10-inch	24-inch	2 ½-inch”
over 10-inch	32-inch	3 ½-inch

D. Colors: As indicated in schedule.

E. Locations:

1. On accessible piping, whether insulated or not (including mechanical rooms, attic and ceiling spaces); except that labels shall be omitted from piping where contained material is obvious due to its connection to fixtures (such as faucets, water closets, etc.).

2. Near each valve and branch connection in such accessible piping.

3. At each pipe passage through wall or floor.

4. At not more than 20 feet spacing on straight pipe run between bands required in 2 and 3 above.

5. At each change in direction.

F. Application: Install on clean surfaces free of dust, grease, oil, or any material that will prevent proper adhesion. Replace non-adhering or curling labels with new labels, as required by the Project Inspector.

G. Schedule:

Content of Pipe	Legend	Background Color	Lettering Color
Chilled water supply	Chill water supply	Green	White
Chilled water return	Chill water return	Green	White
Heating hot water supply	Heating hot water supply	Yellow	Black
Heating hot water return	Heating hot water return	Yellow	Black
Air conditioning condensation drain	A/C condensate drain	Green	White

2.06 UNDERGROUND PIPE

A. Detectable Marking Tape:

1. Provide and install detectable marking tape along buried piping. Tape shall be specifically manufactured for marking and locating underground utilities with electronic equipment. Tape shall be acid and alkali resistant, and manufactured with integral wires or foil backing, encased with protective cladding. Tape shall be a minimum of two inches in width.

2. Manufacturer: Reef Industries, Inc., Advantage Brands, Inc., Northtown Company, Mutual Industries, Inc., or equal.

3. Detectable marking tape shall be color-coded per APWA Color Code:

a. Blue: Water.

b. Red: Electric power lines, cables, conduit and lighting cables. By Division 26.

c. Orange: Communication, alarm or signal cables. By Divisions 26 and 27.

B. Tracer Wire:

1. Solid copper wire type THWN, 12 AWG gage, with heat and moisture resistant insulation.

2.07 IDENTIFICATION OF AIR CONDITIONING EQUIPMENT

A. Provide identification markers to locate air conditioning equipment above T-bar ceilings. Install 3/4 inch to one inch diameter colored self-adhesive dots to T-bar ceiling grid indicating point of access. The following identification markers shall be recorded on the project record documents:

1. Fire Damper and Combination Fire/Smoke Fire Damper: Red.

2. Manual Volume Dampers, Relief Dampers, Motorized Volume Dampers: Blue.

a. Supply air: Full dot.

b. Return air: Half dot.

3. Fan coil unit: Green.

4. Filter Location if separate from fan coil: Yellow.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Correct detrimental conditions prior to commencing the Work of this Section. Install markers and identification tags as specified with materials and installation procedures recommended by manufacturer.

B. Place tracer wire on top of non-metal utility lines allowing some slack. Do not wrap tracer wire around pipe. Fasten tracer wire in place at approximately 10 feet on centers with non-metal ties.

C. Install underground detectable pipe marking tape continuously buried 8 to 10 inches above the buried utility pipe. Wrap tape on pipe risers up to a height of 12 inches above grade.

3.02 CLEANUP

A. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

END OF SECTION

SECTION 23 07 00

MECHANICAL INSULATION

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Condensate drain piping from air conditioning equipment.
2. High and Low temperature equipment.
3. Heating hot water supply and return piping.
4. Chilled water supply and return piping.
5. Refrigerant piping.
6. Supply and return air ducts for heating and cooling systems air ducts.

B. Related Requirements:

1. Division 01: General Requirements.
2. Section 23 05 00: Mechanical Common Work.
3. Section 23 05 13: Mechanical Basic Materials and Methods.
4. Section 23 05 53: Mechanical Identification.
5. Section 23 20 13: Mechanical Above Grade Piping.
6. Section 23 20 16: Mechanical Underground Piping.
7. Section 23 30 00: Mechanical Air Distribution.
8. Section 23 50 00: Mechanical Central Heating Equipment.
9. Section 23 80 00: Mechanical Equipment.

1.02 REFERENCES

A. American Society for Testing and Materials International (ASTM):

1. ASTM C167 - Standard Test Methods for Thickness and Density of Blanket or Batt Thermal Insulations.
2. ASTM C209 - Standard Test Methods for Cellulosic Fiber Insulating Board.
3. ASTM C302 - Standard Test Method for Density and Dimensions of Preformed Pipe-Covering-Type Thermal Insulation.

4. ASTM C411 - Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.

5. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.

6. ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.

7. ASTM C534 - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.

8. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation.

9. ASTM D5116 - Standard Guide for Small-Scale Environmental Chamber Determinations of Organic Emissions from Indoor Materials/Products.

10. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

11. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.

12. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.

13. ASTM G22 - Standard Practice for Determining Resistance of Plastics to Bacteria.

B. Underwriters Laboratories Inc.:

1. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors.

2. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials.

C. National Fire Protection Association:

1. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems .

2. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.

3. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.

1.03 SUBMITTALS

A. Submit in accordance with Division 01 and Section 23 05 00.

1. Complete material list of items to be furnished and installed under this Section.

2. Manufacturer's specifications and other data required demonstrating compliance with the specified requirements.

3. Shop Drawings, catalog cuts and manufacturer's data indicating insulation, jacketing, adhesives, and coating. Insulating materials shall be certified by manufacturer to comply with the California quality standards for insulating materials.

4. Display sample cutaway sections.

5. Manufacturer's recommended method of installation procedures, which will become part of this Section.

1.04 QUALITY ASSURANCE

A. Qualifications of Manufacturer and Installer, Materials, Fabrication, Execution, and Standard of Quality: Comply with provisions stated under Section 23 05 00: Mechanical Common Work and Section 23 05 13: Mechanical Basic Materials and Methods.

B. Test Ratings:

1. Comply with provisions stated under Section 23 05 00 and 23 05 13 with emphasis on ASTM E84, NFPA 255, or UL 723. ASTM C167, ASTM C302, UL label or listing of satisfactory test results from the National Institute of Standards and Technology, or a satisfactory certified test report from an acceptable testing laboratory. Approval by the State Fire Marshal is required.

2. Furnish labels, legibly printed with the name of the manufacturer or listings indicate that fire hazard ratings do not exceed those specified for materials proposed for installation. Flame spread index of not more than 25 and smoke developed rating not exceeding 50.

3. Tests shall be performed on each item individually when insulation, vapor barrier covering, wrapping materials, or adhesives are installed separately at the Project site.

4. Test insulation, vapor barrier covering, wrapping materials and adhesives as an assembly when they are factory composite systems.

C. Regulatory Requirements: Insulation furnished and installed under this Section shall conform to the requirements of the California Building Code Parts 4, Mechanical Code, Part 5, Plumbing Code and Part 6, Energy Code.

D. All chemically based products such as sealers, primers, fillers, adhesives, etc. shall meet the California air quality regulations.

1.05 PRODUCT HANDLING

A. Protection, Replacement, Delivery and Storage: Comply with provisions stated under Sections 23 0500: Mechanical Common Work and 23 05 13: Mechanical Basic Materials and Methods.

PART 2 – PRODUCTS

2.01 MATERIALS

A. General:

1. Piping insulating material shall be fire resistant, non-corrosive, shall not break, settle, sag, pack or disintegrate under vibration, nor absorb more than 1 percent moisture by weight.

2. Piping insulating material shall be furnished with thickness indicated in Table 1, unless otherwise noted on the drawings, and shall furnish thermal resistance in the range of R-4.0 to 4.6 in accordance with inch at 75 degrees F. For any other value of R, insulation thickness shall be calculated accordingly and submitted for review.

3. Asbestos in any quantity in insulating material is not permitted.

4. Provide insulation materials, adhesives, coatings, sealants, fitting covers, and other accessories with a fire hazard rating not to exceed 25 for flame spread, 25 for fuel contributed and 50 for smoke developed, except for materials listed as follows:

   a. Nylon anchors for installing insulation to ducts or equipment.

   b. Treated wood blocks.

5. Flame-proofing treatments subject to moisture damage are not permitted.

TABLE 1 - MINIMUM PIPING INSULATION THICKNESS (1)

Insulation Thickness Required (in inches)

Piping System Type	Temp. Range (degrees F)	Run-outs up to 2 (2)	1 and less	1.25 to 2	2.5 to 4	5 to 6	8 and larger
Space Heating Systems (Steam, Steam Condensate and Hot Water)							
Low Pres Temp	201 to 250	1.0	1.5	1.5	2.0	2.0	3.5
Hot Water	Up to 200	0.5	1.5	1.5	1.5	1.5	1.5
Service Water Heating Systems (recirculating, piping supply and return)							
Hot Water	Up to 180	0.5	1.0	1.0	1.5	1.5	1.5
Space Cooling Systems (Chilled water, Brine and Refrigerant)							
Chilled Water	40-60	0.5	0.5	0.75	1.0	1.0	1.0
Refrigerant	Below 40	1.0	1.0	1.5	1.5	1.5	1.5
Condensate Drain	½-inch Minimum insulation thickness.	0.5	0.5	0.5	0.5	0.5	0.5
From Air Conditioning Equipment:	Insulate condensate drain lines within building, in room, inside walls and above ceilings.	0.5	0.5	0.5	0.5	0.5	0.5

NOTES:

(1) For Underground HVAC Piping refer to section 23 20 16 Mechanical Underground Piping.

(2) For piping exposed to ambient temperatures, increase thickness by 0.5 inch.

(3) Run-outs to individual terminal units, not exceeding 12 feet in length.

B. Lagging Adhesives: Shall be nonflammable and fire-resistant and shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in

accordance with ASTM E84. Insulation finished with canvas shall be provided with laps adhered in accordance to manufacturer's recommendation. A finish coat of same material shall be applied to entire outer surface of lagging cloth at coverage specified by manufacturer.

C. Canvas Jackets: Furnish 6 ounce in accordance with square foot minimum, 48 by 48 thread count canvas jacketing.

D. Insulation Jackets:

1. Exterior insulation exposed to weather shall be weatherproofed with Childers aluminum jacketing as basis of design, or Pabco, RPR, or equal. Jacketing shall be manufactured from 1100, 3105 or 5010 aluminum alloy with 3/16-inch corrugations. Smooth or embossed jackets may be permitted in special situations to match an existing installation. Jacketing shall be furnished with an integrally bonded moisture barrier over entire surface in contact with insulation. A minimum thickness of 0.016 aluminum jacketing is to be provided on ducts and piping. A minimum thickness of 0.020 shall be provided on tanks, equipment, and heat exchangers.

2. Insulated elbows, of 90 degrees and 45 degrees, with a nominal iron pipe size of ½-inch to 8-inch shall be provided with Childers aluminum Ell-Jacs insulation covers as basis of design, or Pabco, RPR, or equal, manufactured from 1100 aluminum alloy of 0.024-inch thickness. Insulated elbows with a nominal pipe size of 10 inches to 18 inches shall be provided with Childers 4-piece aluminum Ell-Jacs as basis of design, or Pabco, RPR, or equal.

3. Tees, Flanges, and Valve Insulation in Conjunction with Aluminum Jacketing: Furnish Childers Aluminum Special Fabrications Insulation Covers as manufactured by Childers Products Company, Pabco, RPR, or equal.

E. Adhesives: Adhesives shall be water based, UL Classified, meet the requirements of NFPA 90A and NFPA 90B, have been tested according to relevant ASTM requirements, and be acceptable to the State Fire Marshal. Name, type and method of installation shall be submitted for review.

F. Valve and Fitting Cover: When installed in conjunction with PVC jacketing, furnish Zeston 25/50 rated polyvinyl chloride fitting covers as manufactured by Johns Manville, Knauf Insulation, Speedline, or equal.

2.02 SPACE HEATING PIPING SYSTEM

A. General: Insulate steam, steam condensate return, and hot water space heating supply and return, including valves, strainers and fittings with insulation thickness as indicated on Table 1.

B. Materials:

1. Classes of Insulation:

a. Class A: Calcium silicate molded pipe insulation, suitable for service temperature up to 1200 degrees F, ASTM C533; Johns Manville Thermo-12 Gold, or equal. Fittings: diatomaceous silica thermal insulating cement.

b. Class B: Glass fiber molded pipe insulation suitable for service temperatures up to 850 degrees F. Pipe insulation shall be one piece, preformed, and provide a minimum R factor of 4.0 at 75 degrees F mean temperature. Insulation shall be faced with all-purpose fire-retardant vapor barrier jacket. Pipe insulation shall be Johns Manville Micro-Lok, Knauf Redi-Klad 1000, Owens Corning FIBERGLAS Pipe Insulation SSL II-ASJ, or equal.

c. Class C: Flexible open-cell melamine (foam insulation) suitable for service temperature -150 degrees F to 400 degrees F. Thermal conductivity at 75 degrees F, K = 0.26. Pipe insulation, one-piece pre-formed, laminated to heavy non-reinforced PVC jacket, with locking track, factory installed to jacket, to snap insulation and jacket onto pipe. Similar to TechLite 079 Series as manufactured by Accessible Products Co., or equal. Installation shall comply with manufacturers recommendations.

d. Class D: Mineral fiber pipe insulation suitable for service temperatures up to 1,200 degrees F. Pipe insulation shall be one-piece, preformed up to 3 inches thickness, and provide a minimum R factor of 4.0 at 75 degrees F mean temperature. Insulation shall be faced with all-purpose fire-retardant vapor barrier jacket. Pipe insulation shall be 8 pounds in accordance with cubic foot density by Roxul Techton 1200, Fibrex COREPLUS 1200, Industrial Insulation Group, LLC (IIG) MinWool-1200, or equal.

2. Locations and Class of Insulation Required:

TABLE 2 – LOCATIONS AND CLASS OF INSULATION REQUIRED

LOCATION	CLASS OF INSULATION
Boiler and Mechanical Equipment Room	A, B, C, or D
All Other Locations	A, B, C, or D

3. Fittings on indoor piping shall be covered with flush, hand-wrapped Class A, B, C, or D insulation, to match the adjoining pipe insulation and covered with polyvinyl chloride fitting covers: Zeston 2000 25/50 by Johns Manville, Knauf Insulation Proto PVC Fitting Cover, Speedline Polyco Smoke Safe, or equal.

4. Adhesive: Fibrous Adhesive to bond calcium silicate to itself and non-porous surfaces.

2.03 COOLING PIPING SYSTEM INSULATION

A. General: Insulate chilled water supply and return piping and refrigerant piping.

B. Materials:

1. Classes of Insulation:

a. Class A: Expanded polystyrene pipe insulation, self-extinguishing type, either molded or extruded; Dow Chemical Co. STYROFOAM, ITW Insulation Systems XPS PIB, Foam-Control EPS, or equal.

b. Class B: Glass fiber molded pipe insulation ASTM C547. Pipe insulation shall be one piece, preformed, and provide a minimum R factor of 4 at 75 degrees F mean temperature. Insulation shall be faced with all-purpose fire-retardant vapor barrier jacket. Pipe insulation shall be Johns Manville Micro-Lok, CertainTeed Snap-On, Owens Corning FIBERGLAS SSL II-ASJ, or equal.

c. Class C: Expanded (foamed) urethane (polyurethane) or polyisocyanurate pipe insulation of self-extinguishing type molded or fabricated, Dyplast Products, LLC ISO-C1/2.0, ITW Trymer, Specialty Products & Insulation Co. Polyisocyanurate Pipe Insulation, Armacell Armalok, or equal.

d. Class D: Foamed plastic pipe insulation, self-extinguishing type, ASTM C534 Type 1 - tubular. Pipe insulation shall be one-piece preformed, flexible tubing type and provide a maximum K factor of 0.28 at 75 degrees F mean temperature. Pipe insulation shall be Armacell Armaflex, Aeroflex Aerocel, Rubatex INSUL-TUBE 180, or equal.

2. Locations and Class of Insulation Required: For thickness required, refer to Table 1 of this Section.

TABLE 3 – SERVICE, LOCATION AND CLASS OF INSULATION REQUIRED

SERVICE	LOCATION	CLASS OF INSULATION
Condensate drains from air conditioning equipment	Indoors at all locations including above ceilings and between stud walls	D
Refrigerant suction Liquid line as required	All locations except underground	D
All other piping, except underground	All locations except underground	A, B, C

3. Adhesives:

a. Polystyrene adhesives: Synthetic rubber and resin adhesives specifically designed to adhere extruded and expanded rigid polystyrene and urethane insulation to themselves and to other porous and non-porous substrates.

b. Vapor barrier laps and penetrations: Furnish protective coating and lagging adhesive on butt joints of foil-faced vapor barriers, and where pins and staples puncture facings.

2.04 LOW TEMPERATURE EQUIPMENT INSULATION

A. General:

1. Insulate water chillers, heat exchangers, air eliminators and similar equipment operating at reduced surface temperatures.

2. Do not insulate chilled water expansion tanks, and chemical feeders.

B. Materials:

1. Expanded polystyrene, 2-inch thick, self-extinguishing type, Dow Chemical Co.'s STYROFOAM, Owens Corning FOAMULAR, Foam-Control EPS, or equal, or 1½-inch thick expanded urethane (polyurethane) or polyisocyanurate, self-extinguishing type, Dyplast Products, LLC ISO-C1/2.0, ITW Trymer, Specialty Products & Insulation Co. Polyisocyanurate Pipe Insulation, or equal.

2. Canvas Jackets: 6 ounce in accordance with square foot minimum.

3. Vapor Barrier Laps and Penetrations: Furnish protective coating and lagging adhesive on butt joints of foil-faced vapor barriers and where pins and staples puncture facings.

2.05 DUCTWORK AND PLENUM INSULATION

A. General: Insulate ductwork and plenums with not less than the amount of insulation tabulated in Table 4, unless noted otherwise on the drawings. Insulation may be omitted under the following conditions:

1. Exposed return air ductwork in conditioned space.

2. Return air ductwork between wall studs inside an interior wall.

TABLE 4 - INSULATION OF DUCTS AND PLENUM

Duct Location	Insulation Type
Exposed interior round and oval supply air ductwork located at Gyms and MPR Stages	DW-1
Exposed interior rectangular supply air ductwork located at Gyms and MPR Stages	L-1
Exterior locations of Health Units and Clinics	DW-2
Exterior locations other than Health Units and Clinics	L-2
In walls, within floor/ ceiling spaces	F-1 or L-1 See note 3
Hot and cold plenums	F-2, DW-1 or L-2 See note 3
Attics, Garages, and Crawl Spaces, within unconditioned space or in basement	F-3 or L-2 See note 3

B. Insulation Types:

1. DW-1: 1-inch thick insulation sandwiched inside double-wall type ducts and fittings.

2. DW-2: 2-inch thick insulation sandwiched inside double-wall type ducts and fittings. Duct joints shall be waterproofed.

3. F-1: 1½-inch blanket fiberglass, factory-laminated with all-service jacket vapor barrier.

4. F-2: 2-inch blanket fiberglass, factory-laminated with all-service jacket vapor barrier.

5. F-3: 3-inch blanket fiberglass, factory-laminated with all-service jacket vapor barrier.

6. L-1: 1½-inch Internal duct lining.

7. L-2: 2-inch Internal duct lining.

C. Notes:

1. Minimum insulation provided shall be as required by the current California Mechanical Code Title 24 for the most restrictive condition.

2. Refer to the materials indicated in this section for external insulation & Internal Lining.

3. External insulation shall be replaced with internal duct lining (of equivalent thermal resistance value unless noted otherwise) where indicated on the drawings or specified elsewhere for sound attenuation.

4. Provide internal duct lining (1 ½-inch unless noted otherwise) where indicated on the drawings or specified elsewhere for sound attenuation.

5. All exterior insulated ductworks shall be water proofed at joints, seams and duct penetrations.

D. Materials:

1. Fire-Resistive Insulation Materials and Coatings: Submit State Fire Marshal pre-approved materials only.

2. Adhesives: See Paragraph 2.01.E for applicable products.

3. External Insulation: Provide glass fiber blankets that are factory-laminated with Foil Reinforced Kraft (FRK) vapor barrier facing; Johns Manville Microlite, Owens-Corning SOFTR Duct Wrap, Knauf Insulation Friendly Feel Duct Wrap, or equal. Provide a minimum installed R value as required by the CEC Building Energy Efficiency Standards; but not less than scheduled on Table 5:

TABLE 5

INSULATION OF DUCTS AND PLENUM INSTALLED

THERMAL RESISTANCE “R” VALUES

Type	Labeled Thickness (in inches)	Installed R Value ($hr.ft^2.°F/Btu$)
F-1	1 ½	4.2
F-2	2	5.6
F-3	3	8.3
DW-1	1	4.2
DW-2	2	5.6
L1	1 ½	6.0
L2	2	8.0

4. Internal Lining: Internal Lining shall be of the type that inhibits the growth of mold, mildew and fungi and shall not contain harmful VOC's or contain glass fiber. Approved Material:

   a. Polyester Duct Liner:

      1) Polyester duct liner shall be an engineered nonwoven, thermally bonded Polyester with a smooth and durable FSK facing.

      2) Polyester duct liner must be able to withstand a constant internal temperature up to 250°F must be compliant with Greenguard Environmental Institute and contain zero VOCs per ASTM D5116. Liner must comply with all applicable standards including ASTM E84, ASTM C411, ASTM C518, ASTM G21, NFPA 90A and 90B, and UL 181.

      3) Approved Manufacturer: Ductmate Industries "PolyArmor" duct liner or approved equal.

   b. Elastomeric duct liner:

      1) Closed-cell, sponge- or expanded-rubber materials. Elastomeric liner must be able to withstand a constant internal temperature up to 300°F and must comply with all applicable standards including ASTM E84, ASTM E96, ASTM C209, ASTM C534 - Type II sheet materials, ASTM C411, ASTM C518, ASTM G21, ASTM G22, NFPA 90A and 90B, and UL 181.

      2) Approved Manufacturer: Armacell LLC "AP Armaflex FS" duct liner or approved equal.

   c. Duct liner must be attached per manufacturer's requirements using a non-flammable, low VOC water-based adhesive. When applicable, apply a non-flammable, low VOC water-based lagging adhesive to the exposed leading edge of the insulation. Install fasteners per SMACNA HVAC Duct Liner installation instructions.

   d. Duct liner must be installed per SMACNA Manual, "HVAC Duct Construction Standards, Metal and Flexible," Third Edition unless otherwise specified.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Except as specified herein, install material in accordance with recommendations of manufacturer. Do not install insulation materials until tests specified in other sections are completed. Remove foreign material such as rust, scale, or dirt. Surfaces shall be clean and dry. Maintain insulation clean and dry at all times.

B. On cold surfaces where a vapor barrier must be provided and maintained, insulation shall be installed with a continuous, unbroken moisture and vapor seal. Hangers, supports,

anchors, or other projections that are fastened to cold surfaces shall be insulated and vapor sealed to prevent condensation.

C. Surface finishes shall be extended in such a manner as to protect raw edges, ends, and surfaces of insulation.

D. Pipe or duct insulation shall be continuous through walls, ceiling or floor openings, or sleeves; except where fire-stop or fire-safing materials are required.

E. Metal shields shall be installed between hangers or supports and the piping insulation. Rigid insulation inserts shall be installed between the pipe and the insulation shields. Inserts shall be of equal thickness to adjacent insulation and shall be vapor sealed accordingly.

F. Insulation shall not be installed in the following locations unless otherwise noted:

1. On vacuum return lines less than 50 feet long.

2. On unions, flanged connections or valve handles.

3. Over edges of any manhole, clean-out hole, clean-out plug, access door or opening to a fire damper, so as to restrict opening or identification of access.

4. Over any label or stamp indicating make, approval, rating, inspection, or similar data, unless provision is made for identification and access to label or stamp.

3.02 INSTALLATION OF COOLING PIPING SYSTEM INSULATION

A. General: Chilled water supply and return piping, refrigerant piping and condensate drain lines, after having been tested, shall be cleaned and insulated.

B. Application: Insulation on chilled water lines, refrigerant suction lines and liquid lines, if indicated, and air conditioner interior drain lines shall be jacketed with fire-resistant vapor barrier of laminated aluminum foil consisting of 2 plies with glass-yarn reinforcing. Jacket joints shall be lapped and sealed with an approved adhesive. Insulation shall be secured with aluminum bands not less than 0.005-inch thick by ¾-inches wide, spaced not over 12-inch on centers, or as recommended by manufacturer.

1. Longitudinal Seams: Butt hinged sections of covering tightly together and seal down jacket flap with adhesive, or with factory-applied, self-sealing lap with pressure-sensitive sealer protected with release paper.

2. End Joints: Wrap joint with a 3-inch wide (minimum) self-sealing tape.

3. Fittings and Valves: Fittings and valves shall be covered with same material of same thickness as pipe insulation, sealed with an approved, vapor-sealing tape or compound and covered with Johns Manville Zeston polyvinyl-chloride cover, Knauf Insulation Proto PVC Fitting Cover, Speedline Polyco Smoke Safe, or equal.

4. Pipe hangers shall be insulated or attached to pipe by an insulating insert, butted between adjoining insulation sections.

C. Additional Jackets:

1. Exposed Indoor Insulation: Cover with 26 gage galvanized sheet metal jacket to 8 feet above floors, except in mechanical equipment rooms and accessible pipe tunnels.

2. Exposed Outdoor Insulation: In addition to canvas or fiberglass cloth cover, provide 0.016-inch thick aluminum jacket with 1-inch wide aluminum bands and seals. Install appropriate jackets on valves and fittings.

3.03 INSTALLATION OF LOW-TEMPERATURE EQUIPMENT INSULATION

A. General: Provide removable sections of insulation over parts of chillers and similar equipment requiring insulation and having removable heads or sections.

B. Exterior surfaces of chilled water system expansion tanks and chilled water pumps shall be insulated with not less than 2-inch thick expanded polystyrene or fiberglass, as specified. Fill spaces between insulation and equipment with granulated polystyrene or urethane to eliminate voids. Insulation shall be secured with metal band, and covered with one inch, 20 gage hexagon galvanized mesh and ¼-inch thick insulating cement toweled smooth. Cement surface shall then be covered with 0.002-inch aluminum foil applied smoothly and secured with suitable adhesive, and a layer of 6-oz. canvas.

C. Coat joints of polyurethane insulation with neoprene based contact adhesive. Adhesives furnished shall be approved by insulation manufacturer. Fill and seal external voids and seams with non-shrinking sealant.

D. Canvas Jacket: Cover completed insulation with canvas jacket tightly pasted to covering with lagging adhesive. Lap jacket seams a minimum of 1 ½-inch. Finish entire surface of canvas jacket with one brush coat of diluted lagging adhesive, Childers CP-50A, Foster 30-36, Mon-Eco Industries (MEI) Eco-Lag Adhesive, or equal, and heavy final coat of undiluted adhesive.

3.04 INSTALLATION OF DUCTWORK AND PLENUM INSULATION

A. External Covering:

1. Before installing duct insulation, sheet metal ducts shall be clean, dry, and tightly sealed at joints and seams, inspected pressure tested, and accepted by LAUSD OAR/ Inspector.

2. Duct exterior insulation shall be firmly wrapped around ductwork with joints lapped a minimum of 2-inch. Insulation shall be securely fastened with 18 gage copper-lined steel wire, or 16 gage soft-annealed galvanized wire spaced approximately 12-inch on centers and at loose ends, presenting a neat and workmanlike appearance. Where duct width is such that wiring will not fasten insulation firmly against duct an adhesive shall be furnished to fasten insulation to duct with wiring being installed at ends of insulation segment.

3. Insulation on ductwork transporting conditioned air, both supply and return, and outside air intake ducts when pre-conditioned, shall be furnished with a factory-applied, fire-resistant vapor barrier.

4. Exposed Ducts or Plenum:

a. Install insulation to ducts or plenum furnished with butt joints, without voids and with adhesive over entire surface of duct. Cover insulation with canvas

jacket, fastened tightly to insulation with lagging adhesive. Install 2 finish coats of undiluted adhesive.

b. When installing jacket, finished covering shall be even and level, without humps, with constant diameters on round ducts maintained.

B. Interior insulation - lining:

1. Dimensions of ducts indicated are net inside dimensions and must include thickness of duct liners to obtain the required duct size.

2. Install insulation in square turns, where required, to cover interior surfaces before duct turns are installed.

3. Install lining material during fabrication of duct with sealed face only exposed to air stream.

4. Interior insulation in ducts or plenums shall not have exposed edges. Edges open to entering or leaving air streams shall be covered, secured in place and sealed with approved duct liner edge sealers.

5. Insulation shall be fastened to sheet metal with an approved fire-retardant adhesive, with minimum 90 percent coverage and edges firmly adhered.

6. Mechanical fasteners shall supplement the adhesive on top sections of ducts more than 12-inch wide and on sides of ducts more than 24-inch high and shall be spaced on 16-inch centers maximum. Fastener posts shall be cut off approximately ¼-inch from metal disc.

3.05 CLEANUP

A. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

3.06 PROTECTION

A. Protect the Work of this Section until Substantial Completion.

END OF SECTION

SECTION 23 08 00

MECHANICAL SYSTEMS COMMISSIONING

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. General requirements for Commissioning (Cx) of HVAC systems and equipment including installation, start-up, testing, documentation, and training according to the Construction Documents.
2. Standard procedures for the execution of commissioning work shall be in conformance with Division 01, Section 01 91 13: General Commissioning Requirements. Coordinate work with the Commissioning Services Provider (CxSP).

B. Related Requirements:

1. Division 01: General Requirements.
2. Section 01 45 23: Testing and Inspection.
3. Section 01 45 25: Testing, Adjusting, and Balancing for HVAC.
4. Section 01 79 00: Maintenance and Operations Staff Demonstration and Training.
5. Section 01 91 13: General Commissioning Requirements.
6. Section 23 05 00: Mechanical Common Work
7. Section 23 25 00: Mechanical Water Treatment.
8. Section 23 30 00: Mechanical Air Distribution.
9. Section 23 50 00: Mechanical Central Heating Equipment.
10. Section 23 80 00: Mechanical Equipment.
11. Section 26 05 00: Common Work Results for Electrical.
12. Section 26 05 13: Basic Electrical Materials and Methods.
13. Section 26 05 19: Low Voltage Wires (600 Volt AC).
14. Section 26 05 26: Grounding and Bonding.
15. Section 28 31 49: Carbon Monoxide Detection and Alarm Systems.
16. Section 26 05 86: Motors and Drives.
17. Section 26 08 00: Electrical Systems Commissioning.
18. Section 26 29 13: Adjustable Frequency Drives.
19. Project Commissioning Plan (CxP).

1.02 REFERENCES

A. Applicable codes, standards, and references: inspections and tests shall be in accordance with the following applicable codes and standards:

1. InterNational Electrical Testing Association – NETA.
2. National Electrical Manufacturers Association – NEMA.
3. American Society for Testing and Materials – ASTM.
4. Institute of Electrical and Electronics Engineers – IEEE.
5. American National Standards Institute – ANSI.
6. National Electrical Safety Code – NESC.
7. California Building Code – CBC.
8. California Electrical Code – CEC.
9. California Mechanical Code – CMC.
10. Insulated Cables Engineers Association – ICEA.
11. Occupational Safety and Health Administration – OSHA.
12. National Institute of Standards and Technology – NIST.
13. National Fire Protection Association – NFPA.
14. American Society of Heating and Air-Conditioning Engineers – ASHRAE

    (The HVAC Commissioning Process, ASHRAE Guideline).
15. Associated Air Balance Council – AABC (National Standards for Total System Balance).

1.03 SUBMITTALS

A. Submittals package shall include the following:

1. Commissioning required submittals in accordance with Division 01 Specification Sections.
2. Copy of the Architect's reviewed and accepted submittals to the CxSP via the OAR.
3. List of team members who will represent the Contractor in the Pre-functional Equipment Checks (PEC) and Functional Performance Tests (FPT), at least six weeks prior to the start of Pre-functional Equipment Checks.
4. Detailed manufacturer installation and start-up, operating, troubleshooting and maintenance procedures, a copy of full details of Owner-contracted tests, full factory testing reports, if any, and Warranty information, including responsibilities of Owner to keep Warranty in force clearly defined.
5. Installation and checklist documentation shipped with equipment and field checklist forms to be used by factory or field technicians.
6. Detailed manufacturer's recommended procedures and schedules for PECs, supplemented by Contractor's specific procedures, and FPTs, at least four weeks prior to the start of PEC.

1.04 MEETINGS, SEQUENCING AND SCHEDULING

A. Meetings: Attend the Cx meetings as required under Section 01 91 13 and Cx Plan.

B. Sequencing and Scheduling: The work described in this Section shall begin only after work required in related Divisions 23 and 26 Sections has been successfully completed and tests, inspection reports, and Operation and Maintenance manuals required have been submitted and accepted. The start-up and PEC shall be completed and submitted to the Owner at least two weeks prior to beginning FPT.

1. Coordinate HVAC work with the work of other trades prior to scheduling of any Cx procedures.

2. Coordinate the completion of HVAC testing, inspection, and calibration prior to start of Cx activities.

1.05 QUALITY CONTROL

A. Comply with Division 01 quality control specifications.

B. Incorporate manufacturer's recommended Cx procedures for the systems and equipment to be commissioned under this Section.

C. Comply with Section 01 45 25: Testing, Adjusting, and Balancing for HVAC.

1.06 EQUIPMENT AND SYSTEMS TO BE COMMISIONED

A. Split Systems.

B. Make Up Air Units, with gas fired heat and evaporative cooling.

C. Fan Coil Units.

D. Variable Volume and Temperature System.

E. Exhaust Fans.

F. Ventilators.

G. Pumps.

H. Water Heaters, Gas and Electric.

I. Boilers.

J. Air Handling Units.

K. Air Conditioning Units.

PART 2 – PRODUCTS

2.01 TEST EQUIPMENT

A. Equipment to be utilized in the commissioning process shall meet the following requirements:

1. Provide test equipment as necessary for the testing of the equipment and systems to be commissioned.

2. Provide testing equipment and accessories that are free of defects and certified for use.

3. Provide testing equipment with current calibration labels as per NIST Standards.

4. Equipment shall be calibrated on the manufacturer’s recommended intervals with calibration tags affixed to the instrument. In the absence of calibration tags,

calibration documentation shall be submitted to the CxSP at least thirty days prior to use; this documentation shall include description and serial number of instrument and calibration data and date.

5. Testing equipment shall be maintained in good operating condition for the duration of the project.

PART 3 – EXECUTION

3.01 COMMISSIONING PROCESS REQUIREMENTS

A. Work to be performed prior to commissioning:

1. Complete phases of the work so the system(s) can be started, tested, adjusted, balanced, and otherwise commissioned.

2. If modifications or corrections to the installed system(s) are required to bring the system(s) to acceptance levels due to Contractor's incorrect installation or defective materials, such modifications shall be made at no additional cost to the Owner.

3. Normal start-up services required to bring each system into full operational state:

a. Testing, motor rotation check, control sequences of operation, full and part load performance.

b. Commissioning shall not start until each system is complete and start-up has been performed.

B. Pre-Commissioning responsibilities:

1. Inspection, calibration and testing of the equipment required to commission the following systems:

a. HVAC System(s).

C. Commissioning Process Requirements:

1. Refer to Section 01 91 13: General Commissioning Requirements and related Sections for information on meetings, start-up plans, Pre-Functional and FPT, operations and maintenance data, training requirements, and other Cx activities.

3.02 PREPARATION

A. Provide certified HVAC technicians as required, with tools and equipment necessary to perform Cx activities specified.

B. Provide certified testing agency personnel and equipment factory representatives as require in the Cx plan and other related Sections.

C. Verify that work required in this Section and in Section 01 91 13 is complete prior to starting of FPT.

D. Verify that complete operational manuals have been reviewed and accepted by the CxSP as specified before starting FPT.

3.03 TESTING

A. Testing procedures shall include the following minimum information:

1. Test number.

2. Equipment used for the test, with manufacturer and model number and date of last calibration.
3. Date and time of the test.
4. Indication of whether the record is for a first test or retest following correction of a problem or issue.
5. Identification of the system, subsystem, assembly, or equipment.
6. Conditions under which the test was conducted, including (as applicable); ambient conditions, set points, override conditions, status, and operating conditions that impact the results of the test.
7. Systems and assemblies test results and performance and compliance with contract requirements.
8. Issue number, if any, generated as the result of the test.
9. Name(s) and signature(s) of witnesses and the person(s) performing the test.

B. Contractor shall participate and perform Cx related testing requirements as specified.

C. General Requirements for Mechanical, Controls, and Testing and Balance:

1. Construction and Acceptance Phases:
   a. Provide assistance to CxSP in preparing FPT procedures specified. Sample test forms are included in the project Cx Plan.
   b. Develop full startup and initial checkout plan using manufacturer's start-up procedures and Cx checklists for commissioned equipment. Submit to CxSP for review and approval prior to startup.
   c. During startup and initial checkout process, execute mechanical-related portions of PEC for the equipment and systems to be commissioned.
   d. Perform and clearly document completed startup and system operational checkout procedure. Providing four copies of the results to the Owner.
   e. Resolve any open punch list items before FPT. Air testing and balance shall be completed with discrepancies and problems remedied before FPT of respective air -related systems.
   f. Provide skilled technicians to execute starting of equipment and to execute PFT. Ensure that technicians are available and present during agreed upon schedules and for sufficient duration to complete necessary tests, adjustments, and solutions to identified problems.
   g. Maintain a log of events and issues of tests and related Cx activities. Submit handwritten reports of discrepancies, deficient or uncompleted work by others, contract interpretation requests, and lists of completed tests as specified.
   h. Correct open issues and re-test as needed to prove compliance with system operational standards.
   i. Prepare Operation and Maintenance Manuals and provide training for the Owner maintenance personnel and end-users per Section 01 79 00.
   j. Coordinate with equipment manufacturers to determine specific requirements to maintain validity of Warranty and notify the Owner.

k. Execute simulated seasonal FPT, witnessed by the Owner and the CxSP, as specified. Document results and perform corrections as needed for system acceptance and make necessary adjustments to Maintenance and Operations Manuals and Record Drawings.

3.04 SENSOR CALIBRATION

A. Field-installed temperature, relative humidity, CO_2, pressure sensors, pressure gages, and actuators (dampers and valves) shall be calibrated using the methods described below. Calibration procedures shall be documented during execution of the Start-up and the PEC. Alternate methods may be used, if approved by the CxSP.

B. Test instruments shall have had a NIST certified calibration within the last 12 months. Sensors installed in the unit at the factory with provided calibration certification need not be field calibrated.

C. Sensors:

1. Verify that sensor locations are appropriate and away from causes of erratic operation.

2. Verify that sensors with shielded cable are grounded only at one end.

3. For sensor pairs that determine a temperature difference, make sure they are reading within 0.2 degrees F of each other.

4. For sensor pairs that determine a pressure difference, make sure they are reading within 2 percent of each other.

5. Calibration: Put the equipment in operation. Make a reading with a calibrated test instrument within six inches of the site sensor. Verify that the sensor reading (via the permanent thermostat or gage) is within the tolerance listed in the table below of the instrument-measured value. If not, calibrate or replace sensor.

6. Tolerances:

Sensor	Required Tolerance (+/-)
AHU wet bulb or dew point	2.0 degrees F
Outside air, space air, duct air temps	0.4 degrees F
Watt-hour, voltage, and amperage	1 percent of design
Pressures, air, water and gas	3 percent of sensor range (inc. design value)
Flow rates, air	10 percent of sensor range (inc. design value)
Flow rates, natural gas	5 percent of sensor range (inc. design value)

Relative humidity	4 percent
CO_2 monitor	100 ppm
Sound level	5 db - Type 1 meter (Per Calibrator Mfg.)
Domestic Hot Water Temperature	1.5 degrees F
Domestic Hot Water Pressures Water and Gas	3 percent of sensor range (inc. design value)
Flow Rates, Domestic Water	4 percent of sensor range (inc. design value)
Flow Rates	5 percent of sensor range (inc. design value)

3.05 ADJUSTING

A. Perform work required to rectify installations not meeting contract requirements at no additional cost to the Owner.

B. Corrective work shall be completed in a timely manner to permit completion of the Cx process.

C. If systems' Cx deadline, as defined in the Project Schedule, goes beyond the scheduled completion without resolution of the problem(s), the Owner reserves the right to obtain supplementary services or equipment to resolve the problem.

3.06 TRAINING

A. Provide training plan for systems to be commissioned as required in applicable Division 23 specification sections and Section 01 79 00.

END OF SECTION

SECTION 23 08 13

MECHANICAL ENVIRONMENTAL CONTROLS AND ENERGY MANAGEMENT SYSTEMS COMMISSIONING

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. General requirements for the Commissioning (Cx) of the Environmental Controls and Energy Management System (ECEMS), and interfacing with other systems such as, lighting controls and HVAC systems interconnection, including installation, start-up, testing and documentation according to Construction Documents and Commissioning Plan (CxP).

2. Standard procedures for the execution of commissioning work shall be in conformance with Division 01, Section 01 91 13: General Commissioning Requirements. Coordinate work with the Commissioning Services Provider (CxSP).

B. Related Requirements:

1. Division 01: General Requirements.

2. Section 01 45 23: Testing and Inspection.

3. Section 01 77 00: Contract Closeout.

4. Section 01 79 00: Maintenance and Operations Staff Demonstration and Training.

5. Section 01 91 13: General Commissioning Requirements.

6. Section 23 05 00: Mechanical Common Work.

7. Section 23 05 13: Mechanical Basic Materials and Methods.

8. Section 23 08 00: Mechanical Systems Commissioning.

9. Section 23 09 23: Mechanical Environmental Controls and Energy Management Systems.

10. Section 23 25 00: Mechanical Water Treatment.

11. Section 23 30 00: Mechanical Air Distribution.

12. Section 23 50 00: Mechanical Central Heating Equipment.

13. Section 23 70 00: Mechanical Air Handling Units.

14. Section 23 80 00: Mechanical Equipment.

15. Section 26 05 00: Common Work Results for Electrical.

16. Section 26 05 13: Basic Electrical Materials and Methods.

17. Section 26 05 19: Low Voltage Wires (600 Volt AC).

18. Section 26 05 26: Grounding and Bonding.

19. Section 26 05 86: Motors and Drives.

20. Section 26 08 00: Electrical Systems Commissioning.
21. Section 26 24 19: Motor Control Centers and Motor Control Devices.
22. Section 26 29 13: Adjustable Frequency Drives.
23. Project Commissioning Plan.

1.02 REFERENCES

A. The latest version of applicable codes, standards, and references: Inspections and tests shall be in accordance with the following applicable codes and standards, except as provided otherwise herein:

1. National Electrical Manufacturers Association – NEMA.
2. American Society for Testing and Materials – ASTM.
3. American National Standards Institute – ANSI.
4. California Electrical Code – CEC.
5. Occupational Safety and Health Administration – OSHA.
6. National Institute of Standards and Technology – NIST.
7. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE). – Building Management and Energy Management Systems Commissioning, ASHRAE Guideline.
8. California Building Code – CBC.
9. California Mechanical Code – CMC.
10. InterNational Electrical Testing Association (NETA) Acceptance Testing.

1.03 SUBMITTALS

A. Submittals shall include the following:

1. Required Cx submittals in accordance with Division 01 Specifications.
2. Copy of the Architect's reviewed and accepted submittals to the CxSP via the OAR.
3. List of team members who will represent the CONTRACTOR in the Pre-functional and Functional Performance Testing, at least two weeks prior to the start of Pre-functional Equipment Checks.
4. Detailed manufacturer installation and start-up, operating, troubleshooting and maintenance procedures, checklist documentation and field checklist forms to be used by factory or field technicians, and a copy of full details of OWNER-contracted tests, full factory testing reports, if any, and Warranty information, including responsibilities of OWNER to keep Warranty in force, clearly defined.
5. Detailed manufacturer's recommended procedures and schedules for Pre-functional Equipment Checks, supplemented by CONTRACTOR's specific procedures, and Functional Performance Tests, at least four weeks prior to the start of Pre-functional Performance Tests.
6. System logic documentation and sequence of operations for review and approval.
7. Provide Level 1 passwords.

8. After facility's commission is complete, submit completed Pre-functional Equipment Checklists and Functional Performance Test checklists organized by system and by subsystem. Bind information in a single package. The results of failed tests shall be included along with a description of the corrective actions taken.

1.04 MEETINGS, SEQUENCING AND SCHEDULING

A. Meetings: Attend Cx meetings as required under Section 01 91 13, any other related Sections and the CxP.

B. Sequencing and Scheduling: The work described in this Section shall begin only after work required in related Division 23 and 26 Sections have been successfully completed, and tests, inspection reports and Operation & Maintenance manuals required have been submitted and reviewed. The start-up and Pre-functional Equipment Checklists shall be completed and submitted to the OWNER's Authorized Representative (OAR) prior to the Functional Performance Tests.

1. Coordinate electrical work with the work of other trades prior to scheduling of any Cx procedures.

2. Coordinate the completion of electrical testing, inspection, and calibration prior to start of Cx activities.

3. Cx activities shall be scheduled in accordance with project's Section 01 91 13 and Cx plan.

1.05 QUALITY CONTROL

A. Comply with OWNER's Quality Control Specifications.

B. Incorporate manufacturer's recommended Cx procedures for the systems and equipment to be commissioned under this Section.

C. Typical quality control procedures include but are not limited to the following:

1. Attend CxSP progress and coordination meetings.

2. Establish trend logs of system schedules as required in Section 23 09 23.

3. Demonstrate system operation and compliance with contract documents.

4. Manipulate systems and equipment to facilitate testing.

5. Provide instrumentation necessary for verification and performance testing.

D. Provide ECEMS technician(s) to work at the direction of the CxSP for software optimization assistance for a minimum of 8 hours. Refer to Part 3 for a description of the software optimization.

E. Compensation for Retesting: Compensate OWNER for site time necessitated by incompleteness of systems or equipment at time of Functional Performance Testing (FPT). Testing failures, which require on-site time for retesting, will be considered actual damages to the OWNER. Parties under contract with the OWNER who are affected by the retesting shall be included in the contract modification.

F. Allow sufficient time before final commissioning dates to complete electrical testing, inspection, and calibration to avoid delays in the commissioning process.

G. During the commissioning activities, provide labor and materials to make corrections when required, without undue delay.

1.06 COORDINATION

A. Coordinate the completion of electrical testing, inspection, programming and calibration prior to start of commissioning activities.

B. Coordinate factory field-testing per the requirements of this Section.

C. Coordinate commissioning efforts with CxSP prior to commencing any activities.

PART 2 – PRODUCTS

2.01 TEST EQUIPMENT

A. Equipment to be used in the commissioning process shall meet the following requirements.

1. Provide test equipment as necessary for start-up and commissioning of the EMS system.

2. Provide testing equipment and accessories that are free of defects and are certified for use.

3. Provide testing equipment with current calibration labels as per NIST Standards; Equipment shall be calibrated on the manufacturer's recommended intervals with calibration tags affixed to the instrument. In the absence of calibration tags, calibration documentation shall be submitted to the CxSP at least thirty days prior to use; this documentation shall include description and serial number of instrument and calibration date and time.

4. Testing equipment shall be maintained in good operating condition for the duration of the project.

5. Testing equipment shall be UL Listed.

B. Instrumentation required to verify readings and test the system and equipment performance shall be provided by the CONTRACTOR and made available to CxSP. Generally, no testing equipment will be required beyond that required to perform CONTRACTOR's work under contract documents.

2.02 TESTING AND AIR BALANCING AND COMMISSIONING

A. Provide a portable operator's terminal or hand-held device to facilitate testing, adjusting, and calibration of controls. This device shall support functions and allow querying and editing of parameters required for proper calibration and start up.

B. Connections shall be provided local to the device being calibrated. For instance, for VAV boxes, connection of the operator's terminal shall be either at the sensor or at the terminal box. Otherwise, a wireless system shall be provided to facilitate this local functionality.

PART 3 – EXECUTION

3.01 COMMISSIONING PROCESS REQUIREMENTS

A. Work prior to commissioning:

1. Complete phases of the work so the system(s) can be started, tested, adjusted, balanced, and otherwise commissioned.

2. If contractual modifications are required to bring the system(s) to acceptance levels, such modifications shall be made at no additional cost to the OWNER.

3. Normal start-up services required to bring each system into full operational state:

a. Testing, motor rotation check, control sequences of operation, full and part load performance.

b. Commissioning will not start until each system is complete and start-up has been performed.

B. Pre-Commissioning responsibilities:

1. Inspection, calibration and testing of the equipment required to commission the following systems:

a. Environmental Controls and Energy Management Systems.

b. Interface and connections of EMS system with lighting controls, electric utility meter, gas meter, photo voltaic system, or as otherwise indicated in contract documents.

C. Commissioning Process Requirements:

1. Refer to Section 01 91 13: General Commissioning Requirements and related Sections for information on meetings, start-up plans, Functional Performance Testing (FPT), operations and maintenance data, training requirements, and other Commissioning activities.

3.02 PREPARATION

A. Provide certified EMS technicians as required, with tools and equipment necessary to perform Cx activities specified.

B. Provide certified testing agency personnel and equipment factory representatives as required in the Cx plan and other related Sections.

C. Verify that work required in this Section and in Section 01 91 13 is complete prior to starting of FPT.

D. Verify that complete operational manuals have been reviewed and accepted by the CxSP as specified before starting FPT.

3.03 START-UP, TESTING, ADJUSTING, AND CALIBRATION

A. Work or systems installed shall be fully functioning prior to Demonstration and Acceptance Phase. Start, test, adjust, and calibrate work as described below:

1. Inspect the installation of devices. Review the manufacturer's installation instructions and validate that the device is installed in accordance with them.

2. Verify proper electrical voltages and amperages and verify that circuits are free from faults.

3. Verify integrity/safety of electrical connections.

4. For AHUs that use a throttled outside air damper position when minimum outside air is required, mark the minimum outside air damper position.

5. Coordinate with testing and air balance (TAB) subCONTRACTOR to obtain, Cx and fine-tune control settings that are determined from balancing procedures. Record the following control settings as obtained from TAB CONTRACTOR, and note any TAB deficiencies in the ECEMS Start-up report:

a. Optimum duct static pressure setpoints for VAV air handling units.

b. Minimum outside air damper settings for air handling units.

c. Optimum differential pressure setpoints for variable speed pumping systems.

d. Calibration parameters for flow control devices such as VAV boxes and flow measuring stations.

6. Test, calibrate, and set digital and analog sensing and actuating devices. Test equipment shall be 50 percent more accurate that the filed device over the same range. Calibrate each instrumentation device by making a comparison between the ECEMS display and the reading at the device. (e.g., if field device is plus or minus 0.5 percent accurate, test equipment shall be plus or minus 0.25 percent accurate over the same range). Record the measured value and displayed value for each device in the ECEMS start-up report.

7. Check and set zero and span adjustments for transducers and transmitters.

8. Dampers and Valves:

   a. Check for adequate installation including free travel throughout range and adequate seal.

   b. Where loops are sequenced, check for proper control with overlap.

9. Actuators:

   a. Check to ensure that device seals tightly when the appropriate signal is applied to the operator.

   b. Check for appropriate fail position, and that the stroke and range is as required.

10. Check each digital control point by making a comparison between the control command at the central command unit and the status of the controlled device. Check each digital input point by making a comparison of the state of the sensing device and the ECEMS display. Record the results for each devise in the ECEMS start-up report.

11. For outputs to reset other manufacturer's devices (for example, VSDs) and for feedback from them, calibrate ranges to establish proper parameters. Coordinate with representative of the respective manufacturer and obtain their approval of the installation.

12. Verify proper sequences by using the checklists to record results and submit with ECEMS start-up report. Verify proper sequence and operation of specified functions.

13. Verify that safety devices trip at appropriate conditions. Adjust setpoints accordingly.

14. Tune control loops to obtain the fastest stable response without hunting, offset or overshoot. Record tuning parameters and response test results for each control loop in the ECEMS start-up report. Except from a startup, maximum allowable variance from setpoint for controlled variables under normal load fluctuations shall be as follows. Within 3 minutes of any upset (for which the system has the capability to respond) in the control loop, tolerances shall be maintained (exceptions noted):

    a. Duct air temperature: plus or minus 1-degree F.

    b. Space temperature: plus or minus 2-degrees F.

    c. Hot water temperature: plus or minus 3-degrees F

d. Duct pressure: plus or minus 0.25 inches w.g.

e. Water pressure: plus or minus 1 psid.

f. Air flow control: plus or minus 5 percent of setpoint velocity.

g. Space pressurization: plus or minus 0.05 inches w.g.

15. For interface and DDC control panels:

a. Ensure devices are properly installed with adequate clearance for maintenance and with clear labels in accordance with the record drawings.

b. Ensure that terminations are safe, secure and labeled in accordance with the record drawings.

c. Check power supplies for proper voltage ranges and loading.

d. Ensure that wiring and tubing are run in a neat and workman-like manner, either bound or enclosed in trough.

e. Check for adequate signal strength on communication networks.

f. Check for standalone performance of controllers by disconnecting the controller from the LAN. Verify that the controlling LAN reconfigures as specified in the event of a LAN disconnection.

g. Ensure that outputs and devices fail to their proper positions/states.

h. Ensure that buffered or volatile information is held through power outage.

i. With system and communications operating normally, sample and record update/annunciation times for critical alarms fed from the panel to the Operator Interface.

j. Check for adequate grounding of DDC panels and devices.

16. Operator Interfaces:

a. Verify that elements on the graphics are functional and are properly bound to physical devices or virtual points, and that hot links or page jumps are functional and logical.

b. Output specified ECEMS reports for review and approval.

c. Verify that the alarm printing and logging is functional and per requirements.

d. Verify that trends are archiving to disk and provide a sample to the CxSP and OWNER for review.

e. Verify that e-mail alarm annunciation is functional.

f. Verify that functionality of remote operator interfaces.

g. Verify that required third party software applications required with the bid are installed and are functional.

h. Verify proper interface with fire alarm, lighting control system, photo voltaic system, gas and electrical meters.

B. Submit start-up test report: Report shall be completed, submitted, and reviewed prior to Substantial Completion.

3.04 SENSOR CHECKOUT AND CALIBRATION

A. General Checkout: Verify that sensor locations are appropriate and are away from causes of erratic operation. Verify that sensor with shielded cable are grounded only at one end.

B. Calibration: Calibrate sensors using one of the following procedures:

1. Sensors Without Transmitters – Standard Application: Make a reading with a calibrated test instrument within 6 inches of the site sensor at various points across the range. Verify that the sensor reading (via the permanent thermostat, gage, or ECEMS) is within the tolerances specified for the sensor. Where sensors are subject to wide variations in the sensed variable, calibrate sensor within the highest and lowest 20 percent for the expected range.

C. Sensor Tolerance: Sensors shall be within the tolerances specified for the device.

3.05 COIL VALVE LEAK CHECK

A. Verify proper close off of the valves. Ensure that valve seats properly by simulating the maximum anticipated pressure difference across the circuit. Calibrate air temperature sensor on each side of coil to be within 0.5 degrees F of each other. Via the Operator Interface, command the valve to close. Energize fans. After five minutes observe air temperature difference across coil. If a temperature difference is indicated, and the piping surface temperature entering the coil is within 3 degrees F of the water supply temperature, leakage is probably occurring. If it appears that it is occurring, close the isolation valve to the coil to ensure the conditions change. If they do, this validates that the valve is not closing. Remedy the condition by adjusting the stroke and range, increasing the actuator size/torque, replacing the seat, or replacing the valve as applicable.

3.06 VALVE STROKE SETUP AND CHECK

A. For valve and actuator positions check, verify the actual position against the ECEMS display.

B. Set pumps to normal operating mode. Command valve closed, verify that valve is closed, and adjust output zero signal as required. Command valve open, verify position is full open and adjust output signal as required. Command the valve to various few intermediate positions. If actual valve position does not reasonably correspond, replace actuator.

3.07 ECEMS DEMONSTRATION

A. Demonstrate the operation of the ECEMS hardware, software, and related components and systems to the satisfaction of the CxSP and OWNER. Schedule the demonstration with the OWNER's representative two weeks in advance. Demonstration shall not be scheduled until hardware and software submittals and the start-up test report are reviewed. If the work fails to be demonstrated to conform with contract specifications, so as to require scheduling of additional site visits by the CxSP and OWNER's representative for re-demonstration, reimburse OWNER for reasonable local costs of subsequent CxSP site visits as detailed elsewhere in these specifications.

B. Supply personnel and equipment for the demonstration, including, but not limited to, instruments, ladders, etcetera. Contractor-supplied personnel shall be competent with and knowledgeable of project-specific hardware, software, and the HVAC systems. Training documentation and submittals shall be at the job site.

C. Demonstration shall typically involve small representative samples of systems and equipment randomly selected by the OWNER and CxSP.

D. The system shall be demonstrated following the same procedures used in the start-up test by using the Commissioning checklist. Demonstration shall include, but not necessarily be limed to, the following:

1. Demonstrate that required software is installed on ECEMS workstations. Demonstrate that graphic screens, alarms, trends, and reports are installed as submitted. Demonstrate directory structure and file system matches that submitted.

2. Demonstrate that points specified and shown can be interrogated or commanded (as applicable) from workstations, as specified, in less than the maximum response time.

3. Demonstrate correct calibration of input/output devices using the same methods specified for the start-up tests. A maximum of 10 percent of I/O points shall be selected at random by the CxSP or OWNER for demonstration. Upon failure of any device to meet the specified end-to-end accuracy, an additional 10 percent of I/O points shall be selected at random by CxSP for demonstration. This process shall be repeated until 100 percent of randomly selected I/O points have been demonstrated to meet specified end-to-end accuracy.

4. Demonstrate that DDC and other software programs exist at respective field panels. The DDC programming and point database shall be as submitted.

5. Demonstrate that DDC programs accomplish the specified sequences of operation including failure sequences.

6. Demonstrate that the panels automatically recover from power failure, as specified. Demonstrate alarms as specified.

7. Demonstrate that the stand-alone operation of panels meets the requirements of these Specifications. Demonstrate that the panels' response to LAN communication failures meets the requirements of these Specifications.

8. Identify access to equipment selected by CxSP or by the OWNER. Demonstrate that access is sufficient to perform required maintenance.

9. Demonstrate that required trend graphs and trend logs are set up per the requirements. Provide a sample of the data archive. Indicate the file names and locations.

E. ECEMS demonstration shall be completed and prior to Substantial Completion.

F. Tests successfully completed during the demonstration will be recorded as passed for the Functional Performance Testing (FPT) and will not have to be retested.

3.08 RESOLUTION OF DEFICIENCIES

A. Maladjustments, misapplied equipment, or deficient CONTRACTOR's performance may result in additional work being required for Cx acceptance.

1. Perform work required to correct the installations not meeting contract requirements at no additional cost to the OWNER.

B. Corrective work shall be completed in a timely manner to permit completion of the Cx process.

1. If the system's Cx deadline, as defined in the CxP, goes beyond the scheduled completion of Cx without resolution of the problem, the OWNER reserves the right to obtain supplementary services or equipment to resolve the problem.

3.09 ECEMS ACCEPTANCE PERIOD

A. After approval of the ECEMS demonstration and prior to contract close-out acceptance phase shall commence. Acceptance period shall not be scheduled until HVAC systems are in operation and have been accepted, required cleaning and lubrication has been completed (i.e., filters changed, piping flushed, strainers cleaned, and the like), and Testing and Balancing report has been submitted and reviewed. Acceptance Period and its approval will be performed on a system-by-system basis if mutually agreed upon by the CONTRACTOR and the OWNER.

B. Operational Test: At the beginning of the Acceptance Phase, the system shall operate properly for two weeks without malfunction, without alarm caused by control action or device failure, and with smooth and stable control of systems and equipment in conformance with these specifications. At the end of the two weeks, forward the trend logs to the CxSP for review and acceptance. CxSP shall determine is the system is ready for Functional Performance Testing (FPT) and document any problems requiring CONTRACTOR attention.

1. If the systems are not ready for Functional Performance Testing (FPT), correct problems and provide notification to the OWNER's representative that problems have been corrected. The acceptance period shall be restarted at the mutually scheduled time for an additional one-week period. This process shall be repeated until CxSP issues notice that the ECEMS is ready for Functional Performance Testing (FPT).

C. During the acceptance period, maintain a hard copy log of alarms generated by the ECEMS. For each alarm received, diagnose the cause of the alarm, and list on the log for each alarm the diagnosed cause of the alarm, and the corrective action taken.

3.10 TREND LOGS

A. Configure and analyze trends required under Section 23 0923.

3.11 TREND GRAPHS

A. Trend graphs as specified in Section 23 09 23 shall generally be used during the acceptance phase to facilitate and document testing. Prepare controller and workstation software to display graphical format trends during the acceptance period. Trend graphs shall demonstrate compliance with contract documents.

B. Each graph shall be clearly labeled wit HVAC subsystem title, date, and times.

3.12 WARRANTY PHASE

A. Trending: Throughout the Warranty phase, trend logs shall be maintained as required for the acceptance period. Forward archive trend logs to the CxSP and OWNER for review. CxSP or OWNER will review these and notify CONTRACTOR of Warranty work required.

3.13 SOFTWARE OPTIMIZATION ASSISTANCE

A. Provide the services of an ECEMS technician at the project site to be at the disposal of the CxSP and OWNER. The technician is to make changes, enhancements, and additions to control unit or workstation software that has been identified by the CxSP or OWNER during the Construction and Commissioning of the project and that are beyond the specified contract requirements. The cost for this service to include a total of 40 hour will be included with the bid. Request for assistance shall be for contiguous or non-contiguous 8-hour days, unless otherwise mutually agreed upon by the CONTRACTOR, CxSP, and OAR. The OWNER Authorized Representative (OAR) shall notify CONTRACTOR two days in advance of each day of requested assistance.

B. The ECEMS technician provided shall be trained in the programming and operation of the controller and workstation software. If the ECEMS technician provided cannot perform every software task requested by the CxSP or OWNER in a timely fashion, provide additional qualified personnel at the project site as requested by the CxSP or OWNER.

END OF SECTION

SECTION 23 09 23

MECHANICAL ENVIRONMENTAL CONTROLS AND ENERGY MANAGEMENT SYSTEMS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes: Environmental controls and energy management systems, including equipment, materials, installation, start-up, testing, documentation and training according to construction documents. The project drawings establish the scope of HVAC controls work in conjunction with the scope of work indicated in Division 23. This Section complements the requirements of Division 23 and construction drawings for controls and system communications.

B. Related Requirements:

1. Division 01: General Requirements.
2. Section 01 45 23: Testing and Inspection.
3. Section 01 79 00: Maintenance and Operations Staff Demonstration and Training.
4. Section 01 91 13: General Commissioning Requirements.
5. Section 21 13 13: Fire-Suppression Sprinkler Systems.
6. Section 23 05 00: Mechanical Common Work.
7. Section 23 05 13: Mechanical Basic Materials and Methods.
8. Section 23 08 00: Mechanical Systems Commissioning.
9. Section 23 08 13: Mechanical Environmental Controls and Energy Management Systems Commissioning.
10. Section 23 30 00: Mechanical Air Distribution.
11. Section 23 50 00: Mechanical Central Heating Equipment.
12. Section 23 70 00: Mechanical Air Handling Units.
13. Section 23 80 00: Mechanical Equipment.
14. Section 26 05 00: Common Work Results for Electrical.
15. Section 26 05 13: Basic Electrical Materials and Methods.

16. Section 26 05 19: Low-Voltage Wires (600 Volt AC).

17. Section 26 05 26: Grounding and Bonding.

18. Section 26 09 23: Lighting Control Systems.

19. Section 28 31 49: Carbon Monoxide Detection and Alarm Systems.

20. Project Commissioning Plan (CxP).

1.02 REFERENCES

A. The latest version of applicable codes, standards, and references. Inspections and tests shall be in accordance with the following applicable codes and standards, except as provided otherwise herein.

1. International Electrical Testing Association – NETA.

2. National Electrical Manufacturers Association – NEMA.

3. American Society for Testing and Materials – ASTM.

4. Institute of Electrical and Electronics Engineers – IEEE.

5. American National Standards Institute – ANSI.

6. National Electrical Safety Code – NESC.

7. California Building Code – CBC.

8. California Electrical Code – CEC.

9. California Mechanical Code – CMC.

10. Insulated Cables Engineers Association – ICEA.

11. Occupational Safety and Health Administration – OSHA.

12. National Institute of Standards and Technology – NIST.

13. National Fire Protection Association – NFPA.

14. American Society of Heating, Refrigerating, and Air-Conditioning Engineers – ASHRAE
(The HVAC Commissioning Process, ASHRAE Guideline).

15. International Building Code – IBC.

16. International Mechanical Code – IMC.

17. InterNational Electrical Testing Association (NETA) Acceptance Testing.

1.03 SUBMITTALS

A. Provide in accordance with Division 01 and Section 23 0500: Mechanical Common Work.

B. Shop Drawings shall include but not limited to:

1. Cover page with legend, common notes, symbol schedule, and drawing index.

2. Complete point to point environmental controls and energy management network communication diagram(s) for Direct Digital Controls (DDC) of each system:

a. Identify all components.

b. Indicate conduit and wire characteristics, sizes and quantities.

c. Provide bill of materials.

3. Floor plans showing control panels and intercommunication wiring.

a. Show system(s) interface connections.

4. Valve Schedules where required.

5. Operations and Maintenance Manuals.

6. As-built submittal drawings.

7. Installation Instructions of each control device.

8. PC Workstation.

9. Software flow diagram of each unique system sequence of operation.

10. Software licenses and electronic keys.

11. Supplemental local or factory training schedule for post warranty support.

12. A complete list of recommended spare parts with pricing for the OWNER’s use in keeping the environmental control system downtime to a minimum.

13. Composite CD-ROM with AutoCAD drawings in a “.dwg” format.

1.04 QUALITY CONTROL

A. CONTRACTOR shall have adequate experience installing systems of similar size and complexity with the control product line proposed for this project.

1. Qualifications of Installer: Minimum five years experience installing products and systems of similar scope and complexity.

2. Installer shall submit certification from the equipment manufacturer indicating that installer is an authorized representative of the equipment manufacturer and is trained on network applications.

3. Installer shall maintain a fully equipped service organization capable of furnishing repair service to the equipment and shall maintain a spare set of major parts for the system at all times.

4. Installer shall furnish a letter from manufacturer of equipment certifying equipment has been installed according to factory standards and that system is operating properly.

5. CONTRACTOR shall have participated in the commissioning of a minimum of 10 projects of similar magnitude to those needed for this project.

6. System startup and testing shall be performed under the direct observation of the Project Inspector and OAR.

B. Materials and equipment installed shall be new.

C. System installation shall not begin until Shop Drawings are submitted and reviewed by the Architect or Engineer of Record.

D. Components for Direct Digital Control (DDC) shall comply with ASHRAE standards.

E. The installer shall provide the system components required by code and for the life safety of the service personnel.

F. System shall be able to interface with open protocol BACnet systems.

G. Provide all ancillary components for the system to perform the required sequence of operations. Install, test and adjust the system accordingly.

H. System components shall operate per industry standards. The standards shall be as defined by ASHRAE, SMACNA, AABC, NEBB, TABB, and the literature of the manufacturers listed in this Section.

I. Provide field engineering tools including software and hardware needed for programing and/or modifying system controller and devices.

1.05 WARRANTY

A. Components, system hardware and software, and parts and labor shall be guaranteed against defects in materials, fabrication, and execution for three years from date of system acceptance. Provide labor and materials to repair, reprogram, or replace defective components at no charge to the OWNER during the warranty period.

B. Provide a list of applicable warranties for equipment and components, this list shall include warranty information, names, addresses, telephone numbers, and procedures for filing a claim and obtaining warranty services.

C. CONTRACTOR shall respond to OWNER's request for warranty service within four hours of initial call to schedule a mutually agreeable time for service. Submit records of the nature of the call, the work performed, and the parts replaced or service rendered.

1.06 TRAINING

A. Provide a competent instructor who is factory trained and has comprehensive knowledge of system components and operations to provide full instructions to designated personnel in the system operation, maintenance, and programming. Training shall be specifically oriented to installed equipment and systems.

1. Provide four hours of onsite OWNER familiarization and training for the installed system. Training shall include system overview, time schedules, override commands, emergency operation, and programming and report generation. OWNER employees attending this training session shall be provided with the following documentation:

a. As-built drawings of System layouts and point to point connection diagrams.

b. System components cut sheets.

c. Operations and maintenance data.

2. Programmer and maintenance training shall include database entry; trend logs application programs, diagnostic routines, reporting, failure recovery and calibration.

a. Provide 24 hours of training as follows:

1) Training session shall accommodate a minimum of 20 persons and be facilitated at CONTRACTOR's training facility, which should be no more than 50 miles from the Project Site.

a) Training shall be delivered in 6 hours per session increments.

b) Obtain OWNER's approval for training locations exceeding 50 miles. In such cases, the CONTRACTOR shall be responsible for transportation expenses.

c) CONTRACTOR shall provide training computers for all attendees. Computers shall be ready for live training sessions.

2) Training shall cover instruction, theory, and expose the trainees to system's features, components, architecture, operations, programming, report generation, communications, and any other pertinent information required for the operations and maintenance of the system.

3) Each training session shall have an itemized agenda covering all aspects of the training to be covered in the sessions. CONTRACTOR shall obtain agendas approval from OWNER and Commissioning Agent.

3) Instructor(s) shall give the trainees the opportunity to practice on simulated and actual (installed) systems.

4) The training session shall cover, but not be limited to the following instruction modules or sessions:

a) System Architecture:

(1) System layout and components interrelations and hierarchical structure.

(2) Controllers interfacing and functions.

(3) Server functionality and data management, error messages, and alarm conditions.

(4) Connectivity and communication losses.

(5) Replacement procedures for system components.

b) User Operations:

(1) Familiarization and navigation with the EMS operating System.

(2) Window panes, menus, navigation buttons, alarm response windows, system passwords and accessibility features and options, monitoring and managing data points (inputs, outputs, numeric values, time and date, strings).

(3) Views: Provide sufficient information as to train staff on how and where to access programs, functions, adjust or alter diagnostic points and related data, override messages, reports and actions taken.

c) Trending: Setting trend(s) intervals, accessing data trends and history logs for diagnosis points or groups, and reporting. Working with trended data graphical displays, including but not limited to hiding points, setting display types and colors, viewing and setting scales.

d) Graphics: Standard symbols and color codes, graphics customization, how and where to access and manage the system with the graphic displays, including changing points and values, using HOA switches and viewing results, mapping to or with other graphic sources and functions, including groups, navigation, sequence of operations, and displays and reports.

e) Alarms: Reading and interpreting alarms, acknowledging and silencing alarms, routing and setting priorities, viewing and responding e-mailed and paged alarms.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Environmental controls and energy management systems shall be approved products of Alerton

2.02 SYSTEM ARCHITECTURE

A. The system shall be capable of providing a peer-to-peer network of distributed stand-alone DDC controllers that meet ANSI/ASHRAE Standard 135 for open protocol communications.

B. A maximum of 32 controllers shall be connected to any one MS/TP bus. Minimum Speed of 38kb and can support 127 devices per COM port. Provide a minimum of 2 ports.

1. Provide a Building Automation System (BAS) that consists of Network Server/Controllers (NSCs), a family of Standalone Digital Control Units (SDCUs), Administration and Programming Workstations (APWs), and Web-based Operator Workstations (WOWs). The BAS shall provide control, alarm detection, scheduling, reporting and information management for the entire facility, WEB enable capabilities, and Wide Area Network (WAN).

2. The Enterprise Level BAS shall consist of an Enterprise Server, which enables multiple NSCs (including all graphics, alarms, schedules, trends, programming, and configuration) to be accessible from a single Workstation simultaneously for operations and engineering tasks. The Enterprise Level BAS shall be able to host up to 250 servers, or NSCs, beneath it.

3. For Enterprise and robust reporting capability outside of the trend chart and listing ability of the Workstation, a Reports Server shall be provided and installed on a Microsoft Windows based computer. The Reports Server can be installed on the same computer as the Enterprise Server.

4. The system shall be a top-level 100/1000bT Ethernet network that utilizes BACnet/IP.

a. A sub-network of SDCUs using the BACnet MS/TP protocol shall connect the local, and stand-alone controllers with Ethernet-level Network Server Controllers/IP Routers.

5. The system shall match the existing LonWorks IP, and/or Modbus TCP protocol.

a. Integration to existing Modbus RTU/ASCII (and J-bus), Modbus TCP, LonTalk FTT-10A, and Web Services shall be native to the NSCs. There shall not be a need to provide multiple NSCs or additional software to allow all three protocols to be natively supported.

b. A sub-network of SDCUs using LonTalk FTT-10A, and/or Modbus RTU protocol shall connect the local, stand-alone controllers with Ethernet-level Network Server Controllers/IP Routers.

C. Only systems that use HTML 5 structured language are allowed.

D. The supplied computer software shall employ object-oriented technology (OOT) for representation of data and control devices within the system. For each global, system or unitary controller, provide a PICS document showing the installed device's compliance level. Minimum compliance is Level 3 with the ability to support data read and write functionality.

E. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed three seconds for network connected controllers or user interfaces.

1. For each system point, alarms can be created based on high/low limits or in comparison to other point values.

2. There is no limit to the number of alarms that can be created or stored in system hardware for any point, up to the system capacity.

3. System shall generate configured alarms from single or multiple system conditions.

4. Alarms will be generated from an evaluation of the alarm condition, and presented to the user in a fully configurable order, by priority, time, and category,
   a. Alarm views shall be presented to the user upon logging into the system WorkStation and/or Webstation.

5. Program the alarm management system to create and report alarm events history; the alarm events history data base shall provide the option to select alarm cause and action notes associated with an alarm event. The alarm management system shall also generate checklists for operators' use when utilizing a suggested mode of troubleshooting.

6. Provide alarm event history for a feature use to permit assigning of events for resolution to OWNER staff. The system shall notify the user and assigned resolution personnel.

7. Alarms shall be capable of being routed to any BACnet workstation that conforms to the B-OWS device profile and uses the BACnet/IP protocol.

F. The system shall be able to interface with subsystems that utilize ANSI/CEA-709.1: Control Network Protocol Specification.

2.03 EMS SERVER AND USER INTERFACE WORKSTATION

A. EMS Server: The EMS Server shall include a tower or rack mounted server with an Intel Xeon E5 2600 processor, 8 Gb RAM, RAID 1 configuration with two hot swap 2TB 7200 RPM SATA drive, DVDRW drive, keyboard, mouse, 27 inch LCD color display and the latest version of

Microsoft Windows Server operating system software. The workstation shall connect to the network through an internal 1Gbps Ethernet interface card.

1. Software licensing shall be provided for local or remote unlimited simultaneous users of the system, unlimited future point expansion, user graphical display generation and non-vendor controllers. Licenses and electronic keys shall be included with the M&O manuals for project acceptance. Conditional Licenses will not be acceptable.

2. The system shall be programmed to email selected alarms to designated response personnel.

    a. The ability to utilize email paging of alarms shall be a standard feature of the operating system's mail application interface (MAPI). No special software and no email client software must be running in order for the system to distribute emails.

    b. The email notification shall be able to be sent to an individual user or a user group.

    c. The NSC shall support the use of Web Services based on open standards, such as SOAP and REST. Use incoming third-party data (temperature forecast, energy cost) over the Web to determine site modes, scheduling, and programming.

3. Web-based operation shall be supported directly by the NSCs and shall not require additional software.

4. The supplied system shall incorporate the ability to access all data using HTML5 enabled browsers without requiring proprietary operator interface and configuration programs.

5. Programming of SDCUs shall be capable of being done either off-line or on-line from any operator workstation. All information shall be available in graphic or text displays stored at the NSC. Graphic displays shall feature animation effects to enhance the presentation of the data, to alert operators of problems, and to facilitate location of information throughout the DDC system. All operator functions shall be selectable through a mouse.

6. Programming in the NSC shall be either in graphical block format or line-programming format or both.

7. Programming of the NSC shall be available offline from system prior to deployment into the field. All engineering tasks shall be possible, except the viewing of live tasks or values.

8. The programmer's environment shall include access to a superset of the same programming language supported in the SDCUs.

9. Provided NSC devices shall support both script programming language as well as the graphical function block programming language. For both languages, the programmer will be able to configure application software for custom program development, and

write global control programs. Both languages will have debugging capabilities in their editors.

10. The system shall be able to save custom programs as libraries for reuse throughout the system. A wizard tool shall be available for loading programs from a library file in the program editor.

11. The system shall be capable providing views of graphical programming in live and real-time from Workstation(s).

12. The system shall be capable of creating ‘binding templates’ allowing the user to bind multiple points to multiple objects all at once.

13. Automatic detecting zone that may be excessively driving the reset logic and generate an alarm.

14. Readily allow operator removal of zones from reset algorithm.

15. Applications shall be able to be assigned different priorities and cycle times for a prioritized execution of different function.

16. The provided system shall be able to create objects that allow common objects such as power meters, VFD drives, etc. to be integrated into the system with simple import actions without the need of complicated programming or configuration setups.

17. The BAS workstation software shall allow the creation of a custom, browser-style interface linked to the user when logging into any workstation. Additionally, it shall be possible to create customized workspaces that can be assigned to user groups. This interface shall support the creation of “hot-spots” that the user may link to view/edit any object in the system or run any object editor or configuration tool contained in the software. Furthermore, this interface shall be able to be configured to become a user’s “PC Desktop” – with all the links that a user needs to run other applications. This, along with the Windows user security capabilities, shall enable a system administrator to setup workstation accounts that not only limit the capabilities of the user within the BAS software, but may also limit what a user can do on the PC and/or LAN/WAN. This might be used to ensure, for example, that the user of an alarm monitoring workstation is unable to shut down the active alarm viewer and/or unable to load software onto the PC.

18. The workstation software shall automatically log and timestamp every operation that a user performs at a workstation, from logging on and off a workstation to changing a point value, modifying a program, enabling/disabling an object, viewing a graphic display, running a report, modifying a schedule, etc.

19. Provide a Web Server to automatically convert system displays on the workstation to an Internet page. Internet page shall be readable from standard PC browsers. Acceptable browsers shall be latest version of internet explorer, Chrome, or Firefox. No additional plug-ins, programs, software, hardware, etc. shall be needed to access the Internet page. The server shall be a separate device to provide security protection for the building system from outside hackers.

a. Coordinate individual system components IP addresses, switch port assignments, security settings such as but not limited to SNMP alarm delivery, HTTPS/SSL settings, VLAN assignment and authorized IP address ranges with the OWNER's Information Technology Division. Coordination activities with ITD shall be executed through the OAR.

b. Provide IP address label on the interior of each cabinet door or equipment.

c. The system shall support the ability to notify school or OWNER designated personnel by SMS or Email messages, utilizing the OWNER's mail server when problems or situations that require immediate attention arise.

20. Operator Workstation shall display data associated with the project as called out on drawings or object type list supplied. Graphic files shall be created using digital, full color photographs of system installation, AutoCAD or Visio drawing files of field installation drawings and wiring diagrams from as-built drawings. Operator's workstation shall display data using three-dimensional graphic representations of mechanical equipment. System shall be capable of displaying graphic files, text, trend data and dynamic object data together on each display screen with animation of equipment operation.

21. Controllers shall be programmed using graphical software tools that allow connection of function blocks for visual sequencing of control logic. Function blocks shall display real time data and be animated to show status of data inputs and outputs when in real time operation. Animation shall also show change of status on logic devices and countdown of timer devices in a graphical format.

22. Operator Tracking Log shall record operator changes to the system for future review. This shall include, but not be limited to setpoint changes, time schedule overrides, alarm limits, etc.

23. The system shall be equipped with a battery back-up source capable of providing 30 minutes of operation (computer and monitor) in the absence of normal power, to allow for an orderly shutdown and data back-up.

B. EMS Workstation: The EMS Workstation shall be an enterprise level tower with an Intel Core™ i7 or better processor, 16GB of RAM, 256 GB solid state drive, DVD drive, keyboard, mouse, 27 inch LCD color display and the latest version of Microsoft Windows professional operating system software. The workstation shall connect to the network through an internal 1Gbps Ethernet interface card.

2.04 GLOBAL CONTROLLER

A. Building controllers shall incorporate the functions of a 3-way BACnet router. Controller shall route BACnet messages between the high-speed LAN (Ethernet 100MHz), master slave token passing (MS/TP) LANs, a point-to-point (PTP/RS-232) connection and telephone modem.

B. Provide global control strategies for the system based on information from any point objects in the system. Programming shall be object-oriented using graphical control function blocks. Global strategies shall include, but not limited to unit scheduling, electrical demand limiting, optimized start-stop of equipment, central plan reset control, etc.

C. Battery shall retain static RAM memory and real-time clock functions for a minimum of 1.5 years (cumulative). Battery shall provide up to five minutes of powerless operation for orderly shutdown and data backup.

D. Each building controller shall support a minimum of 250 BACnet Schedule Objects and 250 BACnet Calendar Objects.

E. Each building controller shall log a minimum 1,000 trend logs. Any point object in the system (real or calculated) may be logged. Sample time interval shall be adjustable at the operator's workstation. Building controller shall periodically upload trended data to networked operator's workstation for long term archiving if desired. Archived data shall be available for use in third-party spreadsheet or database programs.

F. Alarms may be generated within the system for any object change of value or state either real or calculated. This includes events such as analog object value changes, binary object state changes and various controller communication failures. Each alarm may be automatically dialed out to a telephone pager or emailed to any Internet PC computer.

G. Provide a 1.5 KVA UPS with battery back-up capability to provide a minimum of 30 minutes of operation (computer and monitor) for orderly shutdown and data backup. Make connections and test the system for proper operation in the presence of the Project Inspector.

H. The global controller shall be equipped with ADR demand limiting capacity interface.

1. The system shall include 5 DI for interfacing to local utility ADR program. The 5 DI shall be located in a 24 X 24 X 6 NEMA 12 cabinet mounted in the MDF or IDF room. Upon closer of each DI the control system shall raise or lower (depend on system mode) global room temperature set point 1 degree (user adjustable).

2. The system shall also include a demand-limiting program that utilizes data from site utility meter. Features indicated below shall be available via a switchable graphical user interface in all operating stations:

a. Shed/Restore equipment in digital format shall include 5 data input points for interface to future ADR web appliance located in an MDF/IDF room. System server shall accept ADR command from utility service via web interface, and shall include at least 5 priority levels of equipment shedding. Load shedding on a given priority level shall include two methods. In one the loads shall be shed and restored in a "first-off/first-on" mode and in the other; the loads shall be shed/restored in a linear fashion.

b. Adjust operator selected control setpoints in analog format based on energy usage when compared to shed and restore settings.

c. Shedding may be implemented independently on each and every zone or piece of equipment connected to the system.

d. Status of every load shed shall be capable of being displayed on every operator terminal connected to the system. Statuses shall be displayed along with the English description of each load.

2.05 APPLICATION (system and unitary) DDC CONTROLLERS.

A. Application controllers shall include universal inputs with 10-bit resolution that accept 3K and 10K thermistors, 0 to 10VDC, 0 to 5 VDC, 4 to 20 mA and dry contact signals. Any input on a controller may be either analog or digital with a minimum of three inputs that accept pulses. Controller shall include support and modifiable programming for interface to intelligent room sensor with digital display, and set point adjustment and override button. Controller shall include binary and analog outputs on board. Analog outputs shall be switch selectable as either 0–10VDC or 0–20mA. Software shall include scaling features for analog outputs. Application controller shall include a supply voltage to power external sensors.

B. Program sequences shall be stored in EEPROM or flash memory. No batteries shall be needed to retain logic program. Controller shall execute program sequences 10 times per second and be capable of multiple PID loops for control of multiple devices. Calculations shall be completed using floating-point math. Programming of application controller shall be completely modifiable in the field over the installed BACnet LANs or remotely via modem interface.

C. Central Plant Controllers shall interface to chiller gateways. Point objects shall reside in the central plant controller. Hand-Off-Auto switches shall be provided for direct wired output control circuits.

D. Controllers for VAV boxes shall include one onboard airflow sensor microprocessor driven and pre-calibrated at the factory. Pre-calibration shall be at 16 flow points as a minimum. Factory calibration data shall be stored in EEPROM. Calibration data shall be field adjustable to compensate for variations in VAV box type and installation. Calibration parameters shall be adjustable through intelligent room sensor with digital display, and set point adjustment and override button. Operator workstation, portable computers and special hand-held field tools shall not be needed for field calibration. Boxes shall be controlled using pressure independent control algorithms and flow readings shall be in CFM

E. Controllers for Dual Duct boxes shall include two onboard airflow sensors and function similar to the VAV box controller. Multiple VAV box controllers or controllers with remote airflow sensors are not acceptable.

F. CONTRACTOR shall provide a laminated wiring diagram for each control panel. Locate diagrams on interior side of control panel’s doors.

2.06 TEMPERATURE SENSORS

A. Temperature sensors shall be 10K ohm thermistor factory-calibrated to within 0.5 degrees F, totally interchangeable with housings appropriate for the application.

B. Wall sensors shall be installed 48 inches above finished floor. Duct sensors to be installed such that the sensing element is in the main air stream. Immersion sensors to be installed in wells filled with thermal compound. Outside air sensors shall be installed away from exhaust or relief vents, not in an outside air intake and in a location that is in the shade most of the day.

C. Intelligent room sensors shall be equipped with digital display, set point adjustment and override button. Smart room temperature sensor/thermostat shall incorporate PIR motion sensor, temperature display, set point adjustment and override button. Acceptable Manufacturers: Schneider Electric SE8600 series, Viconics VT8600 series, Sigler 8600 series or equal.

D. Room thermostat shall be BACnet capable, Acceptable manufacturers: Schneider Electric SE8600 series, Viconics VT8600 series, Sigler VT8600 series or equal.

2.07 CARBON DIOXIDE (CO_2) SENSORS

A. Sensors shall be wall mounted at a height of approximately 4 feet. Locate sensors adjacent to room thermostat.

B. Sensors are not permitted on marker boards, between shelving, in recesses or above heat producing equipment.

C. Sensors shall be furnished with a display window that provides continuous monitoring and sensor status readings, and with tamperproof cover.

D. Sensors shall be gold plated for long-calibration stability, be factory calibrated and certified for a minimum of five years.

E. CO_2 sensors shall be BACnet capable, acceptable manufacturers: Honeywell C7232A, Telaire Ventostat Wall Mount, Johnson Control CD-WRD-00-0, or equal.

2.08 WINDOWS AND DOOR SENSOR

A. Provide windows and door switches at every operable windows and door in controlled spaces. Each switch shall be connected to a DI point on the DDC controller. Each switch shall be wired independently. Wiring multiple switches in series shall not be acceptable. Acceptable Manufacturers: Illumra E3-MDCCP or equal.

2.09 HUMIDITY SENSORS

A. The humidity sensor shall be a solid-state device that is factory calibrated to provide a linear output with an accuracy of 3.0 percent from 0 to 90 percent RH. A metal fabric filter shall protect the humidity-sensing element.

B. Duct humidity sensors shall utilize a sampling tube enclosure that is accessible for maintenance personnel.

C. Room and duct sensors shall incorporate a temperature sensor in the same enclosure when required.

2.10 PRESSURE SENSORS

A. Differential and pressure sensors shall have a tensioned stainless steel diaphragm to form a variable capacitor that produces a linear output with an accuracy of 1.0 percent of full scale. The unit shall be able to withstand 10 PSIG over pressurization.

B. Differential pressure switches shall utilize a diaphragm operated snap-acting switch with a setpoint range of 0.05 to 2.0 inches WC.

2.11 CARBON DIOXIDE (CO_2) SENSORS

A. Carbon dioxide concentration levels shall be sensed by non-dispersive infrared technology. A corrosion-free sensing chamber shall be used for accurate, stable CO_2 sensing. An LCD shall display sensed CO_2 concentration.

B. Sensor shall be gold plated and have a range of 0-2000 PPM at +/- 5 percent accuracy for long-term calibration stability. Both analog and binary relay output circuits shall be available on the sensor. An automatic background calibration algorithm shall reduce required maintenance.

C. Acceptable Manufacturers: Telaire, Honeywell, Johnson Controls, or equal.

2.12 ELECTRONIC VALVES

A. Control Valves ½ inch to 2-inch shall be characterized stainless steel ball valves with actuators sized to close off against twice the maximum fluid pressure. Valve body shall be NPT screwed for 2-way or 3-way application. A push button release shall be provided for manual operation.

B. Control Valves 2 ½-inch and larger shall be butterfly type with actuators sized to close off against twice the maximum fluid pressure. Valve body shall be flanged for 2-way or 3-way application. Contacts shall be provided to mechanically indicate the full open and full closed position of the valve.

C. Valve control shall be accomplish with 2-10 VDC. All valve shall provide feedback signal to EMS/BMS for monitoring on GUI.

D. Acceptable Manufacturers: Belimo, Honeywell, Johnson Controls, Schneider Electric or equal.

2.13 DAMPER ACTUATORS

A. Electric damper actuators (including VAV box actuators) shall be direct shaft mounted and use a V-bolt and toothed V-clamp. The actuator mounting arrangement and spring return feature shall permit normally open or normally closed positions of the damper as required.

B. Actuators shall be sized for 200 percent of the design torque requirements.

C. Damper actuators shall incorporate a release mechanism to manually position the damper for maintenance or emergency override.

D. Damper Actuators located outdoors shall have a clear plastic weather shield specifically designed for the application.

E. Damper motor control shall be with 2-10 VDC

F. Acceptable Manufacturers: Belimo, Honeywell, Johnson Controls, Schneider Electric, or equal.

2.14 CURRENT SWITCH

A. Current sensing switch shall be self-powered with solid-state circuitry and a dry contact output. A multi-turn setpoint adjustment shall set the trip point status. An LED shall indicate the on or off status.

2.15 CONTROL RELAY

A. The relay shall be contained in a plenum rated NEMA 12 enclosure with a ¾" NPT conduit fitting. Coil voltage shall be 24 or 120 VAC with a contact rating of 10A. An LED on the enclosure cover shall indicate the relay is energized.

2.16 POWER SUPPLIES

Power supplies and panel assemblies shall be UL or NRTL listed.

2.17 ENCLOSURES

A. Controllers, power supplies and relays shall be mounted in Hoffman A-LP NEMA 12 enclosures or equal when located in an indoor environment.

B. Enclosures for outdoor applications shall be metal NEMA 4, Hoffman A-ALP, A-BLP or equal, and be mounted on the north exposure of the controlled unit.

C. Enclosures shall have hinged, locking doors with common keying (CAT-60) for control panel on the Project Site.

D. Enclosures shall have permanently affixed to the door an engraved nametag identifying the equipment served. The nametag shall be a minimum 1 inch by 3-inch with ½ inch lettering.

PART 3 – EXECUTION

3.01 CONTROLS INSTALLATION

A. Wiring methods for control system shall be as defined in the Division 26 specifications. Wire types shall conform to manufacturers' recommendations.

B. Mount control panels adjacent to associated equipment on vibration-free walls or freestanding angle iron supports. One cabinet may accommodate more than one system in same equipment room. Control panel assemblies must be UL listed.

C. Provide software and hardware required to provide controls and monitoring of diagnostic points indicated in specification Section 23 8000.

D. Coordinate with Division 26 electrical installer so that "Hand/Off/Auto" selector switches are installed to override automatic interlock controls when switch is in the "Hand" position. Safety shutdown interlock wiring shall disable the equipment regardless of the position of the H-O-A switch.

3.02 ROOM SENSORS INSTALLATION

A. Room sensors shall be wall mounted at a 48-inch height above finished floor. Room sensors are not permitted on outside walls, at chalkboards, between shelving, in recesses or above heat producing equipment. Coordinate with Division 26 for sensor or thermostat mounting adjacent to light switches.

3.03 COORDINATION

A. Coordinate the work with other aspects of mechanical, electrical, fire-life safety and security systems, controls, and photo voltaic systems to obtain a complete and operating system in accordance with the contract documents.

B. Meet with the OAR and school principal and other school staff to determine when each zone or building will be occupied, and to determine programming and scheduling of the heating, ventilating and air conditioning equipment.

C. CONTRACTOR shall contact OAR to coordinate for timely availability of VPN access point(s) form OWNER's Information Technology Division.

3.04 DDC CONTROL SYSTEM ADJUSTMENTS

A. Make adjustments under operating conditions to provide sequence of operation for each control system per design intent. If required operating conditions cannot be obtained prior to completion date of the contract due to outdoor seasonal temperatures, return to the job site when requested by the OWNER and re-adjust control system when outdoor temperatures will permit proper operating conditions. Start re-adjustment within seven calendar days after notification.

3.05 PERFORMANCE AND ACCEPTANCE:

A. Test and calibrate each device including but not limited to the following for proper operation, connection, signal value or response.

1. Building Controllers.
2. Custom Application Controllers.
3. Application Specific Controllers.
4. Input / Output Devices. (Sensors, actuators and monitoring devices)
5. Operator Interfaces.

B. Verify that systems are standalone and operable upon network failure.

C. Verify that systems return to normal operation automatically upon resumption of network operation or return of power.

D. Test each system for functions of the required control sequence of operation either by normal control operation or forced operation as required. Log and submit results.

E. Test the network for connectivity, data transmission rates, input/output responses, and other appropriate parameters Failure modes, including network failure, individual control system failure, and power outages, shall be simulated and responses logged, with any effects on network operation noted and corrected.

F. Test each preprogrammed time and holiday schedule.

G. Commissioning requirements of Divisions 01, 23, and 26 apply to this Section.

H. Schedule of Responsibilities: Refer to Appendix A. The schedule identifies the responsibilities of the CONTRACTOR for the installation of the environmental controls and energy management system. Deviations and clarifications of this schedule only if allowed by the

OAR, provided trade CONTRACTOR coordination and schedule requirements are met. Submit a record copy of the Schedule of Responsibilities to the OAR at the commencement of this Section's Work.

3.06 WIRING AND INFRASTRUCTURE

A. Provide necessary wiring, terminations, connections and conduit infrastructure for the complete system as indicated in the construction documents.

B. Exterior cables whether above or below ground level shall be rated for exterior applications. When entering a building provide a code sized pull box with necessary hardware to transition exterior rated cables to interior applications.

C. Underground EMS cables are permitted to be installed with lighting control wiring in underground applications. Provide innerduct to separate EMS cables from lighting control system cables.

D. Provide both labeling and record documentation for all EMS system cabling. A cable management schedule and diagram shall be provided at each system panel or cabinet, in addition to a complete cabling diagram to be provided at the head end equipment location.

1. The cable management spread file shall include the following:

    a. Cable Schedule.
    b. Cable Test Forms.
    c. Cable Label sequence and nomenclature.
    d. Network chart.

2. Cable numbering shall be based on a defined format which readily identifies cable type, and allows maintenance technicians to determine originating and terminating locations.

3. Present the data in an Excel spreadsheet that will operate on the latest Windows platform. Information shall be presented in paper and electronic formats.

4. A copy of the cable schedule in a transparent plastic sleeve shall be affixed in the interior side of the front door of each network cabinet or cables convergence hub points.

3.07 DATA LOGGING REQUIREMENTS

A. The system must be capable of storing the system's collected and diagnosis data for a minimum of seven days.

B. Program the system for a standard seven day schedule including holydays.

3.08 CLEANUP

A. Remove rubbish, debris and waste materials and legally dispose of off Project Site.

3.09 PROTECTION

A. Protect Work of this Section until Substantial Completion.

END OF SECTION

APPENDIX A

SCHEDULE OF RESPONSIBILITIES

	ITEM	FURNISH BY	INSTALL BY	POWER BY	CONTROL WIRING BY
1	Magnetic Motor Starters:				
	a. Automatic controlled, with or without HOA switches.	E	E	E	DDC
	b. Manually controlled	E	E	E	N/A
	c. Manually controlled furnished as factory wired unit equipment	M	M	E	E
	d. Special duty type (part winding, multi-speed, etc.)	M	See Note 1	E	See Note 1
	e. Adjustable frequency drives with or without manual bypass.	DDC	E	E	DDC See Note 2
	f. Domestic booster pump. Motor Controls	M	M	E	DDC
2	Line voltage contactors.	E	E	E	DDC
3	Control relay transformers (other than starters).	DDC	DDC	E	DDC
4	Control and Instrumentation panels	DDC	NI	E	DDC
5	Automatic control valves, automatic dampers and damper operators, solenoid valves, insertion temperature and pressure sensors including wells	DDC	M	E	DDC
6	Control interlock wiring between pumps, fans and air handling units and other miscellaneous mechanical equipment.	DDC	DDC	E	DDC
7	Duct Smoke Detectors	E	M	E	E
8	Dampers				
	a. Control Dampers	M	M	N/A	DDC
	b. Smoke Dampers and Combination Fire/Smoke Dampers	M	M	E	E
9	Airflow Stations with transmitter.	M	M	E	DDC
10	Air terminal devices (I.e., VAV and fan powered boxes).	M	M	E	DDC
11	Intelligent Devices and Control Units provided with packaged mechanical equipment such as: Large VAV and constant volume package units and Boilers.	M	M	E	NI
12	Intelligent Devices and Control Units not provided by equipment manufacturer such as: Air handling units, Heat pumps, AC units (small < 20 tons), Air terminal units (VAV boxes)	DDC	DDC	E	DDC
13	Intelligent Devices and Control Units provided with electrical systems such as: Occupancy / motion sensors, Lighting Control Panels, Switches and dimmers, Switch Multiplexing Control Units, Door Entry Control Units.	E	E	E	DDC
14	Gateways for proprietary non-BACnet equipment	M	M	E	DDC
15	Communications network devices such as Routers, Bridges and Repeaters.	DDC	DDC	DDC	DDC

Abbreviations	
DDC	DDC CONTRACTOR (controls CONTRACTOR)
M	Mechanical CONTRACTOR
E	Electrical CONTRACTOR
N/A	Not Applicable

Notes:

1. Magnetic motor starters (special duty type) shall be set in place under electrical division except when part of factory wired equipment, in which case they shall be set in place under mechanical division.
2. Where a remote motor disconnect is required in addition to the one provided integral to a Variable Frequency Drive (VFD), controls CONTRACTOR shall provide the necessary control interlock between the disconnects.

SECTION 23 20 13

MECHANICAL ABOVE GROUND PIPING

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes: Above ground piping systems for heating, ventilating, and air conditioning systems. Systems include but are not limited to the following:

1. Chilled Water System.
2. Hot Water Heating System.
3. Miscellaneous Piping Required for Equipment of this Section.
4. Connections to Exterior Utilities.

B. Related Requirements:

1. Division 01: General Requirements.
2. Section 23 05 00: Mechanical Common Work.
3. Section 23 05 13: Mechanical Basic Materials and Methods.
4. Section 23 05 48: Mechanical Sound, Vibration and Seismic Control.
5. Section 23 05 53: Mechanical Identification.
6. Section 23 07 00: Mechanical Insulation.
7. Section 23 20 16: Mechanical Underground Piping.
8. Section 23 25 00: Mechanical Water Treatment.
9. Section 31 23 23: Excavation and Fill for Utilities.

1.02 REFERENCES

A. ASTM International:

1. ASTM A47 – Standard Specification for Ferritic Malleable Iron Castings.
2. ASTM A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
3. ASTM A105 - Standard Specification for Carbon Steel Forgings for Piping Applications.

4. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.

5. ASTM A181 - Standard Specification for Carbon Steel Forgings, for General-Purpose Piping.

6. ASTM A234 - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.

7. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60000 PSI Tensile Strength.

8. ASTM B32 - Standard Specification for Solder Metal.

9. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings.

10. ASTM B88 - Standard Specification for Seamless Copper Water Tube.

B. American National Standard Institute (ANSI) and The American Society for Mechanical Engineers (ASME):

1. ANSI/ASME B1.20.1 - Pipe Threads, General Purpose, Inch.

2. ANSI/ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard.

3. ANSI/ASME B16.9 - Factory Made Wrought Butt-welding Fittings.

4. ANSI/ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings.

1.03 SUBMITTALS

A. Provide submittals in accordance with Division 01, Sections 23 05 00 Mechanical Common Work and 23 05 13 Mechanical Basic Materials and Methods.

B. Provide Shop Drawings with dimensioned piping layout and details of expansion loops, elbows, anchor points, pipe supports, building entry points and other pertinent information required to verify layout. Indicate systems, pipe material and sizes, show location of devices such as pumps, unions, joints, valves, flow measuring devices, fittings, flexible connectors, and location of hangers and supports, intent and type of materials are in accordance with this Section. Prefabricated pipe units shall be dimensioned and numbered to fit actual Work with field verified conditions prior to start of factory fabrication.

C. Submit manufacturer’s Product Data for products listed on Part 2 of this section, demonstrating conformance to specified standards and specification requirements.

1.04 QUALITY ASSURANCE

A. Comply with applicable codes and referenced standards: ASTM, ASME/ANSI, CPC (California Plumbing Code), CMC (California Mechanical Code).

B. Qualifications of Manufacturer: Products used in the Work of this Section shall be produced by manufacturers regularly engaged in manufacture of similar items and with a history of successful production.

1.05 DELIVERY, STORAGE AND HANDLING

A. Delivery and Storage: Deliver materials to Project site in their original unopened containers with labels intact and legible at time of delivery. Store in strict accordance with manufacturer's recommendations.

1.06 COORDINATION

A. Coordinate related and adjacent activities in accordance with Section 01 3113, Project Coordination.

PART 2 – PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. Chilled Water and Heating Hot Water:

1. Pipe:

a. 2-inch and smaller: Standard weight, seamless copper, type L hard drawn, ASTM B88.

b. 2 ½-inches and larger: Schedule 40 seamless black steel, ASTM A53, grade B, type S. Pipes and fittings shall be properly marked with schedule number, ASTM number, manufacturer, etcetera, in accordance with ASTM requirements.

2. Fittings:

a. 2-inch and smaller: Wrought solder-type copper, in accordance with ANSI/ASME B16.22.

b. 2 ½-inch and larger:

1) 150 pound forged steel, weld neck or slip-on, ASTM A181 and ANSI/ASME B16.5. Furnish flat faced flanges against equipment with flat faced flanges.

2) Flange gaskets: Mineral fiber, 1/16 inch thick, equivalent to Garlock Style 9800, Durlon 8300, or equal.

3) Bolting materials: Carbon steel heavy hex bolts and nuts, ASTM A307, type B.

3. Joints:

a. 2-inch and smaller: 95 percent tin and 5 percent antimony solder with non-acid flux type flux, ASTM B32, grade 95TA.

b. 2 ½-inch and larger: Standard weight, seamless steel; welding fittings and flanges ASTM A234 and ANSI/ASME B16.9 for fittings and ASTM A181 or ASTM A105 for flanges.

4. Unions:

a. 2-inch and smaller Wrought solder type, copper to copper; furnish ground joint cast bronze low lead unions, NIBCO 733, where copper connects to steel.

b. 2 ½-inch and larger: Refer to Section 23 0513, Basic HVAC Materials and Methods, for threaded pipe joints and welded connections.

B. Valves: Chilled Water

1. Ball Valves, 2-inch and Smaller: Shall be 600 psi CWP, have cast brass bodies, replaceable reinforced Teflon seats, conventional port, blowout proof stems, chrome plated brass ball, and threaded or solder ends with extended solder cups.

Threaded	Solder
Stockham T-285-FB-R-70 (full port)	Stockham S-285-FB-R-70 (full port)
Crane 9301	Crane 9302
Worcester 44-11-RT-SE	Worcester 44-11-RT-TE
Apollo 70-100	Apollo 70-200

2. Gate Valves, 2-inch and Smaller:

Class 125, body and bonnet ASTM B62. Cast bronze composition. Threaded or soldered ends. Solid disc, copper-silicon alloy stem, brass packing gland. Threaded ends: Stockham B-100 (RS) or B103 (NRS), Crane 428 or 438, Hammond IB640 (RS) or IB645 (NRS), or equal. Soldered ends: Stockham B104 (NRS) or B108 (RS), Milwaukee 115 (NRS) or 149 (RS), NIBCO S-113 (NRS) or S-111 (RS), or equal.

3. Gate Valves, 2 ½-inch and Larger:

Class 125 iron body, bronze mounted, ASTM A126, class B cast iron, flanged ends with Teflon impregnated packing and 2-piece packing glass.

OSY RS	NRS	
Stockham	G-623	G-612
Crane	465 1/2	461
Powell	1793	1787
Hammond	IR1140	IR 1138

4. Butterfly Valves: 150 psi tight shut-off, ASTM A126.

a. Body: Lug type, ASTM A126iron.

b. Disc:

1) For motorized valves: 304 Stainless Steel.

2) For Manual Valves: Cadmium-plated ductile, iron for chilled water.

c. Stem:

1) For motorized valves: 416 Stainless Steel.

2) For manual Valves: Solid one-piece, 304 or 316 or 410 stainless steel.

d. Seat and O-rings: EPDM O-ring.

e. Upper and lower stem bearings: Bronze or reinforced Teflon.

f. Operators:

1) Valves 6-inch and smaller: Bray Series 21 as basis of design or Center Line, Stockham, Crane, Belimo, Nibco or equal, with lever handle, or Electric Actuator and disc position indicator.

2) Valves 8-inch and larger: Bray Series 21 as basis of design or Center Line, Stockham, Crane, Belimo, Nibco or equal, manual gear operator and disc position indicator, or Electric Actuator.

g. Manufacturers: Bray, Milwaukee, Center Line, Stockham, Crane, DeZURIK, Belimo, Nibco or equal.

5. Check Valves, 2-inch and Smaller:

Shall be of class 125, threaded or solder ends, body and caps shall be of ASTM B62 cast bronze composition, swing type disc.

Threaded	Solder
Stockham B-319Y	Stockham B-309Y
Hammond IB 904	Hammond IB 912
Crane 37	Crane 1707S
Powell 578	Powell 1825

a) Class 150 valves meeting above Specifications may be furnished where pressure requires: Stockham B-321, NIBCO T-433-B, Milwaukee 515, or equal, threaded.

6. Check Valves, 2 ½-inch and Larger:

Shall be iron body, bronze mounted with body and cap conforming to ASTM A126, class B, cast iron, flanged ends, swing type disc.

Hammond	IR1124
Stockham	G-931
Crane	373
Powell	559

7. Alternative Check Valves, 2 ½-inch and Larger:

Shall be class 125/250, iron body, bronze mounted, wafer check valves, with ends designed for flanged type connection, aluminum bronze disc, EPDM seats, 316 stainless steel torsion spring, and hinge pin.

Stockham WG-961
Center Line Series 800
Duo-Chek K12 HAP
Marlin M125 HZDSF

8. Non-Slam Check Valves (Pump Discharge):

Semi-steel body, bronze trim, top and bottom center guide, stainless steel spring and 125 pound flanged ends. Miller Manufacturing No. 162 or equivalent by Williams-Hager, Val-Matic Valve & Manufacturing Corp., or equal.

9. Air Vents: Spirotherm model Spirovent as basis of design or Amtrol, Watts, Dole, Bell and Gossett, or equal, manual type, of size for proper venting. Install at high points of systems.

C. Valves: Heating Hot Water.

1. Gate Valves, 2-inch and Smaller: Shall be of class 150 with body and union bonnet of ASTM B62 cast bronze composition, threaded or solder ends, solid disc, copper-silicon stem, brass packing gland, Teflon-impregnated packing, and malleable handwheel.

Threaded	Solder
Stockham B-120 (RS)	
Hammond IB629	Hammond IB648
Crane 431UB	
Powell 2714	

2. Ball Valves, 2-inch and Smaller: Shall be 600 psi CWP, have cast brass bodies, replaceable reinforced Teflon seats, conventional port, blowout proof stems, chrome plated brass ball, and threaded or solder ends with extended solder cups.

Threaded	Solder
Stockham T-285-FB-R-70 (full port)	Stockham S-285-FB-R-70 (full port)
Crane 9301	Crane 9302
Worcester 44-11-RT-SE	Worcester 44-11-RT-TE
Apollo 70-100	Apollo 70-200

3. Gate Valves, 2 ½-inch and Larger: Shall be class 125 iron body, bronze mounted, with body and bonnet conforming to ASTM A126, class B, cast iron, flanged ends, with Teflon-impregnated packing and two-piece packing gland assembly.

	OS & Y	NRS
Stockham	G-623	G-612
Hammond	IR1140	IR1138
Crane	465 1/2	461
Powell	1793	1787

4. Check Valves, 2-inch and Smaller: Shall be class 150 with body and cap of ASTM B62 bronze composition and threaded ends. Class 150 valves shall have lift-type non-metallic disc and union caps, and are to be furnished in lines with globe valves.

a) For backflow prevention in lines with gate valves, Y-pattern valves with swing-type disc may be furnished.

Stockham B-322B
Crane 27TF

b) For class 150 service, threaded ends:

Stockham B-321	Crane 137
NIBCO T-433-B	

c) For class 200 Service, threaded ends:

Hammond IB944	Crane 36
Stockham B-345	Powell 560

5. Check Valves, 2 ½-inch and Larger: Shall be iron body, bronze mounted, with body and cap conforming to ASTM A126, class B, cast iron, flanged ends, and swing-type disc.

Crane 373	Hammond IR1124
Powell 559	Stockham G-931

a) Alternative for above listed check valves shall be class 125/250 iron body, bronze mounted, wafer check valve, with ends designed for flanged type connection, aluminum bronze disc, EPDM seats, 316 stainless steel torsion spring, and hinge pin.

Center Line Series 800	Hammond IR9253
Marlin M125 HZDSF	Duo-Chek G12 HAP
Stockham WG-961	

D. Electric Motor Operated Valves: Belimo, Bray or equal.

E. Valves, General:

1. Handles or hand wheels on valves shall be removable and, unless specified to be of loose key type, shall be securely fastened to their stems. Valve handwheels, except those on radiator valves, shall be of steel, brass, or cast iron.

2. Boiler shut-off valves installed more than 6 feet above floor, shall be furnished with chain wheels and chains to within 6 feet of floor. Chains shall be free hanging and in a position to permit operation of valve from floor. When pulleys or extensions are required to locate these chains in such a position, furnish, and install said pulleys or extensions as required to provide a satisfactory operating installation. Extensions over one foot long shall be furnished with a supported outboard bearing.

3. Furnish and install chains or wire rope with required accessories to open safety valves from boiler room floor.

4. Radiator or convector valves shall be corner or angle type with composition handles, composition renewable discs, packing gland, union nut on tailpiece, unless otherwise specified. If exposed, they shall have a finished or plated exterior.

5. Temperature Control Valves: Refer to Section 23 05 13.

6. Flow Control Valves: Refer to Section 23 05 13.

F. Flow Measuring Devices: Refer to Section 23 05 13.

G. Strainers: Refer to Section 23 05 13.

H. Condensate Drain Piping, from Air Handling Units: Refer to Section 22 0513.

I. Indirect Drains, Relief Valve Discharge Piping and Air Vent Discharge Piping:

1. Pipe: Type L tempered copper water tube.

2. Fittings: Wrought copper. Refer to Section 23 0513. Furnish copper to threaded international pipe size adapters at threaded connections.

3. Joints:

a. Soldered: 95/5 solder.

J. Insulation: Refer to Section 23 07 00.

K. Pipe Anchors, Pipe Guides, Expansion and Contraction Devices:

1. Piping subject to expansion or contraction shall be fastened in a manner permitting strains to be evenly distributed and alleviated by swing joints or expansion loops or joints. Seismic restraints shall be installed so as not to interfere with expansion and contraction of piping.

2. Provide anchors in heating or cooling piping system, to restrain and control direction of movement for expansion or contraction in piping system.

3. Provide guides at specific locations in heating or cooling piping system in conjunction with slip or bellows type expansion joint.

4. When coils or unit housings are shock or vibration isolated, provide piping flexible metal connector not less than 10 inches long whether they are indicated on the Drawings or not.

L. Flexible Metal Connectors:

1. Provide vibration elimination flexible metal connectors on chilled and hot water supply and return piping where rigidly supported pipes connects to unit housing coil attachments and units are supported by vibration isolators.

2. Schedule Numbers:

a. FMC-1: Corrugated bronze metal hose with outer bronze braid in tubular sheath of woven metal wires. Connector with female copper tube ends for copper piping. Metraflex model BBS, Unisource Style UPCB-BRSW, Microflex, or equal.

b. FMC-2: Corrugated stainless steel metal hose with outer stainless steel braid in tubular sheath of woven metal wires. Connector with male pipe

threads (NPT) for threaded piping. Metraflex model SST, Unisource Style UPCS-MMT, Microflex, or equal.

c. FMC-3: Corrugated Bronze Metal Hose with outer bronze braid in tubular sheath of woven metal wires. Connector with female copper tubes ends for refrigeration piping. Metraflex model RAF, Unisource VIB, Anaconda Vibration Eliminators, or equal.

M. Refer to Sections 23 0513for following:

1. Pipe Hangers and Supports.

2. Pipe Sleeves and Plates.

3. Pipe Flashings.

4. Relief Valves.

5. Thermometers.

6. Pressure Gages.

7. Pressure and Temperature Test Plugs.

8. Access Panels.

9. Dielectric Fittings.

10. Expansion Tanks.

11. Condensate Traps.

2.02 EQUIPMENT

A. Furnish centrifugal pumps capable of delivering rated capacity against total dynamic head as indicated on schedule and as specified for following:

1. Chilled Water Pumps:

a. Horizontal, split case, fitted same as above, or end suction similar to that indicated below.

b. Frame mounted with flexible coupling on shaft.

c. Manufacturers: Taco, Armstrong, Paco Bell and Gossett, Weinman, or equal.

2. Hot Water Pumps: End suction, centrifugal, vertical split case, cast iron base mounted. Taco, Armstrong, Paco type L, Bell and Gossett, Grundfos, Weinman, or equal.

3. Boiler Feed Pump: Two-stage, bronze fitted mechanical seals, double suction, regenerative turbine type with cast iron housing. Construction shall permit

disassembly of pump without disturbing suction and discharge pipe connections. Pump impeller shall be bronze, mounted on stainless steel shaft supported by ball bearing on each side of pump casing. Pump shall be directly connected with a flexible coupling to an open drip-proof motor and mounted on a common steel base. Pump shall be operated from a boiler water level controller mounted on boiler. Pump shall be Roth Pump Co., Skidmore, Aurora, or equal. Pumps shall be electrically interlocked to 24-hour day/night operating boiler controls.

PART 3 – EXECUTION

3.01 PIPING INSTALLATION

A. Install piping systems for chilled water and hot water heating systems, condensate drains, and miscellaneous piping required for equipment, as indicated on Drawings and as specified in Section 23 05 13.

B. All piping and fittings size 2-1/2” and larger shall be welded.

3.02 WATER PUMPS

A. Install water pumps as indicated on Drawings and as specified unless otherwise noted. Provide vibration isolation and flexible pipe connections as specified in Sections 23 0548 and 23 05 13.

B. Floor mounted pumps shall be provided with a 4-inch high concrete base. For base, refer to Section 03 30 00: Cast-In-Place Concrete.

C. Provide leveling and alignment for base mounted pumps before and after installation.

D. Provide suction diffuser for pumps where space constraints exist.

E. Install pumps to allow complete removal without having to dismantle connecting pipes.

F. Piping shall be supported from building structure to prevent any strain on pump casing. In-line pumps shall be separately supported from piping by furnishing pump manufacturer's specialized spring support kit, if available; pump shall not be rigidly supported.

G. Flanged connections shall be provided on pumps with a discharge connection larger than 2 inches. Smaller sizes may be furnished with threaded connections. Except for special guided inlet fittings, inlets to suction side of pumps shall be a minimum of 10 diameters of straight pipe free from strainers, valves or fittings. On discharge side, minimum length of uninterrupted length of straight pipe shall be 5 diameters.

H. Pumps, one horsepower or larger, shall be installed with required pump connections for noise and vibration isolation and not to compensate for misalignment.

3.03 AIR AND DIRT ELIMINATION

A. Heating and chilled water piping and hot water heating and/or cooling equipment shall be installed in a manner so that air will be eliminated from lines or equipment during operation. Pitch pipe lines as specified in Section 23 05 13.

B. Manual air valve shall be installed at each high point of chilled or hot water circulating lines, on each chilled water or hot water heating unit unless unit can vent through outlet connection. Refer to valves as specified under Section 23 05 13.

C. Air vent valves shall be installed with drains to nearest floor sink or outside building.

D. Air/Dirt separators shall be installed on all hot water heating system, chilled water system, and closed loop fluid cooler system. Units shall be furnished with internal copper coalescing medium to facilitate maximum air and dirt separation and suppress turbulence. Units shall be furnished with galvanized steel strainer and stainless steel collector tube. Provide integral high capacity float actuated air vent at top fitting of tank. Furnish cast iron float actuated air vent rated at 150 psig, threaded to the top of the fitting. Unit shall be furnished with the bottom of the vessel extended for dirt separation with the system connection nozzles equidistant from the top and bottom of the vessel and shall include a blowdown connection and valve. Refer to Air/Dirt separators as specified under Section 23 0513.

E. Acceptable manufacturers: Spirotherm, Bell and Gossett, Wessels.

3.04 CHEMICAL POT FEEDER

A. Provide a chemical pot feeder in each of chilled water and hot water systems as specified in Section 23 25 00.

3.06 CLEANUP

A. Remove rubbish, debris and waste material and legally dispose of off the Project site.

3.07 PROTECTION

A. Protect the Work of this Section until Substantial Completion.

END OF SECTION

SECTION 23 20 16

MECHANICAL UNDERGROUND PIPING

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes: Underground piping systems for heating, ventilating and air conditioning systems. Systems include, but are not limited to, the following:

1. Chilled Water Piping System.

2. Heating Hot Water Piping System.

B. Related Requirements:

1. Division 01: General Requirements.

2. Section 23 05 00: Mechanical Common Work.

3. Section 23 05 13: Mechanical Basic Materials and Methods.

4. Section 23 05 53: Mechanical Identification.

5. Section 23 07 00: Mechanical Insulation.

6. Section 23 20 13: Mechanical Above Grade Piping.

7. Section 31 23 23: Excavation and Fill for Utilities.

1.02 REFERENCES

A. American Society of Testing and Materials (ASTM) International:

1. ASTM C591 - Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation.

2. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.

3. ASTM D1895 - Standard Test Methods for Apparent Density, Bulk Factor, and Pourability of Plastic Materials.

4. ASTM D2657 - Heat Fusion for Polypropylene Pipe & Fittings.

5. ASTM D2774-12 - Underground Installation of thermoplastic Pressure Piping.

6. ASTM F1290-19 - Electrofusion for Polypropylene Pipe & Fittings.

7. ASTM F1668-16 - Construction Procedures for Buried Plastic Pipe.

8. ASTM F2389 - Standard Specification for Pressure-rated Polypropylene (PP) Piping Systems.

B. National Science Foundation (NSF) and American National Standards Institute (ANSI):

1. NSF/ANSI 14 – Plastic Piping System Components and Related Materials.

C. Canadian Standards Association (CSA):

1. CSA B137.11 - Polypropylene (PP-R) Pipe and Fittings for Pressure Applications.

1.03 DEFINITIONS

A. ANSI: American National Standards Institute.

B. ASTM: American Society for Testing and Materials.

C. CSA: Canadian Standards Association.

D. IOR: Inspector of Record.

E. NSF: National Science Foundation.

F. OAR: OWNER's Authorized Representative.

G. PP: Polypropylene.

H. PP-RCT: Polypropylene Random Copolymer with modified crystallinity and Temperature resistance.

I. SDR: Standard Dimensions Ratio.

J. OWNER: Los Angeles Unified School District.

1.04 SUBMITTALS

A. Provide submittals in accordance with Division 01, Sections 23 05 00, and 23 05 13.

B. Provide Shop Drawings with dimensioned piping layout and details of expansion loops, elbows, anchor points, building or manhole entry points and other pertinent information required to verify layout, intent and type of materials are in accordance with this Section. Prefabricated pipe units shall be dimensioned and numbered to fit actual Work with field verified conditions prior to start of factory fabrication.

C. The CONTRACTOR shall indicate location and depth of all installed fittings, in addition to the as-built drawing content required in accordance with Section 01 77 00.

1.05 QUALITY ASSURANCE

A. Refer to Sections 23 05 00 and 23 05 13.

B. The Pipe and fittings manufacturer's representative shall provide the installing CONTRACTOR with on-site training and certification in the fusion welding methods, the operation of fusion machines, the proper handling of pipe and fittings on site, and the inspection of pipe and fittings for quality control.

C. The CONTRACTOR shall provide the OAR with documentation of the Welders certifications.

D. The CONTRACTOR shall inspect delivered pipe and fittings, shall ensure that piping and associated jacketing is not damaged and shall verify that pipe and fittings are properly stored. The CONTRACTOR shall repair and/or replace damaged materials.

E. As part of the manufacturer's on-site training and certification process, the Contractors preparation and installation of several field joints shall be observed and approved by the pipe manufacturer's authorized representative and the IOR.

F. Plastic piping material shall be certified by NSF International as complying with NSF 14, and ASTM F 2389 or CSA B137.11.

G. Only those fittings recommended by the manufacturer for use on their piping material shall be used and must comply with manufacturer's specifications.

H. Special engineered plastic piping material products shall be certified by NSF International as complying with NSF 14.

1.06 PRODUCT HANDLING

A. Comply with the requirements of Section 23 05 13.

B. Verify that materials delivered to the site are undamaged.

C. Deliver piping in factory applied UV protective plastic bags. UV protective plastic bags end caps. End caps shall remain in place until piping is installed to prevent entrance of dirt, debris and moisture.

D. Deliver fittings in plastic bags to prevent entrance of dirt, debris, and packaged in cartons to protect them from UV exposure.

E. Handle and store materials on site in accordance to manufacturer recommendations.

F. Protect stored piping from moisture and dirt by elevating above grade.

1.07 COORDINATION

A. Coordinate installation and related procedures with provisions of Section 23 05 00.

1.08 WARRANTY

A. Manufacturer shall warrant pipe and fitting to be free of defects in materials or manufacturing for a minimum period of ten years starting at substantial completion.

B. Warranty shall be in effect only upon submission by the contractor to the manufacturer valid pressure/leak test documentation indicating that the system was tested and passed the manufacturer's pressure/leak test.

C. CONTRACTOR shall remedy defects due to faulty material or workmanship and pay for any damage to other work resulting therefrom within a period of three years from substantial completion.

D. Warranty shall cover labor and material costs of repairing and/or replacing defective materials and repairing any incidental damage caused by failure of the piping system due to defects in materials or manufacturing.

PART 2 – PRODUCTS

2.01 UNDERGROUND CHILLED WATER AND HEATING HOT WATER PIPE AND FITTINGS MATERIALS

A. Pipes and Fittings shall be pre-insulated, pre-fabricated type, manufactured from a PP-RCT resin meeting the short-term properties and long-term strength requirements of ASTM F2389 or CSA B137.11. The pipes and fittings shall contain no rework or recycled materials except that generated in the manufacturer's own plant from resin of the same specification from the same raw material. All pipe shall be certified by NSF International as complying with NSF 14, and ASTM F 2389 or CSA B137.11.

B. All pipes shall have a fiberglass reinforced PP-RCT core and with PP-RCT material on the inside and the outside of the pipe wall made in a single extrusion process resulting in a single homogenous pipe wall. All pipes shall comply with the rated pressure requirements of ASTM F2389 or CSA B137.11. All fittings shall be molded type fittings.

C. Approved Products for pipes and fittings:

1. Heating Hot Water pipes and fittings:

   a. PP-RCT, Blue Pipe Multi-layer Faser composite, SDR 7.4 manufactured by Aquatherm.

   b. PP-RCT, Asahitec Climatec, SDR 7.4 manufactured by Asahi-America.

   c. PP-RCT, Niron Clima, SDR 7.3 manufactured by Nupi-Americas.Equal products.

2. Chilled Water pipes and fittings:

   a. PP-RCT, Blue Pipe Multi-layer Faser composite, SDR 11 manufactured by Aquatherm.

   b. PP-RCT, Niron Clima, SDR 11 manufactured by Niron.

   c. PP-RCT, Asahitec Climatec, SDR 11 manufactured by Asahi-America.

   d. Equal products.

D. Insulation:

1. Pre-insulated Pipe and fittings: Pre-insulated pipe shall be a complete system of factory pre-insulated polypropylene PP-RCT piping for the specified service.

   a. Insulation shall be polyurethane foam either spray applied or injected with one shot into the annular space between carrier pipe and jacket with a minimum thickness of one inch.

   b. Insulation shall be rigid, 90-95% closed cell polyurethane with a 2.0 to 3.0 pounds per cubic foot density and coefficient of thermal conductivity (K- Factor) of 0.14 to 0.16 maximum and shall conform to ASTM C-591.

   c. Jacketing material shall be extruded, black, high density polyethylene (HDPE), having a minimum wall thickness of 100 mils (0.1-inch) for jacket sizes less than or equal to 12”, and 125 mils (0.25-inch) for jacket sizes larger than 12” to 24”. Or a white UV protected Polypropylene (PP-R) jacket, having a minimum jacket wall thickness meeting schedule 40 pipe dimensions.

2. Granular Loose Fill Insulation: Inorganic, nontoxic, nonflammable, sodium potassium aluminum silicate with calcium carbonate filler. Include chemical treatment that renders insulation hydrophobic.

   a. Thermal Conductivity (k-Value): 0.60 at 175 deg F and 0.65 at 300 deg F and shall conform to ASTM C177.

   b. Application Temperature Range: 35 to 800 deg F.

   c. Dry Density: 40 to 42 lb/cu. ft. and shall conform to ASTM D1895.

   d. Strength: 12,000 lb/sq. ft.

   e. Manufacturer: Gilsulate International, Inc.

E. Flanged joints shall be used at the transition from the underground pipe to the aboveground metallic piping as required.

F. Verify expansion loop requirement with piping manufacturer. Provide aboveground expansion loops prior to flanged transitioning of the underground Heating Hot Water PP-CRT to the aboveground piping as required by PP-RCT piping manufacturer.

G. Thrust Blocks: Suitably sized concrete thrust blocks shall be installed at changes in direction, both vertical and horizontal, changes in pipe size, dead ends, and valves.

H. Valves: Refer to Section 23 05 13: Mechanical Basic Materials and Methods. Provide valve stem extension and valve boxes.

PART 3 – EXECUTION

3.01 INSTALLATION - GENRAL

A. Refer to Section 23 05 13: Mechanical Basic Materials and Methods.

B. Refer to Section 23 20 13: Mechanical Above Grade Piping.

C. Refer to Section 31 23 23: Excavation and Fill for Utilities.

D. Only trained and certified installers can assemble PP-RCT pipe and fittings. Install in accordance with manufacturer's assembly and installation instructions.

E. Preparation and installation of all field joints shall be observed and approved by the IOR.

F. The CONTRACTOR shall routinely monitor that handling, storage and installation practices are being performed in accordance with manufacturer's recommendations

G. Buried PP-RCT piping shall be fully bedded on sand, with a minimum 6-inch-deep layer on the leveled trench bottom, allowing for the necessary depth for couplings to maintain contact of the pipe on the sand for its entire length. Sand and gravel containing a significant proportion of silt and clay shall be compacted by hand, by mechanical tamper. Provide a 12” or larger thermal barrier between heating hot and chilled water piping or provide a minimum distance of 3 times the pipe diameters between the heating hot and chilled water piping. Underground installations shall conform to ASTM D2774-12 and ASTM F1668-16 for Buried Installation of Plastic Pressure Pipe, Section 312300 of this specification, and shall comply with the piping manufacturer’s installation instructions.

H. Inspections and Tests:

1. Welding Inspection: In accordance with Section 23 05 13.

2. Pressure Testing: In accordance with Section 23 05 13 and following:

a. While still accessible all piping shall be pressure/leak tested to the manufacturer’s standards.

b. Hydrostatic pressure test at 200 psi or 1.5 times the design pressure whichever is greater, and for an air test shall be 200 psi or 1.1 times the design pressure whichever is greater. Maintain test pressure for at least 48 hours, observed by the Project Inspector, to prove tightness without leaks. Tests shall be carried out using water, or a mixture of compressed air and water. The test pressure shall be as indicated in the pressure leak testing procedures required by the manufacturer.

c. Any leaks or defects detected shall be repaired at the contractor’s expense by removing the leaking part and replacing with new parts welded per the pipe manufacturer’s installation and repair guidelines.

3. Video Recording of Underground Installation:

a. Prior to backfill, the CONTRACTOR shall video record the entire extent of the underground piping installation. The video recording shall also note depths, and locations of fittings.

b. The video recording shall be developed on a 12 cm, DVD disk, or Flash Drive. Provide three copies of the recording to the Project Inspector for approval by the ARHITECT, prior to backfill.

c. Provide one copy of the recording within the underground piping “as-built” drawing submittal package.

3.02 INSTALLATION

A. Piping applications:

1. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination layout drawings.

2. Installers shall be trained and certified by the manufacturer or the manufacturer’s representative to install the pipe according to the manufacturer’s guidelines.

3. Installation shall be accomplished with the proper tools for installing piping following manufacturer’s instructions.

4. Install underground piping level and plumb.

B. Fusion welding of joints:

1. Install fittings and joints using butt-fusion, socket fusion, or electrofusion as applicable for the fitting or joint type. All fusion-weld joints shall be made in accordance with the pipe and fitting manufacturer’s specifications, product standards, ASTM F1290, and ASTM D2657 standards.

2. Use electrofusion for repairs of existing piping only or when other fusion methods are not practical.

3. Fusion-weld tooling, welding machines, and electrofusion devices shall be as specified by the pipe and fittings manufacturer.

4. Prior to joining, the pipe and fittings shall be prepared in accordance with ASTM F 2389, ASTM F1290, ASTM D2657, and the pipe and fitting manufacturer’s specifications.

5. Joint preparation, setting and alignment, fusion process, cooling times and working pressure shall be in accordance with the pipe and fitting manufacturer’s specifications.

C. Tracer wire pipe locator:

1. An electrically conductive wire shall be installed with the piping to facilitate locating it with an electronic pipe locator as specified in Section 23 0553 HVAC Identification.

3.03 CLEANING AND INSPECTION

A. Clean water distribution piping following procedures of the manufacturer. Pipe systems shall be flushed with cold water after finishing the installation. Flush the system until the water runs clear of debris and dirt.

B. Inspect and test piping systems following procedures of the IOR and as specified by the piping system manufacturer.

3.04 CLEANUP

A. Remove rubbish, debris and waste materials and legally dispose off the Projectsite.

3.05 PROTECTION

A. Protect the Work of this Section until SubstantialCompletion.

END OF SECTION

SECTION 23 25 00

MECHANICAL WATER TREATMENT

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Water treatment equipment for water systems.

1.02 DESIGN REQUIREMENTS

A. Provide equipment, chemicals, and services to provide a complete water treatment program. A single water treatment company shall provide products and services for the first year from initial start-up. The water treatment company shall be a recognized specialist in the field of chemical water treatment or employs an experienced Certified Water Technologist: CWT consultant certified by Association of Water Technology AWT. The water treatment company shall be available during reasonable times and the course of the Work to consult with Architect and Compton College about water treatment. Technical service representative shall be trained in industrial water treatment, geographically located within 60 miles of the Project site, and have a minimum of three years direct experience in the treatment of industrial water systems.

B. Water treatment equipment shall feed and control chemicals to protect the following systems:

1. Chilled Water Systems: Corrosion control.

2. Hot Water Systems: Corrosion control.

1.03 SUBMITTALS

A. Submit in accordance with Division 01.

B. Submit Shop Drawings indicating flow diagrams and operation, instruction manuals of systems.

1.04 QUALITY ASSURANCE

A. Comply with the provisions of Section 23 05 00.

B. Water treatment company shall submit proof of a fully documented, accredited, and operational quality assurance program.

C. All chemical products to be used shall be pre-approved by Compton College OEHS.

PART 2 – PRODUCTS

2.01 CHEMICAL FEEDING EQUIPMENT

A. Shot feeder shall be constructed of 10 gage steel. Working pressure is 200 psi maximum at 200 degrees F. Capacity shall be 5 gallons minimum for closed loop

application. Installation shall be furnished with piping, valves, and fittings. Fill opening shall be 3 ½-inches. Fill cap shall close threaded. Shot feeder shall be furnished with a bottom drain. Shot feeder shall be capable of accepting filter bag kit for side stream filter operation.

B. Provide a filter pot feeder in bypass piping around chilled and/or hot water pump to control scales and corrosion in chilled/hot water system. Feeder shall be Neptune Chemical Pump Co., or equal. Provide a FTF-2DB for up to 200 gallon capacity; a FTF-5DB for up to 750-gallon capacity and greater. Install a 25-micron filter bag for the initial flushing and change to 1 micron for normal operation.

2.02 WATER TREATMENT

A. Chemicals:

1. Provide a one-year supply of water treatment chemicals. Formulations shall be as prescribed for the various systems specified. Formulations shall not contain any ingredients, which may be harmful to system materials of construction and shall not endanger the health or safety of persons coming into contact with the materials. MSDS shall be provided for each chemical furnished. System shall not be operated without benefit of chemical protection unless specified. Once initial passivation is achieved, any additional chemical necessary to recharge the system due to water loss shall be provided as required.

B. Special Water Treatment Programs:

1. For closed hot/chill water systems, scale and corrosion inhibition shall be achieved with a borate/nitrite formulation with a molybdenum additive. Control range shall be a minimum of 300 ppm sodium nitrite and 10 ppm molybdenum.

2. For closed hot loops where Aluminum metal is a component, scale and corrosion inhibitor shall be maintained at a range of 100- 150 PPM as Tannin, measured by a HACH handheld colorimeter (Model 890 or newer).

3. For closed hot/chill water systems in area where the use of molybdenum is prohibited, scale and corrosion inhibition shall be a minimum of 1000 ppm sodium nitrite.

4. For open recirculation system with make-up water containing less than 200 ppm total hardness, as expressed in $CaCO_3$ equivalent. Scale and corrosion inhibition shall be provided with a non-acid formulation based on 6- 12 PPM phosphonate OP (Organo Phosphonate) test or 100-150 PPB of PTSA using a handheld PTSA tester.

5. Biological control shall be provided with a dual alternating biocide program. Both biocidal chemicals shall be liquid. Biocides shall be EPA approved in the state and locality designated for installation. One liquid biocide compound shall be methyl isothiazoline based. The second liquid biocide compound shall be stabilized liquid bromine based or stabilized bromine in tablet form.

a. The rate of bromine tablet or liquid bromine feed shall be controlled by an ORP (Oxidation reduction potential) sensor that is built-in on the cooling tower controller flow manifold piping. Initial set point for the ORP shall be 250 mV. It shall be adjusted to obtain an Active ATP (Adenosine Tri Phosphate) reading of less than 100 RLU (Relative Light Unit). Active ATP= Total ATP minus Free ATP.

6. In the event a complete make-up water analysis is not available, the local service representative of the water treatment service company shall designate type of chemical treatment most desirable. The treatment prescribed shall be based on local make-up water quality and the application of sound water treatment practice.

2.03 TEST EQUIPMENT

A. Provide necessary test equipment and reagents including a handheld Fluorometer to maintain chemicals in the control ranges specified. Test kits shall be furnished with carrying cases. The handheld fluorometer shall be a Turner Opticheck or equal.

2.04 WATER TREATMENT SERVICE PROGRAM

A. Selected water treatment company shall provide consulting services on a monthly basis for one year from the date of Substantial Completion. Services shall be provided by fully trained representatives of the water treatment company. Services provided shall include:

1. Installation and system start-up recommendations.

2. Initial water analysis and recommendations.

3. Training of operating personnel on proper feeding and control techniques.

4. Periodic field service and consulting meetings.

5. Log sheets and record forms.

6. Any required laboratory and technical assistance.

7. Electronic service reports shall include water meter readings and pictures of the water meter face plate.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Installation of water treatment equipment and startup shall be performed under the observation of a representative of the water treatment equipment supplier.

B. Provide water treatment system as specified in this Section and of the type required for the treatment of water in the system for cooling tower, evaporative cooler, chiller, boiler, etc. Provide bleed-off as required and specified for cooling tower.

C. On water meter controller and chemical pump shall be mounted on a polypropylene panel. Mounted (outside or inside) on same panel shall be piping manifold to include chemical injection fitting and all other valves, piping, and fittings required for a complete installation.

3.02 PRE-OPERATIONAL CLEANING

A. Provide assurance that no untreated water shall be circulated through heating and air conditioning system components for operation. Systems shall be flushed clean before

operation. In the event untreated water causes contamination of the system, remove resulting scale or deposits from lines and equipment, and repair damage.

B. Provide chemical cleaning, flushing and charging. Notify the Project Inspector when system is ready for operation and filling with water.

C. Prior to operation, chilled water and hot water systems shall be cleaned to remove oil, grease, and rust oxides by the following:

1. Flood system with a solution containing cleaning compound.

2. Circulate system at 150 to 180 degrees F for a period of not less than 12 hours and not in excess of 24 hours. If heat cannot be provided, dosage shall be doubled and circulated for two days.

3. Cleaning solutions shall be drained and flushed with clean water until stable pH is provided. Refill with treated water to stabilize water in system.

3.03 PROTECTION

A. Protect the Work of this Section until Substantial Completion.

3.04 CLEANUP

A. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

END OF SECTION

SECTION 23 30 00 - MECHANICAL AIR DISTRIBUTION

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes: Ductwork and appurtenances required for a complete air transmission and distribution system for the heating, ventilating, and air conditioning systems indicated on Drawings and as specified.

B. Related Requirements:

1. Division 01: General Requirements.
2. Section 09 90 00: Painting and Coating.
3. Section 23 05 00: Mechanical Common Work.
4. Section 23 08 00: Mechanical Systems Commissioning.
5. Section 23 05 13: Mechanical Basic Materials and Methods.
6. Section 23 05 48: Mechanical Sound, Vibration and Seismic Control.
7. Section 23 07 00: Mechanical Insulation.
8. Section 23 09 23: Mechanical Environmental Control and Energy Management Systems.
9. Section 23 80 00: Mechanical Equipment.

1.02 SUBMITTALS

A. Provide in accordance with Division 01 and Section 23 05 00: Mechanical Common Work.

B. Manufacturer's Data:

1. Complete list of items to be furnished and installed under this Section. Material lists that do not require performance data shall include manufacturer names, types and model numbers.
2. Manufacturer's specifications and other data required to demonstrate compliance with specified requirements.
3. Literature shall include descriptions of equipment, types, models, sizes, capacity tables or curves marked to indicate performance characteristics, electrical requirements, options selected, space requirements, including allowances for servicing, and other data. Data shall include name and address of nearest service and maintenance organization that regularly stocks repair parts. Listings of items that function as parts of an integrated system shall be furnished at one time.

4. Submit complete acoustical test reports showing that proposed products have been tested in accordance with latest editions of relevant ASHRAE and AHRI Standards (ANSI/ASHRAE Standard 70 for air inlets and outlets; ANSI/ASHRAE Standard 130 and AHRI 880 for terminal units) and will be suitable for operation in Project spaces with specified maximum noise criteria (NC) requirements. The results of all testing shall be certified by an independent testing agency and submitted to the ARCHITECT for approval. The submittal shall include a complete description of the test conditions, methods and procedures.

5. Submittals shall include a tabulation of proposed products, identification of Project spaces where proposed products are to be installed, maximum allowable NC for all Project spaces, and product NC (at specific design air volume) for all Project spaces.

6. Shop Drawings: Shop Drawings indicating methods of installation of equipment and materials, sizes and gages of ducts, and details of supports. Items to be covered shall include but not be limited to following:

   a. Layout of ductwork and equipment drawn to scale to establish that equipment will fit into allotted spaces with clearance for installation and maintenance. Indicate proposed details for attachment, anchoring to, and hanging from structural framing of building. Indicate vibration isolation units, foundations, supports, and openings for passage of pipes and ducts.

   b. Drawings indicating locations and sizes of sleeves and prepared openings for pipes and ducts.

   c. Typical details of supports for equipment and ductwork.

1.03 QUALITY ASSURANCE

A. Installer's and Manufacturer's Qualifications: Comply with provisions stated under Section 23 05 00: Mechanical Common Work.

B. Sound power level measurements and Manufacturers' NC value calculations shall be conducted in complete accordance with the latest version of ANSI/ASHRAE Standards 70 and 130 and AHRI 880.

1.04 DELIVERY, STORAGE AND HANDLING

A. Comply with provisions stated in Section 23 05 00: Mechanical Common Work.

B. Ensure ducts are clean and free of dirt, dust, moisture, oils and other contaminants that can lead to poor air quality. Cover openings of ductwork with a self-adhering protective film. Film shall not leave a residue on metal after removal, and shall be highly resistant to tears and punctures.

1.05 COORDINATION

A. Coordinate activities in accordance with provisions of Section 23 05 00: Mechanical Common Work.

PART 2 – PRODUCTS

2.01 GENERAL

A. Unless otherwise noted, provisions, including amendments thereto, of the latest edition of the HVAC Duct Construction Standards of Sheet Metal and Air Conditioning Contractor's National Association (SMACNA) and the California Mechanical Code (CMC), are hereby made part of this Section.

B. Rectangular, round and flat oval ducts shall be manufactured and installed in accordance with requirements of the latest edition of the HVAC Duct Construction Standards – Metal and Flexible of SMACNA.

C. Sheet metal ducts shall be fabricated from galvanized steel, aluminum or stainless steel.

D. Galvanized steel ducts shall be fabricated of galvanized steel sheet, lock forming grade, conforming to ASTM A653 and A924.

E. Galvanized steel ducts gage thickness and permissible joints and seams of ductwork shall conform to requirements of the latest edition of the HVAC Duct Construction Standards – Metal and Flexible of SMACNA and the CMC unless noted otherwise on the drawings. The more stringent requirements shall prevail.

F. Button punch snap-lock seams, using Lockformer or equal, shall be permitted only in concealed areas using 20 and 22 gage galvanized steel ducts with screws added at the ends. Button punch snap-lock is not permitted for aluminum or duct lighter than 22 gage.

G. Ducts shall be reinforced in accordance with the latest edition of the SMACNA HVAC Duct Construction Standards: Cross-broken Duct: Duct sizes 19 inches wide and larger which have more than 10 square feet of unbraced panel shall be beaded or cross-broken. This requirement is applicable to 20 gage or less thickness and 3 inches w.g. or less pressure. For details, refer to SMACNA manual.

H. Round and Oval Galvanized Steel and Aluminum Ducts:

1. Round Spiral Ducts and Fittings: Fabricated from galvanized sheet steel shall be machine-formed spiral pipe with sealed spiral locking joints. Fittings shall be furnished with continuous corrosion-resistant welds. Provide gages of ducts and fittings recommended by manufacturer.

2. Details of seams and transverse joints for round duct and fittings shall conform to SMACNA standards.

3. Flat oval ducts shall be provided as indicated on the Drawings. Reference standard details in SMACNA manual.

4. Minimum duct wall thickness, and permissible joints and seams of ductwork for flat oval duct construction shall conform to requirements in the latest edition of the HVAC Duct Construction Standards – Metal and Flexible of SMACNA and the CMC. The more stringent requirements shall prevail.

5. These provisions apply for ducts furnished for indoor comfort heating, ventilating and air conditioning service only.

I. Flexible Ducts

1. Flexible duct shall be non-metallic, insulated for conditioned air supply and return. The flexible ducts shall be factory fabricated with exterior reinforced laminated vapor barrier, 1 ½-inch thick fiber glass insulation (K = 0.25 at 75 degrees F), encapsulated zinc-coated spring steel wire helix and impervious, smooth, non-perforated interior vinyl liner and factory fabricated steel connection collars. For the composite assembly, including insulation and vapor barrier, comply with NFPA Standard 90A or 90B and tested in accordance with UL Standard, UL 181. Non-insulated metallic ducts shall be provided for exhaust only.

2. Methods of installations, standards for joining and attaching, and supporting flexible duct shall conform to applicable provisions of SMACNA manual.

3. Specifications herein shall not supersede installation requirements by flexible duct manufacturer if those are more stringent.

J. Aluminum Ducts:

1. Material for aluminum duct shall be of 3003-H14 alloy aluminum sheets, with such designation embossed or stenciled on each sheet. Minimum tensile strength shall be 19,000 psi.

2. Aluminum duct thickness and permissible joint and seams shall conform to requirements of the latest edition of the HVAC Duct Construction Standards-Metal and Flexible of CMC.

3. Aluminum ductwork shall be furnished to transport moisture-laden air from shower rooms, shower drying rooms, dishwashers and discharge ducts from evaporative condenser and cooling towers.

4. Unless otherwise noted, follow HVAC Duct Construction Details for steel construction standards as indicated for unreinforced duct, reinforced duct, or cross-broken duct.

5. Button punch snap-lock seams on aluminum ducts are not permitted.

K. Fittings and Other Construction Details: Details of fittings such as elbows, turning vanes, branch take-off and connections, duct access doors, connections for grilles, registers and ceiling diffusers, flexible connector at fan, etcetera, shall conform to applicable provisions of this Section or manual.

L. Duct Seam and Joint Sealant: Provide sealant for metal ducts at duct joints which are defined as transverse joints between duct sections including girth joints, branch and sub-branch intersections, duct collar tap-ins, fitting subsections, louver and air terminal connections, access doors and frames, and abutments to building structure. Also provide the same at duct seams which are defined as longitudinal joint between duct sections. Spiral lock seams in factory fabricated round or oval ducts are excluded.

1. Sealant for low-pressure ducts shall be: Design Polymerics DP1010 or DP1020, Childers CP-145A/CP-146 Chil-Flex, Foster's 32-19 Duct-Fas, Miracle-Kingco Glenkote Seal-Flex, Ductmate Industries PROseal or FIBERseal, or equal.

2. Provide sealing material for medium-pressure ducts as described in the SMACNA manual for those pressures.

3. Sealant materials shall comply with the flame spread and smoke developed rating of current CMC when tested in accordance with ASTM E84.

4. Sealant for exposed to weather ducts shall pass the Weather Resistance Test per ASTM G154 at 2000 hours QUV.

M. Restrictions:

1. Zinc-coated steel duct shall not be installed for ductwork transporting moisture-laden air. Flexible duct may only be furnished where specifically indicated on Drawings. Aluminum ducts shall not be installed for internal pressures above 2 inches of water.

2. Fiberglass duct is not permitted as a substitute for sheet metal duct.

2.02 DAMPERS

A. Manually Operated Volume Control Dampers:

1. VD-1, Rectangular: Multi-blade type, opposed blade operation, 16 gage galvanized steel blades; center pivoted on 3/8 inch diameter steel trunnions; interlocking edges; dampers shall be in own angle frame, full duct size as indicated on Drawings; frame of minimum 16 gage steel channel construction. Provide with damper operator and axles positively locked to blade. Ruskin MD35, Pottorff MD-42, Greenheck MBD-15 or equal.

2. VD-2, Round: Frame shall be constructed of not less than 20 gage galvanized steel, blades of not less than 20 gage galvanized steel channel construction with factory neoprene seals, ½ inch diameter axle shafts and locking hand quadrant. Ruskin MDRS25, Greenheck MBDR-50, or equal.

3. VD-3, Oval: Frame shall be constructed of not less than 14 gage galvanized steel channels with factory blade seals of not less than 12 gage galvanized steel with not less than ½ inch diameter axle shafts. Provide Ruskin standard construction for frame, blade and axle size, thickness and material variation. Provide adjustable locking hand quadrant. Ruskin CDO25, or equal.

B. Motorized Volume Control Dampers:

1. MVD-1, Rectangular: Multi-blade type opposed blade operation, 16 gage minimum steel channel frame construction; 16 gage galvanized steel blades center pivoted on ½ inch diameter steel trunnions. Interlocking edges. Dampers shall be in own angle frame. Full duct size as indicated on the Drawings. Provide with matching two position motorized actuator with linkages, 24VAC by Belimo, Honeywell, Invensys, or equal. Ruskin CD35, Pottorff CD-42, Greenheck VCD Series, or equal.

2. MVD-2, Round: Butterfly type constructed with minimum 20 gage galvanized steel frame with steel angle reinforcement on above 20-inch diameter. Blade shall be 14 gage minimum thickness. Neoprene seal to ensure air tightness in closed position. Furnish with matching two position motorized actuator with linkage 24 VAC by Belimo, Honeywell, Invensys, or equal. Ruskin CDRS25, American Warming and Ventilating (AMV) VC-25, Air Balance, Inc. AC530, or equal.

3. Electronic Damper Actuators: Belimo, Honeywell, Invensys, or equal.

   a. Sized for torque required for damper seal at load conditions.

   b. Coupling: V-bolt dual nut clamp with a V-shaped toothed cradle. Aluminum clamps or set screws are not acceptable.

   c. Overload Protection: Microprocessor or an electronic based motor controller providing burnout protection if stalled before full rotation is reached. Actuator shall be electronically cut off at full open to eliminate noise generation with the holding noise level to be inaudible.

   d. Power Requirements: As indicated on Drawings.

   e. Actuator Timing: Shall meet 15 seconds.

   f. Temperature Rating: Actuator shall have a UL 555S listing by damper manufacturer for 350 F.

   g. Auxiliary Switches: Provide for signaling, fan control, and position indications.

C. Automatic Fire Dampers:

1. FD, Fire Dampers: Shall conform to requirements of and be listed by State of California Fire Marshal and NFPA 90A. Dampers shall provide airflow resistance not to exceed 0.05 inch water gage static pressure at 900 fpm or 0.25 inch water gage at 2,000 fpm. Dampers shall be installed in required steel sleeve at each penetration of a rated partition.

   a. Vertical-mounted fire dampers: Fire damper shall be curtain type with blades removed from the air stream to allow for maximum free area. Dampers will be provided in factory sleeves as tested and listed by manufacturer. Dampers shall be rated for 1 ½ hours for installation in one or 2-hour partitions. Provide UL listed fusible links of adequate size and temperature rating. Dampers will be installed according to the manufacturer's recommended installation instructions provided with units. Provide suitable access for inspection and servicing of each damper. Pottorff VFD-10/VFD-10D Series, Ruskin IBD/DIBD Series, Greenheck FD/DFD Series, or equal.

   b. Ceiling fire dampers: Ceiling fire dampers shall be butterfly type with ceramic material to minimize heat radiation. Dampers shall be rated for one hour and shall be furnished as a part of an integral sleeve ceiling box that will accept air distribution, have a UL listed and pre-mounted hanger tabs. Dampers shall be installed according to the manufacturers recommended installation instructions. Pottorff CFD-15 Series, Ruskin CFD Series, Greenheck CRD-1 Series/CRD-2, or equal.

c. Combination fire and smoke dampers: Combination fire and smoke dampers shall be louver bladed type. Units shall be tested and listed under UL 555 and UL 555S. Rating 1 ½ hours for installation in one or 2-hour partitions. The seals shall be non-degradable steel to steel. Leakage shall not exceed 15 cfm/sq. ft. at one inch w.g. and shall be tested at 850 degrees F. Dampers shall be capable of being remotely controlled and reset for pressurization and smoke evacuation. Fire-releasing device shall be UL 33 listed melting fusible links. Dampers shall be provided in sleeves with pre-mounted non-stall motor actuators and dual-position indicators for remote annunciation, if required. The complete assembly shall be factory cycled and tested prior to shipment. Provide suitable access for inspection and servicing of each damper. Pottorff FSD-141 with non-stall motor, Ruskin FSD37 or FSD60 with electric fuse link Model EFL 200, with electric non-stall motor, Greenheck FSD Series, with non-stall motor, or equal.

2. Electronic Damper Actuators: Refer to Sub-paragraph 2.04.B.3.

D. Relief Dampers: Parallel multi-blade, counter balanced type with adjustable counter weights. Constructed of 20 gage galvanized sheet steel or extruded aluminum with solid stops all around. Bearings shall be dust proof, ball bearings. Damper shall open on a positive pressure of 0.01 inch within space and close to a backdraft. Interlocking edges shall prevent dust infiltration when closed. Air Balance, Inc., Pottorff, Ruskin, Metal Form Manufacturing Co. Inc., or equal.

E. Duct Access Panels: Provide factory fabricated access panels in ducts where required for servicing fire or smoke dampers, and at other locations as specified in this Section. Units shall consist of removable panel, gasketed and pressure sealed by controlled spring tension locks. Construct unit, including interior parts, of same material as duct. Units shall be constructed to be suitable for installation in systems of up to 5 inches water gage static pressure.

2.03 AIR DISTRIBUTION DEVICES

A. General:

1. Grilles, registers, diffusers and appurtenances shall conform to requirements specified herein and shall be of type and sizes as specified and indicated on Drawings. Performance shall be in accordance with ANSI/ASHRAE Standard 70 including airflow velocity, pressure, temperature, and sound measurements.

2. Sponge neoprene, rubber, vinyl or felt border gaskets shall be provided for surface-mounted registers, grilles or diffusers.

3. The noise generating characteristics of all specified grilles, registers, and diffusers shall be tested to, and comply with, all requirements of this specification. Representative samples shall be subjected to tests in accordance with applicable standards and procedures in order to demonstrate such compliance. A special test for this project is not required if the manufacturer has previous certified test results that can be made applicable to this project. Maximum Sound Levels of diffusers, grilles and registers shall be as follows:

Administrative office area:	NC 30
Classrooms:	NC 20
Libraries and other noise sensitive areas:	NC 25
Gymnasiums, cafeterias, lockers areas:	NC 30

4. Provide suitable frame types to match the ceiling types as specified or indicated on the Architectural Drawings.

5. Ceiling diffusers shall be provided with equalizing grids.

6. Ceiling mounted grilles, registers and diffusers shall be provided with a factory applied, baked enamel, dull finish, bone white to match acoustical ceiling tile.

7. Grilles or registers mounted on painted walls or other surfaces shall be furnished with a baked prime coat and finish painted in accordance with Section 09 9000: Painting and Coating.

8. Do not provide opposed blade dampers at diffusers and registers to balance the airflow, as they tend to create noise. Provide a manual volume damper at each branch take-off and also at branch duct to each diffuser and register upstream of the flexible duct connections. Air throw patterns shall be as indicated on the drawings.

9. Diffusers, registers and grilles indicated or scheduled on the drawings to comply with special requirements shall take precedence over the standard items specified.

B. Ceiling Diffusers - Round, Square, Rectangular:

1. CD-1 For non-classroom areas of less than 10 feet ceiling height only. Units shall be square or rectangular modular core type as indicated on the drawings. Anemostat QC Series, Krueger Model 1240, Price SMCD Series, or equal.

2. CD-2 For typical classrooms. Units shall be square plaque type. Anemostat PG Series, Krueger Model PLQ, Price SPD Series, or equal. The horizontal air discharge pattern shall be 360-degree radial type with factory installed blank-offs for three way, two way corner, two way opposite, or one way discharge pattern.

3. CD-3 For non-classroom areas of higher than 10 feet ceiling height. Units shall be square or rectangular louver faced type. Anemostat D Series, Krueger Model SH, Price SMD/AMD Series, or equal.

4. CD-4: Units shall be round, adjustable pattern, and surface-mounted type. Anemostat C-27, Krueger RM Series, Price RCDE Series, or equal.

5. CD-5: Units shall be adjustable linear slot type. Anemostat SLAD Series, Krueger Model 1900, Price AS Series, or equal.

C. Grilles - Return, Exhaust, Ceiling, Square, Rectangular:

1. GR-1 Acoustical Tile on Plaster Ceiling: Return and exhaust grilles shall be single deflection type with horizontal fixed face bars set at straight or 45 degree angle, ½ inch spacing and flush and flanged for surface mounting. Anemostat S3HD Series, Kruger Model S80/S85, Price 500/600 Series, or equal.

2. GR-2 Prefabricated Acoustical Tile Ceiling with Inverted Exposed T-Bars: Return and exhaust grilles shall be with single deflection horizontal fixed face bars, set at straight or 45 degree angle, ½ inch spacing and flush, lay-in panel type with

nominal overall dimension of 24-inch by 24-inch. Anemostat Type SAC3L Series, Krueger Model S80/S85, Price 500/600 Series, or equal.

D. Registers, Supply, Return, Wall:

1. WR-1: Sidewall supply register shall be double deflecting type with loose key-operated opposed blade volume control. Anemostat S2 Series, Krueger Model 80/880, Price 500/600 Series, or equal.

2. WR-2: Sidewall return register shall be single deflecting type with horizontal fixed face bars set at 45 degree angle flush and flanged for surface mounting and complete with loose key-operated opposed blade volume control. Anemostat S3 Series, Krueger Model S80/S85, Price 500/600 Series, or equal.

2.04 SOUND ATTENUATING EQUIPMENT - DUCT SILENCERS

A. Provide factory fabricated duct silencers of tubular or rectangular type, for high or low velocity service, with arrangements, sizes and capacities as indicated on Drawings. Construct silencers of galvanized steel with casing seams sealed or welded to be airtight at a pressure differential of 8 inches water gage between inside and outside of unit, and stiffen or brace as required to prevent structural failure or deformation at same condition, or audible vibration during normal operation. Filler material shall comply with the following:

Fire Safety Standards:	NFPA 90A and 90B
Temperature:	ASTM C411
Air velocity:	ASTM C1071, UL 181
Fire Hazard Classification:	ASTM E84, UL 723-Class 1, NFPA 255
Corrosion Resistance:	ASTM C739, C665
Fungi Resistance:	ASTM G21
Water Vapor Sorption:	ASTM C1104, less than 1 percent by weight

Formaldehyde, Phenoloc Resins or other Volatile Organic compounds: 0 percent.

B. Select and provide silencers from acoustical and aerodynamic rating tables based on actual test readings or interpolated values of such readings obtained from tests made by recognized independent laboratories. Tests shall be in accordance with ASTM E477.

C. Select and provide silencers for air pressure drops not exceeding those indicated on Drawings, and of types, sizes and models for which noise reduction values, dynamic insertion loss, in decibels reference 10 to 12 watts, are not less than indicated on Drawings.

2.05 ZONE TEMPERATURE CONTROL DEVICES

A. Variable Air Volume Control Terminals:

1. VAV-1: AHRI 880 certified, single duct, pressure independent, variable air volume control terminal with reheat coil, sound attenuators, multi-point flow sensor, electric actuators and electronic direct digital controls. The controllers shall comply with Section 23 0923: Environmental Control and Energy Management Systems. The coils shall be copper tubes with copper fins. Casings shall be 22 gage galvanized steel lined with minimum ½ inch, 1.5 pound density, foil faced insulation that complies with NFPA 90A and UL 181.

   Anemostat, Krueger, Price, or equal.

2.06 SMOKE DETECTORS

A. Refer to Section 28 3100: Fire Detection and Alarm.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions under which Work of this Section will be performed. Correct conditions detrimental to proper and timely completion of Work. Do not proceed until unsatisfactory conditions have been corrected.

3.02 DUCTWORK

A. Construct ductwork according to details of fabrication and methods of support, as indicated in CMC manuals unless specified or indicated otherwise in this Section or on Drawings. In event of conflict, the most stringent requirement shall be provided.

B. Unless otherwise required, construct ducts to conform accurately to dimensions indicated and to be straight and smooth on inside, with joints neatly finished.

C. Duct dimensions indicated are net inside dimensions.

D. Where aluminum is welded, provide a minimum thickness of 16 gage, and use gas inert tungsten process of welding.

E. Anchor ducts to building structural slab, framing and roof decking and detail method of anchoring and fastening if not indicated on Drawings. Supports shall be seismically constructed as required by the latest edition of the CMC guidelines.

F. Construct and install ducts to be completely free from vibration under operating conditions.

G. Indicate on layout drawing, required for suspended ductwork, location of supports, loads imposed on each fastening or anchor, typical details for anchorage, and details for special anchorage for supports attached to metal roof decking.

H. Attach supports only to building structural framing members and concrete slabs.

I. Where supports are required between structural framing members, detail and install suitable intermediate metal framing.

J. Ducts transporting air-conditioned or heated supply air shall be insulated in accordance with requirements of Section 23 0700: HVAC Insulation.

1. Ducts exposed to weather shall be prefabricated double wall type from HVAC equipment through building envelope.

K. Ferrous angles and structural members and joining collars specified for construction and support of ductwork and plenums shall be primed with one heavy coat of required asphaltic aluminum paint before installation or fabrication. Metal surfaces shall be thoroughly cleaned before installation of paint. Galvanizing may be provided instead of painting. Installed duct hanger rods concealed in furred ceilings and walls are not required to be primed or painted.

L. Broken places in galvanized coating shall be acid washed and then completely soldered over or painted with galvanizing paint.

3.03 DUCT CONSTRUCTION

A. Minimum ductwork gages, joints, reinforcing, and bracing of ductwork shall conform to SMACNA and CMC. The most stringent standards shall prevail. Additional bracing shall be provided to prevent objectionable panel vibration.

B. Button punch snap-lock seams, using Lock-former or equal, shall be permitted only in non-accessible areas using 20 and 22 gage galvanized steel ducts with screws added at the ends. Button punch snap-lock is not permitted for aluminum or duct lighter than 22 gage.

C. Provide longitudinal seams of the grooved snap lock, or Pittsburg and standing, sealed spiral or continuously welded.

D. Ferrous angles and structural members and joining collars specified for the construction and support of ductwork and plenums shall be primed with one heavy coat of asphalt aluminum paint before installation or fabrication. The metal surface shall be thoroughly cleaned before application of the paint. Galvanizing may be provided instead of painting. Installed duct hanger rods concealed in furred ceilings and walls is not required to be primed or painted.

E. Broken places in galvanized coating shall be acid washed and then completely soldered over or painted with galvanizing paint.

F. S-type or drive-slip type girths or longitudinal seams shall not be furnished for ductwork installed outdoors or mounted on roofs.

G. Broken places in galvanized coating shall be acid washed and then completely soldered over or painted with galvanizing paint.

3.04 DUCT ELBOWS AND TURNING VANES

A. Duct elbows, including supply, exhaust, and return, shall be provided with a centerline radius of 1.5 times duct width parallel to radius whenever possible; centerline radius shall not be less than width of duct parallel to radius.

B. Where space does not permit above radius, or where square elbows are indicated on Drawings, turning vanes shall be installed whether indicated on Drawings or not.

C. Turning vanes shall conform to CMC.

3.05 DUCT JOINTS AND SEAMS

A. Conditioned air supply ducts shall be furnished with joints and seams sealed, welded for air tightness, except spiral seam factory machine formed duct components. Spiral seam is exempted. Joints between slip-fit components may be assembled with all seams and joint connections fastened with screws.

B. Other ducts shall be furnished with joints and seams sealed by using sealant, taping, soldering, or welding. Ducts for grease hood exhaust shall be furnished with grease-tight welding or brazing on external surface for joints and seams. Fiberglass ducts shall be provided with a thermally activated closure system, Johns Manville Fortifiber Therm-Lock with Automatic Bond Indicator dots, or equal.

C. S-slip or drive-slip type girths or longitudinal seams are not permitted on exterior or exposed rooftop mounted ductwork.

D. Caulking, taping, or other joint or seam treatment shall be provided in accordance with recognized standards.

E. Seams around fan, coil housing and plenums shall be sealed with gaskets or sealing compound to provide an airtight assembly.

F. Stainless steel ductwork connected to range hoods and fume hoods shall be provided with grease-tight, gas tight welded seams, and shall be constructed and installed so that grease or other material cannot become pocketed in any portion thereof, and system shall slope downward toward hood not less than 1/4 inch per lineal foot. Gasketed flanged joints with sealing compound shall be used only at fan and fume hood connections.

G. Alternative duct connectors such as Ductmate Industries, Mez Industries, or equal may be used if the following conditions are met:

1. One of the specifically listed connectors is submitted and approved by the ARCHITECT and OAR.

2. The correct size connector, application, and gage of material conform to CMC Standards.

3. The connector is installed per manufacturer’s specifications.

3.06 DUCT TRANSITION

A. Slopes in sides of transition pieces shall be no greater than 1 to 5. Abrupt changes or offsets in duct system are not permitted, except when reviewed by the ARCHITECT.

3.07 DUCT TEST HOLES

A. Holes in ducts and plenums shall be provided for pilot or static tubes for obtaining air measurements to balance or check air systems. Holes shall be covered with neoprene gasketed sheet metal cover or plugged with a fitted neoprene plug chained to duct.

3.08 SOUND ATTENUATING EQUIPMENT

A. Install sound attenuators where required and indicated on Drawings. Refer to manufacturer's instructions for required installation.

3.09 FLEXIBLE CONNECTIONS

A. At points where sheet metal connections are installed to fans or air handling units, or where ducts of dissimilar metals are connected, a flexible connection of commercial grade, Duro Dyne Durolon, Ventfabrics Ventglas, Ductmate Industries Proflex, or equal, non-combustible material shall be installed and securely fastened by zinc-coated steel clinch-type bands or a flange type connection. Inlet and outlet openings shall be axially in-line, maximum deviation of centerline shall be less than 5 percent of diameter or shortest dimension of a rectangular inlet of fan or air handling unit, with system at rest. Duct end of connection shall be seismically restrained if more than 4 feet from last support.

3.10 AIR TERMINAL DEVICES

A. General: Install supply devices after ducts, plenums, and casings have been cleaned and blown free of small particles, as specified. Devices shall be aligned to be parallel to ceiling construction or walls and ceiling surfaces, and shall be pulled tightly to compress gaskets and to fit neatly against surfaces.

B. Diffusers: Support surface mounted ceiling diffusers from angles or channels resting on and fastened to ceiling construction. Do not support from ducts. Install lay-in diffusers on T-bar ceilings with hanger wires from each corner and not supported by ceiling structure. Provide sheet metal adaptor box above each diffuser to allow space for volume controller with round collars for connection to round ducts where indicated on Drawings. Fasten duct-mounted diffusers to duct collars.

C. Registers and Grilles:

1. Install wall supply registers at least 6 inches below ceiling, unless otherwise indicated. Locate return and exhaust registers 6 inches below ceiling unless otherwise indicated.

2. Support ceiling diffuser type inlets, registers, and grilles as required above for ceiling diffusers.

3. Fasten wall mounted and duct mounted registers and grilles to flanges of duct collars.

3.11 DAMPERS

A. Manually operated dampers, gravity dampers, fire dampers, and motor operated dampers shall be furnished and installed as specified and indicated. Upon completion of installation, dampers shall be checked, lubricated, and adjusted so that they operate freely, without binding. Dampers shall be of standard commercial manufacture, complete with damper frame. Where painting is required, they shall be shop finished unless otherwise noted.

1. Provide and install manual volume dampers per CMC standards to allow balancing per AABC, NEBB or TABB Procedures and Standards whether indicated on the drawings or not.

2. Balancing dampers shall be installed in main supply ducts from fan discharge plenums, where two or more ducts are connected to each plenum, although such balancing dampers may not be indicated. Each zone shall be provided with a manual volume damper. Sheet metal screws shall be installed through handles and into ducts to lock damper in place after test and balance.

3. Each supply, return, and exhaust branch shall be provided with manual volume dampers.

4. Do not provide opposed blade dampers at air inlets and outlets.

5. Each supply, return, and exhaust inlet or outlet shall be provided with a manual volume damper. This damper shall be a minimum of 5 feet upstream of the air outlet and inlets. An acoustic flexible duct should be provided between the outlet and inlet and the damper for concealed ducts.

6. Dampers installed in accessible locations shall be provided with locking and indicating quadrants. Ventfabrics Ventlok, Duro Dyne, Young Regulator Co., or equal.

7. Dampers installed in ductwork in furred ceiling spaces or in roof spaces with less than 30 inches of clearance below beams, joists, or other construction, and where access panels are not provided shall be furnished with damper rods extended below ceiling and terminated with a concealed damper regulation. Ventfabrics Ventlok, Young Regulator Co., Duro Dyne, or equal.

8. Dampers not identified as splitter, extractor, or butterfly dampers shall be of multi-louver type arranged for opposed blade operation. Damper shall be same dimension as adjoining duct and be tight closing. Blades shall not be greater than 9 inches. Dampers shall be not less than 18 gage steel.

9. Motor operated dampers shall be furnished by temperature control manufacturer as part of temperature control equipment and shall conform to requirements of Section 23 0900: HVAC Instrumentation and Controls.

10. Dampers shall be provided with accessible operating mechanisms. Where operators are exposed in finished portions of building, operators shall be chromium-plated with exposed edges rounded. Splitter dampers are not permitted unless specified and reviewed by the ARCHITECT.

11. Dampers shall not be installed in combustion air ducts.

12. Access panels shall be installed for access at each damper’s operating mechanism.

3.12 FIRE AND SMOKE DAMPERS

A. Fire dampers or combination fire and smoke dampers shall be installed and accessible at duct penetrations of rated walls and partitions and as required by State Fire Marshal and NFPA 90A, 92A, 92B, and 101.

B. Fire dampers shall be sized, and adjoining duct enlarged, to assure full size air passage of connecting ductwork.

C. Install smoke dampers as indicated on Drawings and as required in ducts penetrating smoke isolation separations.

D. Fire dampers or combination fire and smoke dampers shall be electrically actuated, power open-fail close type, UL 555 and UL 555S classified for 1-1/2 hours.

E. Provide a service disconnect switch for each and every combination smoke and fire damper.

3.13 DETECTORS

A. Smoke detectors shall be installed in accordance with requirements of the California Mechanical Code.

B. Smoke detectors shall be installed in systems of over 2000 CFM capacity to detect presence of smoke and automatically shut down air handling units or fans unless it has been verified with the electrical installer that Exception 1 to CMC 609.0: Automatic Shutoffs, regarding automatic shutdown of systems with total coverage smoke detection systems is applied.

C. Smoke detectors shall be installed in supply system downstream of filters.

3.14 BACKDRAFT DAMPERS

A. Backdraft dampers shall be installed at locations indicated in accordance with the State of California Building Energy Efficiency Standards, Title 24, CCR.

3.15 DUCT SLEEVES AND PREPARED OPENINGS

A. Furnish duct sleeves for 15-inch diameter ducts or less passing through floors, walls, ceilings, or roof and install during construction of the floor, wall, ceiling, or roof. Install round ducts larger than 15 inches diameter and square and rectangular ducts passing through floors, walls, ceilings or roof through prepared openings. Provide duct sleeves and prepared openings for duct mains and duct branches.

B. Provide one inch clearance between duct and sleeve or between insulation and sleeves for insulated ducts, except at grilles, registers and diffusers.

C. Provide prepared openings for round ducts larger than 15 inches in diameter and for square and rectangular ducts with one inch clearance between duct and openings or between insulation and opening for insulated ducts, except at grilles, registers and diffusers.

D. Provide closure collar of galvanized sheet metal not less than 4 inches wide unless otherwise indicated on Drawings on each side of walls or floors where sleeves or prepared openings are provided except where grilles or diffusers are installed. Install collar tight against surface. Fit sharp edges of collar installed around insulated duct to preclude tearing or puncturing insulation covering vapor barrier. Fabricate collars from round ducts in steel. Provide not less than 4 nails to attach collar where openings are 12 inches in diameter or less and not less than 8 nails where openings are 20 inches in diameter or less.

E. Pack space between sleeve or opening and duct or duct insulation with commercial grade packing yarn.

3.16 FLEXIBLE DUCT RUNOUTS

A. Runouts from branches, risers or mains to air terminal units and outlets may be pre-insulated, factory fabricated flexible ducts complying with NFPA 90A. Flexible ductwork shall not exceed 7 feet in length. When required to suspend flexible ducts, furnish hangers of type recommended by manufacturers of pre-insulated flexible duct and install at intervals recommended. Method of attachment to other components of air distribution system for a vapor-tight joint shall be in accordance with printed instructions of flexible duct manufacturer. Bend radius shall be 1-1/2 times diameter of duct, measured from centerline. Bends greater than 90-degree angle are not permitted. Non-metallic flexible duct shall be permitted only in T-bar suspended ceilings.

3.17 DUCT HANGERS AND SUPPORTS

A. Exposed or easily accessible ductwork: All exposed ducts shall be supported by all-thread Rod as a single hanger and or a trapeze support for rectangular duct work in accordance with requirements of the latest edition of the HVAC Duct Construction Standards – Metal and Flexible of SMACNA.

B. Non-accessible ductwork: Non-exposed and hidden from sight during regular school operations ductwork, rigid round, rectangular, and flat oval metal ducts, shall be installed with support systems conforming to CMC Standards.

C. Where ducts are installed one above the other, they shall be individually supported on a trapeze of steel angles with 3/8 inch supporting steel rods securely fastened to overhead construction. A minimum distance of 3 inches shall be maintained between ducts wherever possible, but in no event shall distance be less than 2 inches. Minimum sizes of steel angles shall be 1 ½-inch by 1 ½-inch by 1/8 inch for duct sizes through 60 inches in greatest dimension, 2-inch by 2-inch by 1/8 inch for duct sizes 61 inches through 84 inches, 2-inch by 2-inch by 3/16 inch for duct sizes 85 inches through 96 inches, and 2-inch by 2-inch by 1/4 inch for duct sizes over 97 inches.

D. Ducts six square feet area and greater and or minimum 28” round or greater shall be seismically restrained. Refer to Section 23 0548: HVAC Sound, Vibration and Seismic Control.

E. Hangers shall not be supported by, or fastened to, non-structural members including blocking. Toggle or Molly type bolts are not permitted.

F. Vertical ducts shall be supported with suitable angles on each side of each duct located at each floor and at intervals not to exceed 8 feet. Angles shall be sized and installed according to SMACNA Standards for required span so that they will be rigid, without bending or sagging.

G. Roof-mounted ductwork shall be installed a minimum 12 inches above roof and shall be supported by galvanized welded pipe, one on each side, fastened to roof structure, flashed and sealed to roof membrane. Install supports at each turn, unit connections, and each penetration, and space at maximum 6 feet off-center in general. Pitch pockets are not allowed.

3.18 ACCESS PLATES AND DOORS

A. Access plates and doors shall be furnished and installed where stops, valves, fire dampers, fusible links, coils, damper operating mechanism, control equipment, lubrication fittings, air filters, air handling equipment and similar items normally requiring adjustment or servicing are installed in concealed spaces.

B. Access plates and doors shall be located to permit convenient access to equipment sized to permit removal of equipment for servicing. Access plates shall be no less than 12-inch by 12-inch in clear opening. Proper servicing of equipment requires adequate access for maintenance personnel. Access doors shall not be less than 24-inches by 24-inch, unless otherwise detailed. Two or more valves shall not be located in same access area unless sufficient clearance is provided for operation, servicing and removal of each valve.

C. Openings in ducts or plenums whose longer dimension does not exceed 12 inches may be covered by a plate of same material as duct, gasketed and fastened to duct or plenum with sheet metal screws.

D. Access plates in floors shall not be less than 8-inch by 8-inch and shall be carborundum surface brass with cast brass frames anchored into concrete. Access plates in tile walls shall be chromium plated brass and polished. Serrated plates furnished as part of a clean-out assembly are permitted in floors instead of a separate plate.

E. Access plates and doors in walls and ceilings of finished rooms and in locations normally accessible to students shall be furnished with continuous piano hinges, unless otherwise specified, and a special flush type spring-loaded latch requiring an Allen wrench to operate. Access devices shall be installed after plastering in plaster ground openings.

F. Access panels or doors penetrating one-hour fire resistive ceilings shall meet code requirements for such openings.

G. Access panels shall be fire-rated; Milcor, or equal. Access doors shall be as required for installation in openings penetrating one-hour fire resistive ceilings. Access doors shall be furnished with a flush, key-operated cylinder lock, furnished with two keys each, instead of Allen headlock for non-rated ceilings.

H. Access panels that are part of an integrated ceiling are specified in Section 09 8433: Cementitious Wood Fiber Acoustical Units. Identification markers shall be affixed to adjacent supports, under this portion of Work, to indicate location and type of mechanical device to be serviced.

I. Access panels installed in ducts or plenums located in heater or equipment rooms containing gas-fired equipment shall be furnished with heavy-duty spring closing hinges and refrigerator door type catches unless otherwise required. When these panels are intended for maintenance personnel access, catches shall be operable from both interior and exterior.

J. Other access panels, except those specified above, shall be furnished with suitable hinges and one or more sash fasteners.

K. Panels located in ducts and plenums shall be installed with gaskets made of synthetic rubber, felt, or similar material to provide an airtight installation. Panels shall be constructed and reinforced to prevent vibration.

L. Label the words "FIRE DAMPERS" on panels over fire dampers and words "DO NOT OPEN - HEATER IS OPERATING" on panels located in heater or equipment rooms. Letters shall be approximately 3 inches high, if space is available.

M. Furnish a key to operate latch access plates, one for each access plate, but not to exceed five keys for any one Project.

N. Access plates and panels shall be furnished with manufacturer's name or trade mark and model number cast or stamped thereon, or upon a label permanently affixed thereon.

O. Provide duct through roof flashing as detailed in the SMACNA standards or as indicated on Drawings.

P. Refer to CMC for access plate and door construction.

3.19 CLEANUP

A. Remove rubbish, debris and waste materials and legally dispose off the Project site.

3.20 PROTECTION

A. Protect the Work of this Section until Substantial Completion.

END OF SECTION

SECTION 23 50 00

MECHANICAL CENTRAL HEATING EQUIPMENT

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Hot Water Heating Boilers.
2. Packaged Heaters, Gas-Fired.
3. Natural Gas Fuel System Piping.

B. Related Requirements:

1. Division 01: General Requirements.
2. Section 09 90 00: Painting and Coatings.
3. Section 22 10 00: Plumbing.
4. Section 23 05 00: Mechanical Common Work.
5. Section 23 05 13: Mechanical Basic Materials and Methods.
6. Section 23 07 00: Mechanical Insulation.
7. Section 23 09 00: Mechanical Instrumentation and Controls.
8. Section 23 20 13: Mechanical Above Grade Piping.
9. Section 23 25 00: Mechanical Water Treatment.
10. Section 23 80 00: Mechanical Equipment.

1.02 QUALITY ASSURANCE

A. Standards and Codes: Comply with applicable codes, specifications, and standards having jurisdiction: ASMECSA, ANSI, ASTM, UL, NFPA 70: NEC, CMC, NFPA 8501, and SCAQMD.

B. Qualifications of Manufacturers and Installers: Comply with provisions in Section 23 05 00.

1.03 SUBMITTALS

A. Comply with provisions of Division 01 and Section 23 05 00: Common Work Results for HVAC.

B. Manufacturer's Data:

1. Complete materials list of items proposed to be furnished and installed under this Section. Materials lists, which do not require performance data, shall include manufacturer's name, type, and model number for indicated installation.

2. Manufacturer's specifications and other data required to demonstrate compliance with specified requirements. Literature shall include descriptions of equipment, types, models, and sizes proposed, capacity tables or curves marked to indicate performance characteristics, electrical requirements, options selected, space requirements (including allowances for servicing if indicated), and other data necessary to ensure compliance with requirements of this Specification and performances indicated on Drawings.

3. Certification by manufacturer and SCAQMD that the boilers or water heater are in compliance with the low NOX and CO emission standard of SCAQMD.

4. Source test report as required by SCAQMD.

5. Permits as required by SCAQMD.

C. Shop Drawings indicating methods of installation of equipment and materials, and details of supporting structures for items indicated. Items to be submitted shall include but not be limited to the following:

1. Layout Drawings of Equipment: Include plans, elevations, and sections, of proposed equipment drawn to scale, to establish which equipment shall fit in allotted spaces with clearance for installation and maintenance. Indicate proposed details for attachment, anchoring to and hanging from structural framing of building. Indicate vibration isolation units, foundations, supports, and openings for passage of pipes and ducts.

2. Electrical interlock or control diagrams for electrically controlled components furnishing more than one automatic or manual control devices, which are not indicated on Drawings.

D. Manufacturer's Recommended Installation Procedures: Manufacturer's recommended installation procedures, when reviewed by the Architect shall become the basis for inspecting actual installation procedures provided.

1.04 PRODUCT HANDLING

A. Protection, Replacements, Delivery, and Storage: Comply with provisions stated under Section 23 05 00.

1.05 COORDINATION

A. Coordinate related and adjacent activities in accordance with provisions of Section 01 31 13: Project Coordination.

PART 2 – PRODUCTS

2.01 HEATING EQUIPMENT AND MATERIALS

A. Provide heating equipment and materials as indicated on Drawings and specified herein. Sizes, capacities, and operating conditions shall be as indicated on equipment schedules.

2.02 BOILER, HOT WATER, WATER TUBE, GAS-FIRED, LOW NOX TYPE

A. General: UL listed or CSA approved, hot water, water tube, copper or steel tube jacketed, insulated, and constructed in accordance with requirements of Section IV of ASME Boiler and Pressure Vessel Code and so labeled, and shall be National Board registered. Boiler shall be furnished with power fired burner, low NOX type, automatic combustion and safety controls, control panel, accessories and trim: Aerco Boiler, Raypak, Parker Boiler Co., Harsco Industrial Patterson-Kelly (HARSCO) are acceptable manufacturers..

1. Design, construction, testing and installation shall be in accordance with CCR Title 8, Subsection: Boiler and Fired Pressure Vessel Safety Orders, UL 795, ASME CSD-1, ANSI Z21.13, and SCAQMD Rule 1121 and Rule 1146.2.

2. Boiler straight tubes shall be 2 inches outside diameter, 13 gage minimum wall steel tubes to ASME specification SA-178 Grade A, bent tubes shall be 1-5/16 inches outside diameter to ASME specification SA-53 Copper tubes shall be 7/8 inch inside diameter with extended finned surface, installed vertically and rolled into removable top and bottom cast iron headers. Complete factory fabricated heat exchanger shall have a minimum three pass design.

3. Straight tubes shall be rolled and flared into tube sheet and inclined for internal circulation.

4. Head plates shall be removable without disturbing piping for ease in inspecting and cleaning tube bundle.

5. Sheet metal surfaces shall be galvanized steel. Exterior surfaces shall be primed with zinc chromate and painted with 2 coats of baked enamel finish or with galvanized finish.

6. Pilot lines, gas valves, relays, and wiring shall be located outside boiler jacket.

7. Boiler shall be furnished with a barometric damper (BD-1) with thermo-electric switch as required by UL, and provide variable air openings and adjusted by counterweights to maintain proper draft condition under varying rates of fire and stack draft conditions.

B. Accessories and Trim: Provide accessories specified or required for satisfactory and safe operation of unit. Trim shall be ASME approved for working pressure of boiler.

1. Safety Relief Valves:

SRV-3: ASME approved type furnished in quantity and size to provide ample relieving capacity in accordance with ASME Boiler and Pressure

Vessel Code, ASME stamped and certified with manual lifting device to permit testing.

2. Combination Pressure and Temperature Gages:

PG-1: As required by ASME Boiler and Pressure Vessel Code. Gages shall indicate pressure-temperature near outlet. Install on front of boiler for easy reading.

3. Burners:

PB-1: Burners shall be low NOX type capable of generating NOX emission in accordance with requirements of SCAQMD Rule 1146.2, power burner, packaged type, completely assembled and wired at factory to operate with natural gas. NOX reductions shall be achieved by use of both flue gas re-circulation and secondary gas combustion. Flue gas damper shall be directly linked to burner modulation motor in order to maintain appropriate flow of re-circulated flue gas. Secondary gas combustion shall be provided by a secondary, gas combustion proportioning control valve. Basic control of secondary combustion shall be obtained from burner mounted main gas butterfly valve. Burner shall incorporate a characterized cam fuel metering system, which shall provide adjustable, accurate, repeatability of fuel/air ration throughout firing range. Flue gas re-circulation blower shall be supplied with fan proving air switch, separate motor starter, and time-delay module which shall activate operation of flue gas re-circulation fan five seconds after main fuel valves are energized.

2.04 AUTOMATIC BOILER CONTROLS

A. Boiler controls shall provide operations listed herein and as indicated on applicable standard boiler control wiring diagrams. Controls shall be set and adjusted by factory authorized personnel only.

1. System shall be started by a manual bypass timer, which shall energize control panel.

3. On a hot water boiler, a thermostat in outside air shall prevent boiler from being energized whenever outside air temperature is above set point.

5. Flame safeguard control for power burner shall be of non-recycling automatic electronic combustion programming type providing pre-ventilation cycle with full protection against flame failure during both ignition and normal burner operating periods. Manual starting required after shutdown on safety. Burner and blower controls interlocked to prevent burner operation without proven draft. Control shall contain interlock circuit for connection to valve seal over-travel switch on main flame valve.

6. Boilers with power burners shall be modulation operation with low fire start.

7. Operating Fuel Shut-Off Valve control.

8. Safety Fuel Shut-Off Valve control.

9. Firing rate valve shall regulate fuel input in response to load demand.

11. Low water control with manual reset shall close safety shut-off valves when water in boiler reaches lowest permissive level.

12. On hot water boilers, low water control with automatic reset shall close safety shut-off valves when water reaches lowest operating level.

15. On hot water boilers, temperature-operating control shall be aquastat with adjustable set point and adjustable differential wired into boiler control circuit to maintain water temperature at set point.

16. On hot water boilers, high limit control shall shut off fuel to burner when temperature reaches predetermined level not to exceed 250 degrees F.

17. Gas pressure supervision shall be provided by pressure switches interlocked to accomplish a non-recycling safety shut-down in event of either high or low gas pressure.

B. Pilot Gas Train: A separate gas cock, gas pressure regulator, and pilot safety shut-off gas valve shall be provided for ignition gas supply.

C. Gas Valve Train: In addition to operating and safety controls such as automatic fuel valve, automatic gas safety shut-off valves and gas pressure switches, furnish the following:

1. 1/4 inch pressure tapping with 1/4 inch pipe plug upstream and downstream of each valve and regulator in gas train.

2. Manually operated CSA approved plug cock or ball valve upstream of all valves.

3. Main gas pressure regulator with vent to outside atmosphere, in accordance with codes.

4. Manually operated CSA approved plug cock or ball valve shall be located downstream of both safety shut-off gas valves to permit leakage testing of valves.

D. Master Sequence Programmer: On two or more boilers, a master sequence programmer shall be provided for fully automatic operation of boilers through selectable sequence programming so that required number of boilers are operating at any time to meet demand. Programmer shall be furnished with temperature sensor for hot water applications, operating plate, boiler sequencing switches, operating relays, lead boiler selector switch, hands-off auto selector switch, indicating lights, pressure gage, wiring, and a numbered terminal strip.

1. Operation of programmer shall start lead boiler on low fire. After lead boiler is modulated to high fire programmer starts first lag boiler. As demand continues, programmer starts second lag boiler. As load decreases burners shall modulate from high fire to low fire in reverse order and shut off as their respective firing rates approach minimum.

3. Programmer shall be Heat-Timer, Honeywell, for hot water boilers.

E. Boiler Control Panel: Panel shall be a NEMA I type and be furnished with programmer controller, and be furnished with wiring, switches, transformer, relays, indicating lights, a numbered terminal strip, and short circuit protection for circuits, and motors.

1. Hot water boilers over 400 MBH shall have a control panel. On systems with two or more boilers, provide a separate master control panel for sequence programmer.

2. Panel shall contain one amber light to indicate panel power on, yellow light for call for heat, amber light for pilot proven, green light for fuel valve open, high temperature (hot water), ignition failure, main flame failure, and high-low gas pressure, white for day run and blue for night run.

3. Provide panel power on-off switch, a safety interlock which turns power off to cabinet when cabinet door is opened, reset buttons operable through cover of cabinet, time switch, boiler run/reset switch, and a boiler control start switch. Indicating lights to be one inch faceted 120 volt type. Switches and lights shall be installed on front of panel and wired to numbered terminal strips. Wiring shall be marked with wire markers. Door shall be furnished with flush type lock, spring latching.

4. Cabinets, control devices, and wiring shall conform to NEC and Electrical Safety Orders of CCR, Title 8, Division of Industrial Safety. Panel shall be listed under UL 508A Standard for Industrial Control Panels. Electrical circuit for boiler controls shall not exceed 120 volts and shall be 2 wire with one conductor grounded with controls in ungrounded conductor. Power wiring and control wiring including required transformers shall be pre-wired at factory. Components shall be UL approved or component recognized. Control panel assemblies shall bear a UL label.

5. Switches and indicator lights on face of panel to be identified with permanently engraved nameplates as noted on Drawings. Identify controls and wiring within panel.

6. Drawings identified with Project name shall be provided with boiler control panels. One copy shall be provided in laminated form.

7. Control panels shall be by burner or boiler manufacturers, Controlco, Klockner Moeller, Calhoun & Poxon Co., or equal.

F. Upon completion of boiler installation, furnish services of factory-trained representative of manufacturer to provide a 4 hour demonstration to Owner personnel operation of boiler controls, accessories and trim, adjustment of burners for proper input and maximum efficiency throughout range of firing rates, and provide boiler full-capacity rating.

1. Before starting boiler for tests, provide visual inspection of complete installation, to ascertain that no damage has occurred to parts of boiler and controls during shipment and installation. Replace damaged parts before proceeding with tests.

2. Provide a flue gas analysis with a carbon monoxide content of zero percent and a minimum carbon dioxide content of 10 percent with boiler operating at practical firing rates of burner and with flue gas temperatures not exceeding 500 degrees F. For boilers 75 MBH and larger, record NOX content in PPM, corrected to 3 percent oxygen.

3. Furnish and install equipment necessary for test and provide sufficient number of operators to conduct test. Provide a complete record of test data with copy for the Project Inspector witnessing test. Set exact date and hour for starting test so the Project Inspector can witness test.

4. Record main gas supply pressure at inlet of gas line control assembly, gas manifold pressure, control settings and chimney draft-inches water column.

2.07 HVAC EQUIPMENT

A. Materials and Installation: Refer to Section 23 80 00: Mechanical Equipment.

2.08 PIPING, FITTINGS, AND VALVES

A. Materials and Installation: Refer to Section 23 05 13: Mechanical Basic Materials and Methods.

2.09 GAS COMBUSTION

A. NOX reductions shall be achieved by use of both flue gas re-circulation and secondary gas combustion. Flue gas damper shall be directly linked to burner modulation motor in order to maintain appropriate flow of re-circulated flue gas. Secondary gas combustion shall be provided by a secondary, gas combustion proportioning control valve. Basic control of secondary combustion shall be obtained from burner mounted main gas butterfly valve. Burner shall incorporate a characterized cam fuel metering system, which shall provide adjustable, accurate, repeatability of fuel/air ration throughout firing range. Flue gas re-circulation blower shall be supplied with fan proving air switch, separate motor starter, and time-delay module which shall activate operation of flue gas re-circulation fan 5 seconds after main fuel valves are energized. Burner shall be Power Flame NOVA.

PART 3 – EXECUTION

3.01 INSTALLATION CODES

A. Installation of boilers and appliances in this Section shall conform to applicable requirements of current issue of National Fire Codes, ANSI, NFPA 70: NEC, CMC, ASME Boiler and Pressure Vessel Code, ASME CDS-1, UL 795 and ANSI Z21.13.

3.02 INSTALLATION

A. Boilers, heating furnaces, and similar equipment shall be installed on level non-combustible surfaces.

B. Clearance:

1. Outdoor boiler design, certified by CSA for outdoor installation, shall not be installed inside any roofed structure or below eaves, roof overhangs, near windows, or near conditioning blowers or intake ducts. Minimum space requirements and clearances from adjoining structure shall conform to manufacturer's recommendations.

2. Indoor boiler design-certified by CSA for indoor installation shall not be installed without appropriate draft hood. Vent cap shall be installed on top of chimney to avoid downdrafts. Minimum space allowances and clearances shall be as recommended by manufacturer.

C. Combustion Air: Fuel-burning boilers and equipment shall be provided with sufficient supply air for proper fuel combustion. Conform to CMC requirements.

D. Venting:

1. Fuel-burning boilers and equipment shall be vented to atmosphere to conform to CMC requirements.

2. Gas vents and chimneys shall be installed in accordance with the terms of their listing, the manufacturer's instruction and applicable code requirements.

3.03 PIPE INSTALLATION

A. Refer to the applicable provisions of Section 23 05 13, Section 22 10 00: Plumbing, and Section 23 20 13:.

B. In addition, conform to following requirements:

1. Before installation, thoroughly clean inside of pipes, fittings, and valves of dirt, scale, sand and foreign materials.

2. Provide offsets, changes in direction, branch connections and changes in size with fittings, bushings are not permitted.

3. Provide connections to equipment so that weight of pipes does not rest on equipment. Provide floor stands or hangers to carry piping weight. Provide final connections to equipment so that equipment may be removed without disturbing piping.

4. Welded pipe branches and changes in direction shall be installed with welding fittings except that reducing branches may be furnished with welding bosses. Fishmouth pipe branches may be furnished instead of welding bosses, when branch is at least 2 pipe sizes smaller than main. When branch is less than 2 pipe sizes smaller than main, furnish Weld-O-Lets. When main is less than 4 inches, furnish welding T's. Reduction in main run of piping shall be provided with eccentric reducers.

5. Furnish threaded joint for pipe up to 2 ½-inch and welded joints for pipes 3-inch and larger.

6. Piping shall be gas and watertight.

3.04 NATURAL GAS FUEL SYSTEMS

A. Install gas fuel systems as indicated on Drawings and as specified herein. Comply with applicable requirements of National Fire Codes and Uniform Mechanical Codes.

3.05 GAS APPLIANCES GENERAL REQUIREMENTS

A. Gas-fired equipment requiring a draft diverter shall be furnished with a CSA approved built-in draft diverter or a CSA approved diverter in vent pipe immediately above, and same size as, vent discharge of equipment.

B. Provide gas burning heating equipment or appliances with flue (or vent). Furnish UL type B gas vent pipe and fittings, double walled metallic type with air space between walls, non-ferrous inter-flue, and non-ferrous or galvanized steel outer casing. Terminate each flue with weather cap of same material.

1. Install and support flues so that their weight cannot be transmitted to equipment or appliance. Support at each joint. Furnish joints tight with suitable lock or manufacturer's sealing cement. Maintain clearance to combustible materials with spacers and collars.

2. Terminate each flue above roof with outlet opening not less than 12 inches from any portion of building, nor less than 4 feet from any portion of building or structure which extends at an angle of more than 45 degrees upward from horizontal. Terminate not less than 4 feet from, or one foot above any door, windows, or air intake.

C. Gas-fired appliances shall be furnished with a gas shut-off on main burner and on pilot line in addition to service stop at point where gas line connects to unit. Flexible connectors shall not be installed in or through walls, partitions or structural members.

D. Unless otherwise specified, gas appliances, and control equipment on gas-fired appliances shall be CSA approved for service in which it is installed.

3.06 PROTECTION

A. Protect the Work of this Section until Substantial Completion.

3.07 CLEANUP

A. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

END OF SECTION

SECTION 23 70 00 - MECHANICAL AIR HANDLING UNITS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Indoor and outdoor air handling units.

B. Related Requirements:

1. Division 01: General Requirements.

2. Section 23 05 00: Mechanical Common Work

3. Section 23 05 13: Mechanical Basic Materials and Methods.

4. Section 23 05 48: Mechanical Sound, Vibration and Seismic Control.

5. Section 23 07 00: Mechanical Insulation.

7. Section 23 20 13: Mechanical Above Ground Piping.

8. Section 23 80 00: Mechanical Equipment.

1.02 REFERENCES

A. Air Movement and Control Association International, Inc. (AMCA):

1. AMCA 211 – Certified Ratings Program - Product Rating Manual for Fan Air Performance.

2. AMCA 300 – Reverberant Room Method for Sound Testing of Fans.

3. AMCA 301 – Methods for Calculating Fan Sound Ratings from Laboratory Test Data.

B. Air-Conditioning, Heating, and Refrigeration Institute (AHRI):

1. AHRI 410 – Forced Circulation Air-Cooling and Air-Heating Coils.

C. American Society for Testing and Materials International (ASTM):

1. ASTM B117 – Standard Practice for Operating Salt Spray (Fog) Apparatus.

2. ASTM D2247 – Standard Practice for Testing Water Resistance of Coatings in 100 Percent Relative Humidity.

3. ASTM E84 – Standard Test Method for Surface Burning Characteristics of Building Materials.

D. National Fire Protection Association (NFPA):

1. NFPA 90A – Standard for the Installation of Air-Conditioning and Ventilating Systems.

E. Underwriters Laboratories, Inc. (UL):

1. UL 181 – Standard for Factory-Made Air Ducts and Air Connectors.

2. UL 723 – Standard for Test for Surface Burning Characteristics of Building Materials.

3. UL 1995 –Heating and Cooling Equipment.

F. Underwriters Laboratories of Canada (ULC):

1. CAN/ULC-S102.2 – Standard Method of Test for Surface Burning Characteristics of Flooring, Floor Coverings, and Miscellaneous Materials and Assemblies.

G. American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE):

1. ASHRAE Standard 62.1 – Ventilation for Acceptable Indoor Air Quality.

H. National Electrical Manufacturers Association (NEMA):

1. NEMA – MG 1, Table 12-10: NEMA Threshold Full-Load Nominal Efficiency Values for Energy-Efficient Motors.

1.03 SUBMITTALS

A. Comply with provisions of Division 01 and Section 23 05 00: Common Work Results for HVAC.

B. Manufacturer's Data:

1. Complete materials list of items proposed to be furnished and installed under this Section. Materials lists, which do not require performance data, shall include manufacturer's name, type, and model number for indicated installation.

2. Manufacturer's specifications and other data required to demonstrate compliance with specified requirements. Literature shall include descriptions of equipment, types, models and sizes proposed, capacity tables or curves marked to indicate performance characteristics, electrical requirements, options selected, space requirements and other data necessary to ensure compliance with requirements of this Specification and performances indicated on Drawings.

3. Provide data of filter media, filter performance data, filter assembly, and filter frames.

C. Shop Drawings indicating methods of installation of equipment and materials, and details of supporting structures for items indicated. Items to be submitted shall include but not be limited to the following:

1. Layout Drawings of Equipment: Include plans, elevations, and sections, of proposed equipment drawn to scale, to establish which equipment shall fit in allotted spaces with clearance for installation and maintenance. Indicate proposed details for attachment. Indicate vibration isolation units, foundations, supports, and openings for passage of pipes and ducts.

2. Electrical interlock or control diagrams for electrically controlled components furnishing more than one automatic or manual control devices, which are not indicated on Drawings.

D. Manufacturer's Recommended Installation Procedures: Manufacturer's recommended installation procedures, when reviewed by the Architect shall become basis for inspecting actual installation procedures provided.

E.

F. Submit test certification stating compliance with the maximum requirement of 1 percent cabinet leakage of the specified airflow.

G. Operations and Maintenance Data: Include instructions for lubrication, filter replacement, motor and drive replacement, spare parts list and wiring diagrams.

1.04 QUALITY ASSURANCE

A. Qualifications of Manufacturers and Installers: Comply with provisions in Section 23 0500: Common Work Results for HVAC.

B. Sound Level Measurements and Calculations:

1. Sound power level measurements and calculations shall be made in complete accordance with latest version of AMCA Standard 300, Methods for Calculating Fan Sound Ratings from Laboratory Test Data, and AMCA Standard 301, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.

2.

C. Factory Leak Testing: Manufacturer shall provide a factory leak test on units at design total static pressure across the cabinet exterior walls. Cabinet leakage shall not exceed 1 percent of specified airflow on the operating side of the unit. All panels shall be sealed with closed cell gasketing material. A written test report shall be prepared by the manufacturer and submitted to the Architect.

1.05 PROJECT RECORD DOCUMENTS

A. Provide Owner instructions on equipment operation and maintenance procedures, as indicated in Section 23 05 00.

1.06 PRODUCT HANDLING

A. Protection, Replacements, Delivery and Storage: Comply with provisions stated under Section 23 05 00.

1.07 COORDINATION

A. Coordinate related and adjacent activities in accordance with provisions of Section 01 31 13: Project Coordination.

PART 2 – PRODUCTS

2.01 CUSTOM CENTRAL STATION AIR HANDLING UNIT:

A. General:

1. Central station air-handling unit specially designed, fabricated and factory tested for the capacity, configuration, arrangement and components as indicated on Drawings.

2. Units shall be UL or ETL approved to ensure compliance with electrical codes.

3. Unit shall be serviceable through service clearances indicated on drawings.

4. Unit dimensions shall not exceed dimensions indicated on drawings.

B. Base Frame: Provide a full perimeter welded base frame capable of mounting to a curb and supporting unit during shipment, installation, and operation. Base frame shall be manufactured with structural steel tubing or C-Channel support members. Formed metal base rails with bolted or screwed support members are not acceptable. Base and unit frame shall be painted with a gray phenolic, corrosion inhibitive primer. Base rails shall be fitted with lifting lugs at corner of unit or section (if demounted). Base rail shall overhang curb to facilitate water run-off and protection of curb-to-base connection from water intrusion. Base shall include a formed pocket that seats on roof curb gasketing to provide a positive, weather-tight seal.

C. Integrated Structural Steel Base: The base shall include 4-inch foam insulation “double bottom” floor with minimum 20 gage G-90 galvanized outer and 0.125” Aluminum Treadplate inner walk-on surface. All floor seams shall be sealed for an airtight unit. Where access is provided to unit interior, floor openings shall be covered with walk on steel safety grating. Single wall floors with glued and pined insulation are not acceptable. Base frame shall be attached to unit at factory.

D. Casing:

1. Sections of unit shall be of same construction and finish except for interior panels that are specified differently for individual sections.

2. Exterior Panels: Exterior panels including cooling coil sections shall be minimum 3-inch thick formed 16 gage galvanized steel. Provide necessary support to limit casing deflection to 1/200 of narrowest panel dimension. If panels cannot meet this deflection, add additional internal reinforcing. Panel seams shall be fully welded or sealed for an airtight unit. Leakage rates shall be less than 1 percent at

design static pressure. The exterior panel finish shall have a polyurethene paint system that is designed for long term corrosion resistance meeting or exceeding ASTM B117, Salt Spray Resistance, at 95 degrees F, 1,000 hrs. and ASTM D2247, Humidity Resistance, at 95 degrees F, 2,500 hrs. The color shall be sterling gray.

3. Interior Panels: Casing shall be of double wall construction with 20 gage interior galvanized steel liner in all sections and 22 gage galvanized steel perforated liner in all fan sections.

4. Insulation: Casing shall have 3-inch minimum thickness fiberglass insulation with a density of not less than 3 pounds per cubic foot. The insulation shall have an effective thermal conductivity (C) of 0.24 BTU in./sq.ft.°F and a noise reduction coefficient (NRC) of 0.70 per inch thick (based on a type "A" mounting). Insulation and insulation adhesive shall be UL listed and shall meet NFPA 90A flame spread and smoke generation requirements. Insulation shall meet erosion requirements of UL 181 facing air stream and fire hazard classification of 25/50 (per ASTM E84 and UL 723 and CAN/ULC-S102.2). All insulation edges shall be encapsulated within exterior panel. Insulation facing air stream shall be provided with black acrylic coating.

5. Thermal Breaks: Casing construction downstream of the cooling coil shall consist of thermal break panels to prevent condensation from accumulating on outer walls

A. Access Doors - The unit shall be equipped with a solid double wall insulated (same as the unit casing), hinged access doors as shown on the plans. The doorframe shall be extruded aluminum, foam filled with a built in thermal break barrier and full perimeter gasket. The door hinge assembly shall be completely adjustable die cast stainless steel. There shall be a minimum of two heavy duty handles per door. Provide ETL, UL 1995, and CAL-OSHA approved tool operated safety latch on all fan section access doors.

7. Roof for outdoor units shall be double wall, pitched away from motor side of unit at a minimum roof pitch of ¼ inch per foot across width of unit. No penetrations shall be permitted in pressure-sensitive panels. Roof shall incorporate a standing top seam. Seams in roof shall be gasketed and capped to prevent water infiltration into unit.

8. Floors shall be double wall. Insulation shall be capped to isolate floor insulation from both airstream and from potential water damage.

9. Units shall be painted with a polyester resin coating designed for long term corrosion resistance meeting or exceeding (ASTM B-117) Salt Spray Resistance at 95 degrees F. 2500 hrs. and (ASTM D-2247) Humidity Resistance at 95 degrees F. 2500 hrs. The color shall be sandstone.

10. Unit shall provide an integral base which is capable of curb, platform or pad mounting and supporting unit during shipment, installation, and operation.

11. Base shall overhang curb to facilitate water run-off and protection of curb-to-base connection from water intrusion.

12. Base shall include a formed pocket that seats on roof curb gasketing to provide a positive, weather-tight seal.

E. Fan Section:

1. The multiple fan array systems shall include multiple, direct driven, arrangement 4 plenum fans constructed per AMCA requirements for the duty specified class III as required. Class I fans are not acceptable. Fans shall be rated in accordance with and certified by AMCA for performance. All fans shall be selected to deliver the specified airflow quantity at the specified operating Total Static Pressure and specified fan/motor speed. The fan array shall be selected to operate at a system Total Static Pressure that does not exceed 90% of the specified fan's peak static pressure producing capability at the specified fan/motor speed. Each fan/motor cube or cell shall include a minimum 10 gauge, G 90 Galvanized steel intake wall, .100 aluminum spun fan inlet funnel, and an 7 gauge HR steel (painted) motor support plate rail and structure.

   The fan array shall consist of multiple fan and motor "cubes" or "cells", spaced in the air way tunnel cross section to provide a uniform air flow and velocity profile across the entire air way tunnel cross section and components contained therein. In order to assure uniform velocity profile in the AHU cross section, the fan cube dimensions must be variable, such that each fan rests in an identically sized cube or cell, and in a spacing that must be such that the submitted array dimensions fill a minimum of 90% of the cross sectional area of the AHU air way tunnel. There shall be no blank off plates or "spacers" between adjacent fan columns or rows to position the fans across the air way tunnel. The array shall produce a uniform air flow profile and velocity profile within the airway tunnel of the air handling unit to equal the specified cooling coil and/or filter bank face velocity by +/- 10% when measured at a point 36" from the intake side of the fan array intake plenum wall, and at a distance of 72" from the discharge side of the fan array intake plenum wall. Submittals for units providing less than the scheduled quantity of fans and/or spacing of the fans for multiple fan arrays shall submit CFD modeling of the air flow profile for pre-bid approval that indicates uniform velocity and flow across all internal components without increasing the length of the AHU unit or changing the aspect ratio of the unit casing as designed.

2. Fans: Provide HPF-P2---ECMi high efficiency centrifugal fan with integral ECM motor featuring running impeller made from composite materials with optimized backward-cruved, fluted blades and integral non-fluted diffuser with matched high efficiency ECM motor.

Each fan/motor assembly shall be dynamically balanced to meet AMCA standard 204-96, exceeding category BV-5, to meet or exceed an equivalent Grade G.55, producing a maximum rotational imbalance of .03" per second peak, filter in (.55mm per second peak, filter in). Fan and motor assemblies submitted for approval incorporating larger than 22" wheel size and 215 T frames size motors shall be balanced in three orthogonal planes to demonstrate compliance with the G.55 requirement with a maximum rotational imbalance of .03" per second peak filter in (.55 mm per second peak, filter in). Copies of the certified balancing reports shall be provided with the unit O&M manuals at the time of shipment. Submittals that do not include a statement of compliance with this requirement will be returned to the contractor without review3.

5. Fan Motor: The ECM motor shall be UL listed with brushless permanent magnet motor with following features:

   Bearings are permanently lubricated

Design life of L10 100,000 hours
Integral means of shaft isolation to prevent electrical arcing across bearings
Mtoor shall feature internal monitoring circuits to detect and protect the motors from overcurrent and over temp conditions.
Motors shall meet IP54 protection and thermal class THCL 155

6. Fan Sound Ratings: Fans shall be AMCA 211 rated for performance and AMCA 300 and 301 rated for sound.

7. Accessories: The fan section shall be furnished with double pane glass viewport with safety wire reinforcement, field wired service light with safety cage and extended lubrication lines to unit exterior for fan motor and fan bearings

F. Coil Section:

1. General: Cooling coils shall be mounted on stainless steel support rack to permit coils to slide out individually from the unit. Provide intermediate drain pans on all stacked cooling coils. The intermediate pan shall drain to the main drain pan through a copper downspout. Water coils shall be constructed of seamless copper tubing mechanically expanded into fin collars. All fins shall be continuous within the coil casing to eliminate carryover inherent with a split fin design. Fins are die formed Plate type.

2. Coil Test and Standards: Coils shall be leak tested at 450 psig air pressure while submerged in water. Coil performance shall be certified in accordance with AHRI Standard 410. Coils shall be furnished with galvanized steel casing as standard.

3. Chilled Water Coils: Chilled water coils shall be aluminum sinusoidal plate fin type with belled collars and shall be bonded to 5/8 inch OD copper tubes by mechanical expansion. Coils shall be provided with headers for MPT or Victaulic connections. Working pressure shall be 300 psig at 200 degrees F. 0.008 inch thick aluminum-fin coils shall be provided with a wet-table finish to minimize water blow off. Coil casings and tube supports shall be 304 stainless steel. Coils shall be drainable and shall be provided with non-trapping circuits. Copper headers shall be provided with drain and vent connections external to unit.

4. Hot Water Coils: Hot water coils shall be 0.008 inch thick aluminum plate fin type with belled collars bonded to 5/8 inch OD Coils shall be provided with copper or red brass headers for MPT connections. Working pressures shall be 175 psig at 400 F. Headers shall be furnished with drain and vent connections external to unit.

5. Steam Distributing Coils: Steam distributing coils (non-freeze type) shall be 0.008” thick aluminum plate fin type with an outer copper tube diameter of 1 in. with a 5/8-inch diameter inner distributing tube and steel headers for MPT connections. Working pressure shall be 175 psig at 400 degrees F.

6. Coil Tubes: Tube wall thickness shall not be less than 0.02 inch. Tube diameter with 0.025 inch brazed return bends on water and refrigerant coils. Tubes shall be 5/8 inch OD to ensure high thermal performance with lower total flow and reduced pumping requirements. Intermediate tube support shall be provided for coils over 44-inch fin length with an additional support every 42 inches.

   a. Coil options shall be furnished with 0.008 inch thick aluminum fin construction.

7. Coil Piping Roof Penetrations: Roof curbs shall be rectangular without any offsets for coil piping to ensure a watertight roof connection. Coil piping which penetrates roof must be externally located from primary unit curb.8.

G. Filter Section:

1. General: Each filter section shall be designed and constructed to house specific type of filter indicated on equipment schedule. Provide filters of type indicated on schedule. A double-walled hinged access door, as specified above, shall be provided on side of section. Internal blank-offs shall be provided to prevent air bypass around filters.

2. Filters: Provide filters of the type indicated on the schedule. Factory fabricated filter sections shall be of the same construction and finish as the unit. Face loaded pre and final filters shall have Type 8 frames as manufactured by BLC, FARR or equal. Filter racks over 72" in length shall require an angle center reinforcement support. Side service filter racks shall be fabricated from no less than 16 gauge galvanized steel and include hinged access doors on both sides of the unit or as indicated on unit drawings. Internal blank-offs shall be provided by the air unit manufacturer as required to prevent air bypass around the filters

3. Filter Gauge: Each Filter bank shall be furnished with Dwyer Series 2000 filter gauge or equal

4. Prefilters: MERV 8 Pleated filters – Provide (2” or 4”) filters as specified on filter schedule. The filters shall be as manufactured by AAF, FARR or equal. Filters shall be in compliance with ANSI/UL 900 – Test Performance of Air Filters. Option: Provide (2) total sets of media

5. Final Filters: MERV (13 or 14) Minipleat filters - Provide (12” deep) filters as specified on the filter schedule. The filters shall be listed as Class II under UL Standard 900. The filters shall be as manufactured by AAF, FARR or equal. Filters shall be in compliance with ANSI/UL 900 – Test Performance of Air Filters. Option: Provide (1) total sets of media

6. Mixing boxes or Economizer Section: Combination exhaust mixing boxes and filter-mixing boxes shall be furnished with opposed blades, interconnecting outside-air and return-air low leak dampers. Mixing boxes and filter-mixing boxes shall be furnished with a double-walled hinged access door as specified. Floors of 16 gage galvanized steel shall be furnished for mixing boxes to protect insulation during installation and servicing of damper actuators. Non-ducted outside air intakes shall include stationary louvers to reduce opportunity for rain or snow to enter unit.

H. Damper Section:

1. Damper blades shall be Ruskin CD-50 extruded aluminum, housed in a galvanized steel frame and mechanically fastened to a hex axle rod rotating in stainless steel bearings. Dampers shall be sectionalized to limit blade length to no more than 48 inches so as to minimize blade warpage. Replaceable neoprene blade seals are to be provided to insure tight closure.

3. Dampers shall be rated for maximum leakage rate per square foot of 7 cf. at 1.0 inch wg. Optional premium dampers shall be available for maximum leakage rate per square foot of 5 cfm at 1.0 inch wg. Damper blades shall be double-skin extruded aluminum airfoil type with stainless steel jam seals.

I. Plenum Sections:

1. General: Inlet, discharge, access, and plenum sections shall be installed where indicated on Drawings and shall be as specified on equipment schedule.

2. OSA section: Ruskin EME3625 extruded aluminum louvers shall be used at O/A location. Louvers shall be stationary, drainable type with built in downspouts and furnished with birdscreen. Blades shall be vertical and housed inside an aluminum frame mounted to the unit exterior. Louver finish to match exterior unit finish.

3. Access sections: Access sections shall be provided by a double-walled hinged door, as specified above and 16 gage galvanized steel floors to protect insulation.

4. Downblast discharge section: Downblast discharge section, which provides an opening through roof, shall be furnished with a grating over duct opening of sufficient size and strength to support a minimum of 300 pounds.

5.

K. Electrical: Provide electrical and automatic control devices that are listed below and on drawings:

1. The units shall be factory pre-wired for a single point electrical power connection for both power and control circuits. Manufacturer shall provide a factory furnished and wired step down transformer with a fused disconnect for 120 Volt service.

2. Provide a main disconnect for each unit.

3. Each fan shall be wired to an individual ABB Variable Frequency drive. One per motor with individual disconnects.

4. The unit shall be equipped with vapor proof light fixtures with guard.

5. Lights shall be controlled by one light switch mounted adjacent to supply air fan access door. Lights shall be provided in each accessible section.

6. Furnish a 120 Volt duplex convenience outlet on exterior of unit. Locate outlet next to fan section access door.

7.

L. Acoustical Performance Requirements: The sound generating characteristics of air handling and multi-zone units shall be tested to, and comply with, all requirements of this specification. Representative samples shall be subjected to tests in accordance with applicable standards and procedures in order to demonstrate such compliance. A special test for this project is not required if manufacturer has previous certified test results that can be made applicable to this project.

M. Manufacturer: Temtrol, UMAS, Dynamic Air. Buffalo Forge

PART 3 – EXECUTION

3.01 GENERAL

A. Examine areas under which Work of this Section will be performed. Correct conditions detrimental to proper and timely completion of Work. Do not proceed until unsatisfactory conditions have been corrected.

3.02 EQUIPMENT FOUNDATIONS

A. Equipment foundations shall be of sufficient size and weight, and of proper design to preclude shifting of equipment under operating conditions, or under any abnormal conditions imposed upon equipment.

B. Foundations shall meet requirements of equipment manufacturer and, when required by the Architect, obtain from equipment manufacturer, approval of foundation design and construction for equipment to be installed. Equipment vibration shall be maintained within design limits, and shall be dampened and isolated. Isolators shall be bolted to a steel member so as to be readily removable.

3.03 EQUIPMENT INSTALLATION

A. Equipment Installation: Equipment installation shall be in strict accordance with these Specifications, and installation instructions of manufacturers. Equipment installed on concrete foundations shall be grouted before piping is installed. Piping shall be installed in such a manner as not to place a strain on any of the equipment. Flanged joints shall be adequately extended before installation.

1. Install equipment in a neat and skillful manner, properly aligned, leveled, and adjusted for satisfactory operation.

2. Install so connecting and disconnecting of piping and accessories can be readily accomplished, parts are readily accessible for inspection, service and repair. Space shall be provided to readily remove filters, coils, and fan wheels.

3.04 NOISE AND VIBRATION

A. Operation of Equipment: Mechanical equipment and piping systems shall operate without exceeding specified noise and/or vibration levels.

B. Corrective Measures: If specified noise and/or vibration levels are exceeded, provide necessary changes to reduce noise and/or vibration levels to within specified levels.

3.05 FIELD TESTS AND INSPECTION

A. General: Perform field inspections, field tests, and trial operations as specified in Section 23 0500: Common Work Results for HVAC. Provide labor, equipment and incidentals required for testing. The Project Inspector will witness field tests and trial operations as specified in Section 23 05 00.

B. Equipment and Material: Equipment and material certified as being successfully tested by manufacturer, in accordance with referenced Specifications and standards, will not require re-testing before installation. Equipment and materials not tested at the place of manufacture will be tested before or after installation, as applicable or necessary, to determine compliance with reference Specifications and standards.

C. Start-Up and Operational Test: System shall be started up and initially operated with components operating. During this test, filters shall be periodically cleaned until no further accumulation of foreign material occurs. Adjust safety and automatic control instruments as required to provide proper operation and control sequence. Refer to Section 23 05 00.

D. Extent of Field Tests: After installation and before completion, Work of this Section shall be subjected to required field tests, including those specified here and in Section 23 05 00.

E. Operation and Maintenance Data: Provide required operation and maintenance data as specified in Section 23 05 00.

3.06 PROTECTION

A. Protect the Work of this Section until Substantial Completion.

3.07 CLEANUP

A. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

END OF SECTION

SECTION 23 80 00

MECHANICAL EQUIPMENT

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes: Air conditioning and air handling equipment including but not limited to:

1. Fans.
2. Split systems

B. Related Requirements:

1. Division 01: General Requirements.
2. Section 07 60 00: Flashing and Sheet Metal.
3. Section 22 10 00: Plumbing.
4. Section 23 05 00: Mechanical Common Work.
5. Section 23 05 13: Mechanical Basic Materials and Methods.
6. Section 23 05 48: Mechanical Sound, Vibration and Seismic Control.
7. Section 23 09 23: Mechanical Environmental Control and Energy Management System.
8. Section 23 30 00: Mechanical Air Distribution.
9. Section 23 50 00: Mechanical Central Heating Equipment.

1.02 DESIGN REQUIREMENTS

A. Work of this Section is based on HVAC equipment units indicated as Basis of Design in Part 2 of this Section. Products from different HVAC equipment manufacturers listed are never identical, although equivalent in capacity, performance and quality. In the cases where dimensions, weight, configuration and utility requirements differ from the products used as a basis of design, the Contractor, at no additional cost to the Owner, shall coordinate and submit, for Architect review, revisions to the design.

1.03 SUBMITTALS

A. Provide in accordance with Division 01 and Section 23 05 00: Mechanical Common Work.

B. For products listed that are not the basis of design, submit the following in addition to above requirements:

1. Title 24 Calculations: Replace HVAC unit values in calculation files provided by the Architect and submit for review.

1.04 QUALITY ASSURANCE

A. Provide submittals in accordance with Section 23 0500: Mechanical Common Work.

1.05 PROJECT RECORD DOCUMENTS

A. Provide Owner instructions on equipment operation and maintenance procedures, as indicated in Section 23 0500: Mechanical Common Work.

1.06 WARRANTY

A. Compressors shall be provided with manufacturer's five year warranty, replacement only.

B. Manufacturer shall warrant parts, except heat exchangers, for a period of five years.

C. Heat exchangers shall be provided with manufacturer’s ten year warranty, replacement only.

PART 2 – PRODUCTS

2.01 EQUIPMENT

A. Capacities of air conditioning equipment indicated on Drawings are net capacities actually required. Standard catalog ratings shall be adjusted to actual Project site environmental conditions.

2.02 AIR CONDITIONING UNITS - AC (2 Tons-25 Tons)

A. Manufacturers: Carrier, Trane, York, Lennox, Nortek.

1. Basis of Design: Nortek

B. Quality Assurance:

1. Units shall be CSA certified for outdoor installation.

2. Cooling capacity shall be rated in accordance with current ANSI/AHRI Standard 210/240.

3. Unit shall be UL or ETL listed and designed to conform to ANSI/ASHRAE Standard 15 Safety Code for Mechanical Refrigeration and ANSI Z21.47-2016/CSA 2.3-2016 Gas

4. ANSI/NFPA 70: National Electrical Code.

5. Unit cooling efficiency EER/SEER ratings shall comply with CCR, Title 24, Building Energy Efficiency Standards for Residential and Nonresidential Buildings, and shall not be less than ratings indicated on drawings.

6. Unit heating efficiencies AFUE ratings shall comply with current CCR, Title 24, Building Energy Efficiency Standards for Residential and Nonresidential Buildings, and shall not be less than ratings indicated on drawings.

7. Unit shall comply with California Maximum Oxides of Nitrogen (NOX) Emission Regulations and current SCAQMD regulations.

8. The unit roof curbs shall conform to NRCA standards.

9. Insulation and adhesive shall meet NFPA 90A and 90B requirements for flame spread and smoke generation.

10. Unit casing shall be capable of withstanding ASTM B117 500-hour salt spray test.

11. Each unit shall be run tested at factory per ANSI/ASHRAE 37 and provided with a certificate indicating tested pressures, amperages, dates, and inspector.

C. Refrigerant circuit components:

1. Thermostatic expansion valve (TXV) with removable power element.

2. Refrigerant strainer.

3. Service gage connections on suction, discharge, and liquid lines.

4. Solid core refrigerant filter driers.

D. Evaporator and Condenser Coils: Standard Evaporator and condenser coils shall be furnished with:

1. Acceptable Condenser Coils:

a. Copper-tube, Aluminum-fin coil, with liquid subcooler. Internally enhanced OD seamless copper tubing mechanically bonded to aluminum fins in combination with a factory applied Corrosion-Resistant Epoxy Coating. Provide Protective Hail Guard.

b. Spine Fin condenser coil shall be continuously wrapped, corrosion resistant aluminum with minimum brazed joints. This coil is 3/8 inch OD seamless aluminum tubing glued to a continuous aluminum fin. Coils are lab tested to withstand 2,000 pounds of pressure per square inch. The outdoor coil provides low airflow resistance and efficient heat transfer. The coil is protected on four sides by louvered panels.

c. Coil shall be air-cooled Micro-Channel Heat Exchanger Technology (MCHX) and shall have a series of flat tubes containing a series of multiple, parallel flow microchannels layered between the refrigerant manifolds. Coils shall consist of a two-pass arrangement. Coil construction shall consist of aluminum alloys for fins, tubes, and manifolds in combination with a factory applied Corrosion-Resistant Epoxy Coating. Provide protective Hail Guard.

2. Evaporator coils

a. Aluminum plate fins mechanically bonded to enhanced copper tubes with joints brazed.

b. Tube sheet openings shall be belled to prevent tube wear.

c. Evaporator coil shall be of full-face active design.

d. Dual circuit models shall have face-split type evaporator coil.

E. Evaporator and Condenser Coils shall be furnished with copper plate fins mechanically bonded to enhanced copper tubes with copper tube sheets and brazed joints with a factory applied Corrosion-Resistant Epoxy Coating utilizing dipping process. Provide protective Hail Guard.

F. Fans and Motors:

1. Direct -drive indoor fans shall be provided for the AC Units with the cooling capacity of less than or equal to 60,000 BTU/H.

2. Belt drive indoor fan shall be provided on AC Units with the cooling capacity of greater than 72,000 BTU/H include an adjustable-pitch motor pulley. Fans shall accommodate from 0.6 inch to 1.6-inch external static pressure without changing drives or motors.

3. Condenser fan shall be a dynamically balanced, propeller type, fabricated of aluminum blades riveted to corrosion resistant steel spiders and direct-driven by a totally enclosed motor. Condenser air shall be discharged vertically. Condenser fan motor shall be ECM type motor and provide cooling operation down to 25 degrees F outdoor temperature with automatic-reset thermal overload protection.

G. Heating Section:

1. Induced draft combustion type with energy saving direct spark ignition system, redundant main gas valve, and 2-stage heat.

2. The heat exchanger shall be of tubular section type fabricated of a minimum of 20 gage steel coated with a nominal 1.2 mil aluminum-silicone alloy or 20 gage type 409 stainless steel, including stainless steel tubes, vestibule plate.

3. Burners shall be of in-shot type fabricated of aluminum coated steel or stainless steel.

4. Gas piping shall enter unit cabinet at a single location.

5. Integrated Controls shall provide following:

a. Timed control of evaporator fan functioning and burner ignition,

b. Anti-cycle protection for gas heat operation (after one cycle on high temperature limit switch and one cycle on flame rollout switch).

c. Diagnostic information.

6. Induced draft motor shall be provided with permanently lubricated, sealed bearings and inherent automatic reset thermal overload protection.

H. Controls, Safeties and Diagnostic Points:

1. Unit Controls: Unit shall be furnished with self-contained, BACnet MS/TP Direct Digital Controls.

   a. Controls shall be factory-installed.

   b. Controls shall operate with zone control systems.

   c. Controls shall furnish built-in diagnostics for thermostat/sensor commands for staged heating and cooling, evaporator-fan operation, and economizer operation.

   d. Controls shall be furnished with a 5-minute time delay between modes of operation.

   e. Control circuit shall be protected by a fuse on 24-V transformer side.

   f. Control shall incorporate passive infrared detection for sensing occupancy in space serve.

2. Compressor high temperature, high current, internal overloads, internal thermostat.

   a. Compressor reverse rotation protection.

   b. Loss-of-charge/low-pressure switch.

   c. Freeze-protection thermostat, evaporator coil.

   d. High-pressure switch.

   e. Internal relief valve.

   f. Anti-recycle relay, or time cycle device to prevent rapid cycling of compressor after any off cycle.

3. Heating section shall be provided with following minimum protections:

   a. High-temperature limit switches.

   b. Induced draft motor speed sensor.

   c. Flame rollout switch.

   d. Flame proving controls.

   e. Redundant main gas valve.

   f. Heating controls shall consist of:

1) 2-stage automatic combination gas valve.

2) Pressure regulator.

3) Electric spark intermittent ignition system or hot surface ignition system.

4) Time delay fan control.

4. Operating Characteristics:

a. Unit shall be capable of starting and operating at 125 degrees F ambient outdoor temperature, meeting maximum load criteria of AHRI Standard 210/240 or 360 at plus or minus 10 percent voltage.

b. Compressor with standard controls shall be capable of operation down to 25 degrees F ambient outdoor temperature.

5. EMS Diagnostic Points: Provide diagnostic points for units, including those at projects with no EMS.

a. Supply air temperature.

b. Return air temperature.

c. Space temperature.

d. Outdoor air temperature.

e. Filter status, via pressure transducer on analog point.

f. Fan status.

g. Compressor status.

h. Economizer damper current position.

i. Other diagnostic point required by current Title 24, automated fault detection and diagnostics (FDD).

I. Filter Section:

1. Provide filter section with factory-installed low-velocity, throwaway, 4-inch or 2-inch thick high capacity, MERV 13 Class 2, filters of commercially available sizes unless noted otherwise on the drawings.

2. Filter face velocity shall not exceed 300 fpm at nominal airflows.

3. Filter section shall allow installation of standard size air filter.

4. Return air filters shall be accessible through a hinged access panel using standard size filters.

J. 100 Percent Outdoor Air Economizer:

1. Provide 100 percent outdoor air economizers as indicated on drawings.

2. Gear-driven integrated economizers.

3. Integrated integral-modulating type capable of simultaneous economizer and compressor operation.

4. Furnish hardware and controls to provide cooling with outdoor air.

5. Low-leakage dampers not to exceed 3 percent leakage, at one inch wg pressure differential (variable sliding economizer).

6. Barometric relief damper. Damper shall close upon unit shutoff.

7. Differential temperature and enthalpy controller unless indicated otherwise on drawings.

8. Provide units with centrifugal power exhaust controlled by a pressure sensor in space or outdoor air measurement and tracking as indicated on drawings. The controller shall modulate VFD in centrifugal power exhaust to maintain a pressure differential of 0.03 inch of water between indoor and atmospheric pressure. Furnish field wiring to power exhaust and install tubing in space. Provide other accessories as required to comply with UL or ETL requirements.

9. Base Rail: Factory installed on both horizontal and down-flow units.

10. Dampers Using Electronic Actuators:

    a. Manufacturer: Belimo, Honeywell, Invensys, Johnson Controls, or equal.

    b. Size for torque required for damper seal at load conditions.

    c. Coupling: V-bolt dual nut clamp with a V-shaped, toothed cradle.

    d. Overload Protection: Electronic overload or digital rotation-sensing circuitry without the use of end switches to prevent damage to the actuator during a stall condition.

    e. Fail-Safe Operation: Mechanical, spring-return mechanism.

    f. Power Requirements: Maximum of 10 VA at 24 VAC or 8 W at 24 VDC.

    g. Proportional Actuators shall be fully programmable. Control input, position feedback and running time shall be factory or field programmable by use of external computer software. Diagnostic feedback shall provide indications of hunting or oscillation, mechanical overload and mechanical travel. Programming shall be through EEPROM without the use of actuator mounted switches.

    h. Actuators shall be listed by ISO 9001, ULC, and CSA C22.2.

K. Furnish programmable digital thermostat with following features for single zone units that are not provided with variable volume and variable temperature type controls:

1. 7-day time clock.

2. Heat, cool, automatic changeover.

3. Occupied/unoccupied modes.

4. Remote sensors. School Areas that could be subject to vandalism or accidental impact damage such as Gymnasiums, Auditoriums, Multipurpose Rooms, Corridors, and Lobbies shall be provided with thermostats with remote return air duct or room sensors. Verify remote location of sensors and thermostats with Architect.

5. Robertshaw, Honeywell, Johnson Controls, Carrier, Schneider Electric, Viconics, or equal with built-in PIR occupancy sensor. Refer to Section 23 0900 for areas with zone damper controls.

L. Demand Controlled Ventilation:

1. Units with 100 percent outdoor air economizers shall be provided with Indoor Air Quality (CO_2) Sensor and Accessory Electronic Expansion Boards.

2. The unit shall have ability to provide demand ventilation indoor-air quality (IAQ) control through economizer when provided with an indoor air quality sensor and accessory expansion board.

3. The IAQ sensor shall be wall mounted unless otherwise indicated on Drawings. The set point shall be adjustable.

4. The IAQ sensor shall be powered through unit. If not, required control transformer shall be provided by manufacturer. Coordinate power requirements and location with Division 26.

5. The IAQ sensor shall provide a 0-10 VDC signal to expansion board.

M. Parts Availability: Submit proof in writing that majority (minimum 80 percent) of the replacements parts are commonly available and not proprietary. Also, submit proof in writing that a local parts sales and service facility exists, where replacement parts will be warehoused in quantity. Guarantee timely availability for parts that are proprietary.

2.03. COOLING ONLY FAN COIL UNITS AND CONDENSING UNITS

A. Manufacturer: Carrier, Trane, York, Lennox, American Standard Heating & Air Conditioning, or equal.

1. Basis of Design: Carrier

B. FCU and CU: Furnish fan coil unit (FCU) and condensing unit (CU), split type, air-cooled, roof or ground for ducted connections or free blow. Units shall be air-cooled condensing unit/direct expansion fan coil combinations. Condensing unit outdoor section shall be factory assembled with a direct-drive condenser fans with horizontal or vertical air discharge, scroll-type

compressor, refrigerant coil, fan motors, pre-wired control panel and a holding charge of a non-ozone depleting refrigerant. Contractor shall provide additional refrigerant for extended lines. Indoor fan coil unit shall be furnished with horizontal discharge and will include evaporator coil, fan and motor, condensate pan with drain, thermal expansion valve, pre-wired control panel and remote thermostat control. Unit shall provide an EER/SEER complying with CCR, Title 24, Building Energy Efficiency Standards for Residential and Nonresidential Buildings. UL listed and rated at AHRI Standard 210/240.

C. Nominal unit cooling, heating capacities, electrical characteristics, and operating conditions shall be as indicated on Drawings.

D. Condenser coils:

1. Acceptable Condenser Coils:

a. Copper-tube, aluminum-fin coil, with liquid subcooler. Internally enhanced 3/8-inch outside diameter, seamless copper tubing mechanically bonded to aluminum fins with a factory applied Corrosion-Resistant Epoxy Coating. Provide Protective Hail Guard.

b. Spine Fin™ condenser coil shall be continuously wrapped, corrosion resistant aluminum with minimum brazed joints. This coil is 3/8 inch outside diameter seamless aluminum tubing glued to a continuous aluminum fin. Coils are lab tested to withstand 2,000 pounds of pressure per square inch. The outdoor coil provides low airflow resistance and efficient heat transfer. The coil is protected on four sides by louvered panels.

c. Coil shall be air-cooled Micro-Channel heat exchanger technology (MCHX) and shall have a series of flat tubes containing a series of multiple, parallel flow microchannels layered between the refrigerant manifolds. Coils shall consist of a two-pass arrangement. Coil construction shall consist of aluminum alloys for fins, tubes, and manifolds in combination with a factory applied Corrosion-Resistant Epoxy Coating. Provide Protective Hail Guard.

E. Condenser Coils shall be furnished with copper plate fins mechanically bonded to enhanced copper tubes with copper tube sheets and brazed joints and with factory applied Corrosion-Resistance Epoxy Coating. Field coated coils are not acceptable.

F. Evaporator coils:

1. Aluminum plate fins mechanically bonded to enhanced copper tubes with joints brazed and factory applied Corrosion-Resistance Epoxy Coating.

2. Tube sheet openings shall be belled to prevent tube wear.

3. Evaporator coil shall be of full-face active design. Dual circuit models shall have face-split type evaporator coil.

G. Evaporator Coils at locations within two miles from ocean shall be furnished with copper plate fins mechanically bonded to enhanced copper tubes with copper tube sheets and brazed joints and with factory applied Corrosion-Resistance Epoxy Coating. Field coated coils are not acceptable.

H. Condenser Fan and Motors: Condenser fan shall be a dynamically balanced, propeller type, fabricated of aluminum blades riveted to corrosion resistant steel spiders and direct-driven by a totally enclosed motor. Condenser air shall be discharged horizontally or vertically. Condenser fan motors shall be high efficiency or ECM type motor.

I. Cabinets: Fabricated of galvanized steel, bonderized and finished with baked enamel.

J. Compressor shall be serviceable two stage or variable speed type hermetic scroll. Compressor shall be furnished with access valves and shall be installed on rubber isolators to reduce sound vibration. It shall be furnished with high and low-pressure protection. Each horizontal discharge condensing unit shall be furnished with a factory installed suction accumulator. Field installed accumulators are not permitted. It shall be furnished with high and low-pressure protection, brass external vapor supply line service valves, vapor return line service valves with service gage connection port, service gage port connections on compressor suction and discharge lines with Schrader-type fittings with brass caps, filter drier, pressure relief, liquid line solenoid valves, thermostatic expansion valves, and a holding charge of refrigerant.

K. Controls: Compressor motor assembly shall be protected with high and low-pressure switches, internal overloads, internal thermostat, internal relief valve, and anti-recycle relay, or time cycle device to prevent rapid cycling of compressor after any off cycle. Unit shall incorporate an automatic relay for indoor circulating air blower. Control panel shall be pre-wired in unit casing. The control circuit shall incorporate a manual reset safety circuit to render refrigerant system (compressor and outdoor air motor) inoperative should there be a loss of airflow or refrigerant. Units shall also be furnished with automatic condenser-fan motor protection, high condensing temperature protection, compressor motor current and temperature overload protection, high pressure relief, and condenser fan failure protection.

L. EMS Diagnostic Points:

1. Supply air temperature.

2. Return air temperature.

3. Space temperature.

4. Filter status, via Pressure transducer on analog point.

5. Fan status.

6. Compressor status.

7. Other diagnostic point required by current Title 24, automated fault detection and diagnostics (FDD).

M. Low Ambient Operation: Head pressure control shall be provided for operation at outside air temperature below 45 degrees F.

N. Filters: Filters shall be 2-inch standard size high capacity replaceable media type MERV 13, installed in an external 2-inch rack filter section and complete with an access door.

O. An in-line filter-drier shall be provided with equipment and shall be installed at Project site.

P. Economizer: Provide on units with capacities equal to, or larger than 4.5 tons nominal capacity, when the Prescriptive Compliance approach is utilized to comply with Energy Efficiency Standards or where necessary to achieve CHPS pre-requisite and/or CHPS building flush-out compliance. Economizer shall be manufacturer's standard; factory furnished and field installed. Economizer control shall maintain a fixed supply air temperature during free cooling operation by providing full modulation of operable outside and return air dampers.

2.04. HEAT PUMP AND FAN COIL UNITS

A. Manufacturer: Carrier, Trane, York, Lennox, American Standard Heating & Air Conditioning, or equal.

1. Basis of Design: Carrier

B. Heat Pump matching indoor fan coil and Outdoor unit: Furnish heat pump, split type, air-cooled, roof or ground installation with ducted connections or free blow. Units shall be air-cooled heat pump/direct expansion fan coil combinations. Heat pump outdoor section shall be factory assembled and furnished with direct-drive Outdoor fans with horizontal or vertical air discharge, scroll type compressor, refrigerant coil, fan motors, pre-wired control panel. Unit shall also be provided with a fully piped refrigerant circuit, fully charged with an environmentally friendly refrigerant that is not scheduled for phase out. Provide additional refrigerant for extended lines. Indoor fan coil unit shall be furnished with horizontal discharge and will include Indoor coil, fan and motor, condensate pan with drain, thermal expansion valve, pre-wired control panel and remote thermostat control. Nominal unit cooling, heating capacities, electrical characteristics, and operating conditions shall be as indicated on Drawings.

C. Quality Assurance:

1. Cooling capacity rated in accordance with current AHRI Standard 210/240 and 270. Units shall be listed in AHRI.

2. Unit construction shall comply with ANSI/ASHRAE 15, latest revision, and with NEC.

3. Units shall be constructed in accordance with UL standards and shall carry UL/ETL label of approval.

4. Units shall be listed in CEC directory.

5. Unit cabinet shall be capable of withstanding ASTM B117 500 hour salt spray test.

6. Unit shall provide an EER/SEER/COP complying with CCR, Title 24, Building Energy Efficiency Standards and per the drawings.

D. Indoor and Outdoor coils: Indoor and Outdoor coils shall be copper with mechanically bonded, smooth aluminum plate fins. Tube joints shall be brazed with copper or silver alloy. Coils shall be pressure-tested at factory. Protective metal guard for inlet and outlet of outdoor coil.

E. Indoor and Outdoor Coils at locations within two miles from ocean shall be furnished with copper plate fins mechanically bonded to enhanced copper tubes with copper tube sheets and brazed joints and with factory applied Corrosion-Resistance Epoxy Coating. Field coated coils are not acceptable.

F. Fans:

1. Outdoor Fan and Motors: Outdoor fan shall be ECM type motor direct driven, propeller type arranged for horizontal or vertical discharge. Outdoor fan motors shall be furnished with inherent protection, and shall be permanently lubricated type, resiliently mounted for quiet operation. Each fan shall be furnished with a safety guard.

2. Indoor fan section shall be furnished with ECM type motor centrifugal, forward curved, double width, double inlet fan or fans installed on a solid shaft. Fan shall be statically and dynamically balanced and shall rotate on permanently lubricated bearings.

G. Unit Cabinets:

1. Cabinets shall be fabricated of galvanized steel, bonderized and finished with baked enamel.

2. Cabinet interior shall be insulated with minimum one inch thick foil face fiberglass.

3. Outdoor unit compartment shall be isolated and have an acoustic lining to assure quiet operation.

H. Compressor: Compressor shall be two stage or variable speed type hermetic scroll.

1. Compressor shall be furnished with access valves and it shall be installed on rubber isolators to reduce sound vibration.

2. Furnish with high and low-pressure protection.

3. Each heat pump shall be furnished with factory installed suction accumulator. Field installed accumulators are not permitted.

4. It shall be furnished with high and low-pressure protection, brass external vapor supply line service valves, vapor return line service valves with service gage connection port, service gage port connections on compressor suction and discharge lines with Schrader-type fittings with brass caps, filter drier, pressure relief, liquid line solenoid valves, thermostatic expansion valves, and a holding charge of refrigerant.

I. Refrigeration Components: Refrigerant circuit components shall include brass external liquid line service valve with service gage port connections, suction line service valve with service gage connection port, service gage port connections on compressor suction and discharge lines with Schrader type fittings with brass caps, accumulator, bi-flow filter drier, pressure relief, reversing valve, heating mode metering device, and a holding charge of refrigerant.

J. Controls and Safeties:

1. Compressor motor assembly shall be protected with high and low-pressure switches, internal overloads, internal thermostat, internal relief valve, and anti-recycle relay, or time cycle device to prevent rapid cycling of compressor after any off cycle.

2. Control panel shall be pre-wired in unit casing.

3. The control circuit shall incorporate a safety circuit to render refrigerant system (compressor and outdoor air motor) inoperative should there be a loss of refrigerant.

4. Units shall also be furnished with automatic Outdoor-fan motor protection, high condensing temperature protection, compressor motor current and temperature overload protection, high pressure relief and Outdoor fan failure protection.

K. EMS Diagnostic Points:

1. Supply air temperature.

2. Return air temperature.

3. Space temperature.

4. Filter status, via Pressure transducer on analog point.

5. Fan status.

6. Compressor status.

7. Other diagnostic point required by current Title 24, automated fault detection and diagnostics (FDD).

L. Low Ambient Operation: Head pressure control shall be provided for operation at outside air temperature below 45 degrees F.

M. Safeties:

1. High condensing temperature protection.

2. Compressor motor current and temperature overload protection.

3. High pressure relief.

4. Outdoor fan failure protection.

N. Filters:

1. Filters shall be 2-inch standard size high capacity replaceable media type, MERV 13, installed in an external 2-inch rack filter section and complete with an access door.

2. An-line filter-drier shall be furnished with equipment and installed at Project site.

O. Economizer: Provide on units with capacities equal to, or larger than 4.5 tons nominal capacity, when the Prescriptive Compliance approach is utilized to comply with Energy Efficiency Standards or where necessary to achieve CHPS pre-requisite and/or CHPS building flush-out compliance. Economizer shall be manufacturer's standard; factory furnished and field installed. Economizer control shall maintain a fixed supply air temperature during free cooling operation by providing full modulation of operable outside and return air dampers.

P. Provide programmable digital thermostat with following features:

1. 7-day time clock.

2. Heat, cool, automatic changeover.

3. Occupied / Unoccupied modes.

4. Dry contact switch for input from an external device such as a central time clock, occupancy sensor, or a telephone activated device.

5. Robertshaw, Honeywell, Johnson Controls, Carrier, Schneider Electric, Viconics, or equal with built-in occupancy sensor. Refer to Section 23 0900 for areas with zone damper controls.

6. Remote sensors. School Areas that could be subject to vandalism or accidental impact damage such as Gymnasiums, Auditoriums, Multipurpose Rooms, Corridors and Lobbies shall be provided with thermostats with remote return air duct or room sensors. Verify remote location of sensors and thermostats with Architect.

Q. Demand Control Ventilation:

1. Units of 6.25 nominal tons and higher capacity shall be provided with Indoor Air Quality (CO2) Sensor and Accessory Electronic Expansion Boards.

2. The unit shall have ability to provide demand ventilation indoor-air quality (IAQ) control through economizer when provided with an indoor air quality sensor and accessory expansion board.

3. The IAQ sensor shall be duct mounted in return air main duct unless otherwise indicated on Drawings. The set point shall be adjustable.

4. The IAQ sensor shall be powered through unit. If not, required control transformer shall be provided by manufacturer. Coordinate power requirements and location with Division 26.

5. The IAQ sensor shall provide a 4 to 20 mA signal to expansion board.

R. Start-up: Factory test each unit before shipment to Project site. Performance test shall include full refrigeration start-up, fan and controls start-up. Each unit shall be provided with its own report with its own serial number. Non-tested units are not permitted to be delivered to Project site. Provide full start-up of units to include full refrigeration and provide a written report.

S. Parts Availability: Submit proof in writing that majority (minimum 80 percent) of replacements parts are commonly available and not proprietary. Also, submit proof in writing that a local parts sales and service facility exists, where replacement parts will be warehoused in quantity. Guarantee timely availability for parts that are proprietary.

2.05 ROOF MOUNTED POWER EXHAUST VENTILATORS

A. RMEV-1

1. Manufacturer:

CARNES	GREENHECK	LOREN COOK	PENNBARRY	TWIN CITY & BLOWER
VEBK Series	GB Series	ACEB	Domex - Belt Drive	BCRD

2. Spun aluminum, roof mounted, belt driven, downblast centrifugal exhaust ventilator, with components as indicated and specified. Sizes, performances, and accessories shall be as indicated on equipment schedules on Drawings. Provide required accessories for proper operation and balancing of fans in accordance with design intent and sequence of operation.

3. Certification: Fan shall be listed by Underwriters Laboratories Inc (UL 705). Fan shall bear AMCA Certified Ratings Seals for Fan Sound and Air Performance.

4. Housing: The fan shall be of bolted and welded construction utilizing corrosion resistant fasteners. The spun aluminum structural components shall be constructed of minimum 18 gage Aluminum, bolted to a rigid aluminum support structure. The aluminum base shall have continuously welded curb cap corners for maximum leak protection. The discharge baffle shall have a rolled bead for added strength. A two piece top cap shall have stainless steel, or galvanized quick release latches to provide access into motor compartment without use of tools, or screws. An integral conduit chase shall be provided through curb cap and into motor compartment to facilitate wiring connections. The motor, bearings and drives shall be mounted on a minimum 16 gage steel power assembly, isolated from unit structure with rubber vibration isolators. These components shall be enclosed in a weather-tight compartment, separated from exhaust airstream. Lifting lugs shall be provided to help prevent damage from improper lifting. Unit shall bear an engraved aluminum nameplate.

5. Wheel: Wheel shall be centrifugal backward inclined, constructed of 100 percent aluminum, including a precision machined cast aluminum hub. Wheel inlet shall overlap an aerodynamic aluminum inlet cone to provide maximum performance and efficiency. Wheel shall be balanced in accordance with AMCA Standard 204, Balance Quality and Vibration Levels for Fans.

6. Motor: Motor shall be heavy-duty ECM type with permanently lubricated sealed ball bearings and furnished at specified voltage, phase, and enclosure.

7. Bearing: Bearings shall be designed and individually tested specifically for use in air handling applications. Construction shall be heavy duty regreasable ball type in a cast iron pillow block housing selected for a minimum L50 life in excess of 200,000 hours at maximum cataloged operating speed.

8. Belts and Drives: Belts shall be oil and heat resistant, non-static type. Drives shall be precision-machined cast iron type, or heavy gauge galvanized steel, keyed and securely attached to wheel and motor shafts. Drives shall be sized for 150 percent of installed motor horsepower. The variable pitch motor drive must be factory set to specified fan RPM.

B. RMEV-2:

1. Manufacturer:

CARNES	GREENHECK	LOREN COOK	PENNBARRY	TWIN CITY & BLOWER
VEDK Series	G Series	ACED	Domex - Direct Drive	DCRD

2. Spun aluminum, roof mounted, direct driven, downblast centrifugal exhaust ventilator, with components as indicated and specified. Sizes, performances, and accessories shall be as indicated on equipment schedules on Drawings. Also, provide accessories for proper operation and balancing of fans in accordance with design intent and sequence of operation.

3. Certification: Fan shall be listed by Underwriters Laboratories Inc. (UL 705). Fan shall bear AMCA Certified Ratings Seals for Fan Sound and Air Performance.

4. Housing: The fan shall be of bolted and welded construction utilizing corrosion resistant fasteners. The spun aluminum structural components shall be constructed of minimum 18 gage Aluminum, bolted to a rigid aluminum support structure. The aluminum base shall have continuously welded curb cap corners for maximum leak protection. The discharge baffle shall have a rolled bead for added strength. An integral conduit chase shall be provided through curb cap and into motor compartment to facilitate wiring connections. The motor shall be enclosed in a weather-tight compartment, separated from exhaust airstream. Unit shall bear an engraved aluminum nameplate.

5. Wheel: Wheel shall be centrifugal backward inclined, constructed of 100 percent aluminum, including a precision machined cast aluminum hub. An aerodynamic aluminum inlet cone shall be provided for maximum performance and efficiency. Wheel shall be balanced in accordance with AMCA Standard 204, Balance Quality and Vibration Levels for Fans.

6. Motor: Motor shall be heavy-duty ECM type with permanently lubricated sealed bearings and furnished at specified voltage, phase, and enclosure.

C. RMEV-3:

1. Manufacturer:

CARNES	GREENHECK	LOREN COOK	PENNBARRY	TWIN CITY & BLOWER
VUBK Series	CUBE Series	ACRUB	Fumex-Belt Drive	BCRU

2. Spun aluminum, roof mounted, belt driven, upblast centrifugal exhaust ventilator, with components as indicated and specified. Sizes, performances, and accessories shall be as indicated on equipment schedules on Drawings.

Also, provide accessories for proper operation and balancing of fans in accordance with design intent and sequence of operation.

3. Certification: Fan shall be listed by Underwriters Laboratories Inc. (UL 705). Fan shall bear AMCA Certified Ratings Seals for Fan Sound and Air Performance.

4. Housing: The fan shall be of bolted and welded construction utilizing corrosion resistant fasteners. The spun aluminum structural components shall be constructed of minimum 18 gage Aluminum, bolted to a rigid aluminum support structure. The aluminum base shall have a one piece inlet spinning and continuously welded curb cap corners for maximum leak protection. The windband shall have a rolled bead for added strength. A two piece top cap shall have stainless steel, or galvanized quick release latches to provide access into motor compartment without use of tools, or screws. An integral conduit chase shall be provided into motor compartment to facilitate wiring connections. The motor, bearings and drives shall be mounted on a minimum 16 gage steel power assembly, isolated from unit structure with rubber vibration isolators. These components shall be enclosed in a weather-tight compartment, separated from exhaust airstream. Lifting lugs shall be provided to help prevent damage from improper lifting. Unit shall bear an engraved aluminum nameplate.

5. Wheel: Wheel shall be centrifugal backward inclined, constructed of 100 percent aluminum, including a precision machined cast aluminum hub. Wheel inlet shall overlap an aerodynamic aluminum inlet cone to provide maximum performance and efficiency. Wheel shall be balanced in accordance with AMCA Standard 204, Balance Quality and Vibration Levels for Fans.

6. Motor: Motor shall be heavy-duty ECM type with permanently lubricated sealed ball bearings and furnished at specified voltage, phase, and enclosure.

7. Bearing: Bearings shall be designed and individually tested specifically for use in air handling applications. Construction shall be heavy-duty regreasable ball type in a cast iron pillow block housing selected for a minimum L50 life in excess of 200,000 hours at maximum cataloged operating speed.

8. Belts and Drives: Belts shall be oil and heat resistant, non-static type. Drives shall be precision machined cast iron, or galvanized steel type, keyed and securely attached to wheel and motor shafts. Drives shall be sized for 150 percent of installed motor horsepower. The variable pitch motor drive must be factory set to specified fan RPM.

D. RMEV-4:

1. Manufacturer:

CARNES	GREENHECK	LOREN COOK	PENNBARRY	TWIN CITY & BLOWER
VUDK Series	CUE Series	ACRUD	Fumex-Direct Drive	DCRU

2. Spun aluminum, roof mounted, direct driven, upblast centrifugal exhaust ventilator, with components as indicated and specified. Sizes, performances, and accessories shall be as indicated on equipment schedules on Drawings. Also, provide accessories for proper operation and balancing of fans in accordance with design intent and sequence of operation.

3. Certification: Fan shall be listed by Underwriters Laboratories Inc. (UL 705). Fan shall bear AMCA Certified Ratings Seals for Fan Sound and Air Performance.

4. Housing: Fan shall be of bolted and welded construction utilizing corrosion resistant fasteners. The spun aluminum structural components shall be constructed of minimum 18 gage Aluminum, bolted to a rigid aluminum support structure. The aluminum base shall have a one piece inlet spinning and continuously welded curb cap corners for maximum leak protection. The windband shall have a rolled bead for added strength. An integral conduit chase shall be provided into motor compartment to facilitate wiring connections. The motor shall be enclosed in a weather-tight compartment, separated from exhaust airstream. Unit shall bear an engraved aluminum nameplate.

5. Wheel: Wheel shall be centrifugal backward inclined, constructed of 100 percent aluminum, including a precision machined cast aluminum hub. An aerodynamic aluminum inlet cone shall be provided for maximum performance and efficiency. Wheel shall be balanced in accordance with AMCA Standard 204, Balance Quality and Vibration Levels for Fans.

6. Motor: Motor shall be heavy-duty ECM type with permanently lubricated sealed bearings and furnished at specified voltage, phase, and enclosure.

2.06 INLINE FANS

A. ILF-1: (Used as Garage Exhaust Fan GEF-1)

1. Manufacturer:

GREENHECK	PENNBARRY	TWIN CITY & BLOWER
QEI or QEID	ESI	QSL

2. Provide inline mixed flow type fans of sizes, capacities and configurations indicated on drawings, complete with accessories for installation of fans. Also, provide accessories for proper operation and balancing of fans in accordance with design intent and sequence of operation.

3. Certification: Fan shall be listed by Underwriters Laboratories (UL 705). Fan shall bear AMCA certified ratings seal for sound and air performance.

4. Housing: The fan shall be of bolted and welded construction utilizing corrosion resistant fasteners. The housing shall be of minimum 12 gage steel. Bearing supports shall be minimum 10 gage welded steel. Lifting eyes shall be provided for ease of installation. Unit shall bear an engraved aluminum nameplate.

5. Finish: Steel fan components shall be coated with polyester powder coating to exceed 1,000 hour salt spray test under ASTM B117 test method.

6. Wheel: Wheel shall be of mixed flow type with a wheel cone, spherical back plate and single thickness cambered blades, or formed hollow airfoil blades continuously welded to back plate. Hub shall be keyed and securely attached to fan shaft. Wheel shall overlap an aerodynamic aluminum inlet cone to provide maximum performance and efficiency. Wheel shall be balanced in accordance with AMCA Standard 204, Balance Quality and Vibration Levels for Fans.

7. Motor: Motor shall be ECM type, voltage and phase, as indicated on drawings. Provide permanently lubricated sealed ball bearings. Option: Energy efficient motor meets EPAct and NEMA Table 12-10.

8. Shaft: Blower shaft shall be AISI C1045/SAE 1045, or 1040 hot rolled and accurately turned, ground, and polished. Shafting shall be sized for a critical speed of at least 143 percent of maximum RPM.

9. Bearings: Bearings shall be designed and tested specifically for use in air handling applications. Construction shall be heavy-duty regreasable ball or roller type in a cast iron pillow block housing and selected for a minimum L50 life in excess of 200,000 hours at maximum cataloged operating speed.

10. Drive: Fans shall be direct drive or belt driven as indicated on drawings.

11. Belts and Drives: Belts shall be oil and heat resistant, non-static type. Drives shall be precision machined cast iron type, keyed and securely attached to wheel and motor shafts. Drives shall be sized for 150 percent of installed motor horsepower. The variable pitch motor drive must be factory set to specified fan RPM.

2.07 CEILING CABINET FANS

A. CCF-1:

1. Manufacturer:

CARNES	GREENHECK	LOREN COOK	PENNBARRY	TWIN CITY & BLOWER
VCDK or VCDD Series	SP or CSP Series	GC 200 or 900 Series	Zephyr Fans	T or TL Series

2. Provide ceiling, wall, or inline mounted, direct driven, centrifugal exhaust fans of sizes, capacities and configurations indicated on drawings, complete with accessories for installation of fans. Also, provide accessories for proper operation and balancing of fans in accordance with design intent and sequence of operation.

3. Certification: Fan shall be listed by Underwriters Laboratories (UL 507 & 705). Fan shall bear AMCA Certified Ratings Seal for Sound and Air Performance.

4. Housing: The fan housing shall be minimum 22 gage galvanized steel and acoustically insulated. Blower and motor assembly shall be mounted to a minimum 16 gage reinforcing channel and shall be easily removable from housing. Motor shall be mounted on vibration isolators. Unit shall be supplied with integral wiring box and disconnect receptacle shall be standard. Discharge position shall be convertible from right angle to straight through by moving interchangeable panels. The outlet duct collar shall include a reinforced aluminum damper with continuous aluminum hinge rod and brass bushings. To accommodate different ceiling thickness, an adjustable prepunched mounting bracket shall be provided. A powder painted white steel grille shall be provided as standard.

5. Wheel: Wheel shall be centrifugal forward curved type, constructed of galvanized steel. Wheel shall be balanced in accordance with AMCA Standard 204, Balance Quality and Vibration Levels for Fans.

6. Motor: Motor shall be ECM type with permanently lubricated bearings, built-in thermal overload protection and disconnect plug. Motor shall be furnished at specified voltage.

B. CCF-2:

1. Manufacturer:

CARNES	GREENHECK	LOREN COOK	PENNBARRY	TWIN CITY & BLOWER
VCDK or VCDD Series	CSP Series	GN 200 or 900 Series	Zephyr Fans	TL Series

2. Provide inline mounted, direct driven, centrifugal exhaust fans of sizes, capacities and configurations indicated on drawings, complete with accessories for installation of fans. Also, provide accessories for proper operation and balancing of fans in accordance with design intent and sequence of operation.

3. Certification: Fan shall be listed by Underwriters Laboratories (UL 507 & 705). Fan shall bear AMCA Certified Ratings Seal for Sound and Air Performance.

4. Housing: The fan housing shall be minimum 22 gage galvanized steel and acoustically insulated. Blower and motor assembly shall be mounted to a minimum 16 gage reinforcing channel and shall be easily removable from housing. Motor shall be mounted on vibration isolators. Unit shall be supplied with integral wiring box and disconnect receptacle shall be standard. Discharge position shall be convertible from right angle to straight through by moving interchangeable panels. The outlet duct collar shall include a reinforced aluminum damper with continuous aluminum hinge rod and brass bushings. To accommodate different mounting positions, an adjustable pre-punched mounting bracket shall be provided.

5. Wheel: Wheel shall be centrifugal forward curved type, constructed of galvanized steel. Wheel shall be balanced in accordance with AMCA Standard 204, Balance Quality and Vibration Levels for Fans.

6. Motor: Motor shall be ECM type with permanently lubricated bearings, built-in thermal overload protection and disconnect plug. Motor shall be furnished at specified voltage.

C. CCF-3:

1. Manufacturer:

CARNES	GREENHECK	LOREN COOK	PENNBARRY	TWIN CITY & BLOWER
VDBA or VGBA Series	BCF Series	DB	Zephyr Cabinet Fans	DBS or DBT

2. Provide duct mounted, belt driven centrifugal cabinet fans of sizes, capacities and configurations indicated on drawings, complete with accessories for installation of fans. Also, provide accessories for proper operation and balancing of fans in accordance with design intent and sequence of operation.

3. Certification: Fan shall be listed by Underwriters Laboratories (UL 705). Fan shall bear AMCA Certified Ratings Seals for Fan Sound and Air Performance.

4. Housing: The fan shall be of bolted construction utilizing corrosion resistant fasteners. Housing shall be minimum 22 gage galvanized steel with two access doors and integral duct collars. Internal blower and motor assembly shall be mounted on rubber vibration isolators. Hanging brackets shall be provided for horizontal installation. Unit shall bear an engraved aluminum nameplate.

5. Wheel: Wheel shall be DWDI centrifugal forward curved type, constructed of painted steel. Wheel shall be balanced in accordance with AMCA Standard 204, Balance Quality and Vibration Levels for Fans.

6. Motor: Motor shall be heavy duty TEFC inverter duty type with permanently lubricated sealed ball bearings and furnished at specified voltage and phase.

7. Bearing: Bearings shall be permanently lubricated, sealed ball type selected for a minimum L50 life in excess of 200,000 hours at maximum cataloged operating speed.

8. Belts and Drives: Belts shall be oil and heat resistant, non-static type. Drives shall be precision machined cast iron type, keyed and securely attached to wheel and motor shafts. Drives shall be sized for 150 percent of installed motor horsepower. The variable pitch motor drive must be factory set to specified fan RPM.

2.08 GRAVITY EXHAUST/INTAKE VENTILATORS

A. GEIV-1:

1. Manufacturer:

CARNES	GREENHECK	LOREN COOK	PENNBARRY	TWIN CITY & BLOWER
GSAA Series	GRS Series	PR or TR	WCC	GRV

2. Spun aluminum, roof mounted gravity ventilators of sizes, capacities and configurations indicated on drawings, complete with accessories for installation of ventilators. Also, provide accessories for proper operation of ventilators per code and in accordance with design intent and sequence of operation.

3. Housing: The unit shall be of bolted and welded construction utilizing corrosion resistant fasteners. The spun aluminum structural components shall be constructed of minimum 18 gage Aluminum, bolted to a rigid aluminum support structure. The aluminum base shall have continuously welded curb cap corners for maximum leak protection. The spun aluminum baffle shall have a rolled bead for added strength. Birdscreen constructed of 1/2" mesh shall be mounted across air opening. Unit shall bear an engraved aluminum nameplate.

4. Provide gravity type back-draft or relief dampers at relief or exhaust ventilators (with counterweights if required). Gravity relief dampers shall fully open at 0.01” static pressure.

5. Intake ventilators shall be provided with normally closed, motorized dampers that are interlocked with fan to open upon fan activation unless fan is provided with such a damper.

B. GEIV-2:

1. Manufacturer:

CARNES	GREENHECK	LOREN COOK	PENNBARRY	TWIN CITY & BLOWER
GEAB Series	FGR Series	GR	AEG Relief	MGR

2. Provide hooded aluminum, roof mounted gravity relief ventilators of sizes, capacities and configurations indicated on drawings, complete with accessories for installation of ventilators. Also, provide accessories for proper operation and balancing of ventilators in accordance with design intent and sequence of operation.

3. Housing: The unit shall be of bolted and welded construction utilizing corrosion resistant fasteners. The hood interlocking panels shall be constructed of minimum 12 gage Aluminum 5052, hinged to a minimum 12 gage aluminum 5052 support structure. The aluminum base shall have continuously welded curb cap corners for maximum leak protection. Birdscreen constructed of ½ inch mesh shall be mounted across relief opening. Unit shall bear an engraved aluminum nameplate.

4. Provide gravity type back-draft or relief dampers at relief or exhaust ventilators (with counterweights if required). Gravity relief dampers shall fully open at 0.01 inch static pressure.

5. Intake ventilators shall be provided with normally closed, motorized dampers that are interlocked with fan to open upon fan activation unless fan is provided with such a damper.

C. GEIV-3:

1. Manufacturer:

CARNES	GREENHECK	LOREN COOK	PENNBARRY	TWIN CITY & BLOWER
GIAB Series	FGI Series	GI	AEG Intake	MGI

2. Provide hooded aluminum, roof mounted gravity intake ventilators of sizes, capacities and configurations indicated on drawings, complete with accessories for installation of ventilators. Also, provide accessories for proper operation and balancing of ventilators in accordance with design intent and sequence of operation.

3. Housing: The unit shall be of bolted and welded construction utilizing corrosion resistant fasteners. The hood interlocking panels shall be constructed of minimum 18 gage Aluminum, bolted to a minimum 12 gage aluminum 5052 support structure. The aluminum base shall have continuously welded curb cap corners for maximum leak protection. Birdscreen constructed of ½ inch mesh shall be mounted across intake opening. Unit shall bear an engraved aluminum nameplate. Units shall be provided with bird screen and anti-condensate coating as standard.

4. Provide gravity type back-draft or relief dampers at relief or exhaust ventilators (with counterweights if required). Gravity relief dampers shall fully open at 0.01 inch static pressure.

5. Intake ventilators shall be provided with normally closed, motorized dampers that are interlocked with fan to open upon fan activation unless fan is provided with such a damper.

2.09 FILTERS

A. Air filter media shall be minimum 2-inch thick, MERV 13 Class 2, 100% synthetic, high capacity, pleated, disposable type, with support grid and enclosing frame, continuously laminated on a supporting moisture resistant beverage board type frame that conforms to the configuration of the pleats. Media shall be glued to the frame along all four sides and glued horizontally & diagonally to grill members on both sides. The media shall be unaffected by water and humidity, be non-toxic, non-allergenic, and shall not support the growth of any fungi or bacteria. Filter shall have rigid outer frame that will not bend or distort under normal usage. Filter shall be UL 900 listed, Class 2.

B. Filter media shall provide an average efficiency as specified on drawings per ASHRAE Standard 52.2.

C. Initial resistance of air filters shall not exceed following limits for each efficiency level at face velocities indicated. Lower resistance requirements, if indicated on drawings shall have precedence.

85 percent (MERV 13) 0.30 inch water gage at 500 feet per minute
95 percent (MERV 14) 0.38 inch water gage at 500 feet per minute

D. Use standard size Filter Medias only.

E. Media support shall be a welded wire grid or a rigid frame with an effective open area of not less than 96 percent.

1. Media support shall be bonded to filter media to eliminate possibility of media oscillation and media pull-away.

2. Media support grid shall be formed in such a manner that it effectively forms a radial pleat design, providing total use of filter media.

F. Enclosing frame shall be bonded to air entering and air exit side of each pleat, to ensure pleat stability. Inside periphery of enclosing frame shall be bonded to filter pack, thus eliminating possibility of air bypass.

G. Holding frames shall be factory fabricated of 16 gage galvanized steel, or equivalent and shall be furnished with gaskets and spring type positive sealing fasteners. Fasteners shall be capable of being attached or removed without use of tools.

H. Manufacturers: Camfil Farr, Koch, or AAF.

2.10 LOUVERS, AIR CONDITIONING (use in conjunction with relief damper)

A. Standard steel louvers shall be furnished complete with frames, blades, finish and construction details per Drawings and manufacturer’s recommendations.

B. Louvers shall be furnished with horizontal blades, 2 inches deep for air through wall installation in conjunction with gravity relief damper for backdraft protection that will open at 0.01-inch wc room static pressure as indicated on Drawings. Blades shall be 16-gage steel, spaced at 1 7/8-inch at 30 degrees angle, and with baked epoxy coating. Panel size shall be as indicated but not less than 24 inches width by 18 inches in height.

PART 3 – EXECUTION

3.01 GENERAL

A. Examine areas under which Work of this Section will be performed. Correct conditions detrimental to proper and timely completion of Work. Do not proceed until unsatisfactory conditions have been corrected.

3.02 EQUIPMENT FOUNDATIONS

A. Provide foundations (housekeeping pads, level platforms or curbs) for mechanical equipment whether indicated on drawings or not. Equipment foundations shall be of sufficient size and

weight, and of proper design to preclude shifting of equipment under operating conditions, or under abnormal conditions imposed upon equipment.

B. Provide foundations (housekeeping pads, level platforms or curbs) for mechanical equipment whether indicated on drawings or not. Foundations shall meet requirements of equipment manufacturer and, when required by Architect, obtain from equipment manufacturer, approval of foundation design and construction, for equipment to be installed. Equipment vibration shall be maintained within design limits, and shall be dampened and isolated. Isolators shall be bolted to a structural member so as to be readily removable.

3.03 EQUIPMENT DESIGN AND INSTALLATION

A. Uniformity: Unless otherwise specified, equipment of same type or classification shall be product of same manufacturer.

B. Application: Only provide equipment as reviewed by Architect.

C. Equipment Installation: Equipment installation shall be in strict accordance with these Specifications, and installation instructions of manufacturers. Equipment installed on concrete foundations shall be grouted before piping is installed. Piping shall be installed in such a manner as not to place a strain on equipment. Flanged joints shall be adequately extended before installation. Piping shall be graded, anchored, guided and supported, without low pockets.

1. Install equipment in a neat and skillful manner, properly aligned, leveled, and adjusted for satisfactory operation.

2. Install so connecting and disconnecting of piping and accessories can be readily accomplished, parts are readily accessible for inspection, service and repair. Space shall be provided to readily remove filters, coils, compressors and fan wheels. Access doors shall be hinged with cam lock door handles.

3. Provide flexible connections for duct, pipe and conduit connections at moving equipment.

3.04 ROOF-TOP EQUIPMENT MOUNTING

A. Downflow Units: Install unit on a prefabricated mounting frame or curb secured directly to roof. Follow manufacturers recommended installation manuals. Submit Shop Drawings for review by Architect.

B. Horizontal Flow Units: Install unit on platform or prefabricated mounting frame or curb secured directly to roof designed to suit roof conditions and requirements of provided unit. Submit Shop Drawings for review by Architect.

3.05 REFRIGERANT PIPING INSTALATION

A. Unless otherwise indicated, main liquid and suction lines from condensing unit to Indoor coil shall be of sizes specified by manufacturer.

B. Refrigeration piping shall be refrigeration grade copper tubing, type L hard-drawn. In instances where refrigeration lines are installed in an inaccessible location and must be

snaked through conduit or a trench, that portion of tubing required to complete connections through conduit or trench may be soft drawn. Maintain entire system clean and dry during installation. Pipe shall be sealed until installed.

C. Refrigeration piping, both hard and soft-drawn, shall be straight and free from kinks, restrictions and horizontal runs shall be sloped towards compressor one inch to 10 feet wherever possible. Vapor line oil traps shall be installed on bottom of vertical risers and inverted oil trap shall be installed on top of vertical risers.

D. Joints shall be installed with Sil-Fos 15, Silvaloy 15, or equal.

E. Flare nuts required on suction lines shall be of short forged or frost-proof type. Other fittings shall be standard sweat-soldered type. Ells and return bends shall be long radius type. Install leak lock material.

F. Refrigeration Piping: Joints shall be silver brazed and tested according to the section 23 05 00 “Mechanical Common Work”. Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter. Field fabricated lines shall be thoroughly deburred, flushed and cleaned before connection. Bleed nitrogen through lines during silver brazing, maintain Nitrogen flow rate of 1.75 cubic feet per minute or more using a pressure regulator. Cap and seal lines when not completed and connected to equipment.

1. Brazing or Debrazing shall always be conducted with nitrogen purging through the refrigeration system.

2. Arrange a refrigerant piping pre-installation conference between Contractor, Architect, IOR, and OAR to review and confirm installation method.

3. Do not charge refrigerant through the split system prior to testing procedure by contractor and acceptance by Owner.

G. Sleeve penetrations of floors, walls and ceiling to allow for free motion of piping. Provide 24 gage galvanized iron pipe and chrome-plated escutcheon plates. Pack annular space between pipe and sleeve with incombustible material such as fiberglass and seal each end with mastic to provide a waterproof seal.

H. Install insulated couplings at points of connection between dissimilar metals for cathodic protection. Insulate copper tubing from ferrous materials and hangers with 2-inch thickness of 3-inch wide strip, 10 mil polyvinyl tape wrapped around pipe.

I. Support piping by iron hangers and supports. Hydra-Zorb cushion clamps, LSP Products Group Acousto Clamp, or equal, on non-insulated piping, and Klo-Shure coupling clamp on insulated piping, or equal.

J. Provide saddles to protect pipe insulation.

K. Provide connections of copper, copper plated steel, steel, and brass pipe and tubing with Harris Products Group Safety-Silv 56, Lucas-Milhoupt, Inc., or equal, complying with ANSI/AWS A5.8 and NSF 51.

L. Insulate refrigerant suction lines.

M. On split systems, insulate both vapor and liquid lines. For insulation materials, refer to Section 23 0700: HVAC Insulation.

3.06 NOISE AND VIBRATION

A. Operation of Equipment: Mechanical equipment and piping systems shall operate without exceeding specified noise and/or vibration levels.

B. Corrective Measures: If specified noise and/or vibration levels are exceeded, provide necessary changes to reduce noise and/or vibration levels to within specified levels.

3.07 FIELD TESTS AND INSPECTION

A. General: Perform field inspections, field tests, and trial operations as specified in Section 23 05 00: Mechanical Common Work. Provide labor, equipment and incidentals required for testing. The Project Inspector will witness field tests and trial operations as specified in Section 23 05 00: Mechanical Common Work.

B. Equipment and Material: Equipment and material certified as being successfully tested by manufacturer, in accordance with referenced Specifications and standards, will not require re-testing before installation. Equipment and materials not tested at place of manufacture will be tested before or after installation, as applicable or necessary, to determine compliance with reference Specifications and standards.

C. Start-Up and Operational Test: System shall be started up and initially operated with components operating. During this test, various strainers or filters shall be periodically cleaned until no further accumulation of foreign material occurs. Adjust safety and automatic control instruments as required to provide proper operation and control sequence. Refer to Section 23 05 00: Mechanical Common Work..

D. Extent of Field Tests: After installation and before completion, Work of this Section shall be subjected to required field tests, including those specified here and in Section 23 05 00: Common Work Results for HVAC.

E. Operation and Maintenance Data: Provide required operation and maintenance data as specified in Section 23 05 00: Common Work Results for HVAC.

3.08 CLEANUP

A. Remove rubbish, debris and waste materials and legally dispose of off Project site.

3.09 PROTECTION

A. Protect Work of this Section until Substantial Completion.

END OF SECTION

DIVISION 25
INTEGRATED AUTOMATION

SECTION 25 01 00 - ENERGY MANAGEMENT CONTROL SYSTEM (EMCS)

PART 1 – GENERAL

1.01 WORK INCLUDED

A. Furnish a totally native BACnet-based system, based on a distributed control system in accordance with this specification. All building controllers, application controllers, and all input/output devices shall communicate using the protocols and network standards as defined by ANSI/ASHRAE Standard 135–2001, BACnet. In other words, all controllers, including unitary controllers, shall be native BACnet devices. The control system shall be Alerton BACtalk to match existing campus standard.

B. The Energy Management Control System (EMCS) shall consist of an Alerton HVAC control system to match the Compton College standard, no exceptions or substitutions. Please see authorized Alerton dealer in paragraph 1.4 (a).

C. Provide all necessary BACnet-compliant hardware and software to meet the system's functional specifications. Provide Protocol Implementation Conformance Statement (PICS) for Windows-based control software and every controller in system, including unitary controllers.

D. Prepare individual hardware layouts, interconnection drawings, and software configuration from project design data.

E. Design, provide, and install all equipment cabinets, panels, data communication network cables needed, and all associated hardware.

F. Provide and install all interconnecting cables between supplied cabinets, application controllers, and input/output devices.

G. Provide and install all interconnecting cables between all operator's terminals and peripheral devices (such as printers, etc.) supplied under this section.

H. Provide complete manufacturer's specifications for all items that are supplied. Include vendor name of every item supplied.

I. Provide supervisory specialists and technicians at the job site to assist in all phases of system installation, startup, and commissioning

J. Provide a comprehensive operator and technician training program as described herein.

K. Provide as-built documentation, software, diagrams, and all other associated project operational documentation (such as technical manuals) on approved media, the sum total of which accurately represents the final system.

L. Provide new sensors, valves, and install only new electronic actuators. No used components shall be used as any part or piece of installed system.

M. Provide seamless connection to existing Alerton Control System. The new system

shall be an extension of the existing Alerton Control System currently installed at El Camino College. All new controllers and points shall be set-up, programmed, and downloaded from the existing Alerton Workstation utilizing Alerton Technologies, no exceptions.

1.02 HVAC CONTROL SYSTEM DESCRIPTION

A. A distributed logic control system complete with all software and hardware functions shall be provided and installed. System shall be completely based on ANSI/ASHRAE Standard 135-2010, BACnet. This system is to control all mechanical equipment, including all unitary equipment (VAV boxes, heat pumps, fan-coils, AC units, etc.), and all air handlers, boilers, chillers, and any other listed equipment using BACnet-compliant components. Non-BACnet-compliant or proprietary equipment or system (including gateways) shall not be acceptable and are specifically prohibited.

B. Building controllers shall include complete energy management software, including scheduling building control strategies with optimum start and logging routines. All energy management software and firmware shall be resident in field hardware and shall not be dependent on the Master Network. Local operator's terminal software is to be used for access to field-based energy management functions only. Provide zone-by-zone direct digital logic control of space temperature, scheduling, runtime accumulation, equipment alarm reporting, and override timers for after-hours usage.

C. All application controllers for every terminal unit (VAV, HP, UV, etc.) air handler, all central plant equipment, and any other piece of controlled equipment shall be fully programmable and communicate on a peer-to-peer basis. Application controllers shall be mounted next to controlled equipment and communicate with building controller via BACnet.

D. All controllers shall be programmed with graphical logic programming tools. Line code programmed controllers are not allowed.

E. Room sensors shall be provided with digital readout that allows the user to view room temperature, view outside air temperature, adjust the room setpoint within preset limits and set desired override time. User shall also be able to start and stop unit from the digital sensor. Include all necessary wiring and firmware such that room sensor includes field service mode. Field service mode shall allow technician to balance VAV zones and access any parameter in zone controller.

1.03 APPROVED MANUFACTURERS

A. Only Alerton products may be installed for this Section of work.

B. Only BTL approved equipment furnished by the above listed manufacturer will be acceptable. Products not BTL approved will be rejected. Any manufacturer other than the listed above are not acceptable, no exceptions or substitutions.

1.04 APPROVED INSTALLERS

A. The following Alerton Dealer has been pre-qualified by the Compton College to execute this Section of work:
   1. Climatec LLC
      Contact Kirk Davidson at (949-343-1456)

B. Only pre-qualified contractors approved by the owner will be acceptable. Any installer other than the listed above are not acceptable, no exceptions.

1.05 QUALITY ASSURANCE

A. Responsibility: The supplier of the EMCS shall be responsible for inspection and Quality Assurance (QA) for all materials and workmanship furnished.

B. Component Testing: Maximum reliability shall be achieved through extensive use of high-quality, pre-tested components. Each and every controller, sensor, and all other DDC components shall be individually tested by the manufacturer prior to shipment.

C. Tools, Testing and Calibration Equipment: The EMCS supplier shall provide all tools, testing, and calibration equipment necessary to ensure reliability and accuracy of the system.

D. The systems control manufacturer shall have been an established manufacturer of BACnet protocol systems for a minimum of fifteen years.

E. Control system shall be engineered, programmed and supported completely by representative's local office that must be within 70 miles of project site. The control contractor shall be independent; and shall not be a subsidiary or affiliated with a Mechanical Contractor.

1.06 PROJECT MANAGEMENT

A. Have present at the project site, a project manager who shall, as a part of their duties, be responsible for the following activities:
   1. Coordination between the Subcontractor and all other trades, Owner, Local Authorities, and design team.
   2. Coordination of all activities between his subcontractors.
   3. Attendance at subcontractor/general contractor meetings.
   4. Scheduling of work progress, manpower loading, material delivery, equipment installation and checkout.
   5. Coordination of all drawings and submittals between consultants, engineers, other sub-trades and his subcontractors.
   6. Supervision of field technicians and interface with other trades.

1.07 REFERENCE STANDARDS

A. The latest edition of the following standards and codes in effect and amended as of supplier's proposal date, and any applicable subsections thereof, shall govern design and selection of equipment and material supplied:
   1. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE).
   2. ANSI/ASHRAE Standard 135-2010, BACnet.
   3. Uniform Building Code (UBC), including local amendments.
   4. UL 916 Underwriters Laboratories Standard for Energy Management Equipment. Canada and the US.
   5. National Electrical Code (NEC).
   6. FCC Part 15, Subpart J, Class A.
   7. EMC Directive 89/336/EEC (European CE Mark)
   8. City, county, state, and federal regulations and codes in effect as of contract date.

B. Except as otherwise indicated the system supplier shall secure and pay for all permits, inspections, and certifications required for his work and arrange for necessary approvals by the governing authorities.

1.08 SUBMITTALS

A. Drawings:
1. The system supplier shall submit engineered drawings, control sequence, and bill of materials for approval.
2. Drawings shall be available in digital format.

B. System Documentation: Include the following in submittal package:
1. System configuration diagrams in simplified block format
2. All input/output object listings and an alarm point summary listing.
3. Electrical drawings that show all system internal and external connection points, terminal block layouts, and terminal identification.
4. Complete bill of materials, valve schedule and damper schedule.
5. Manufacturer's instructions and drawings for installation, maintenance, and operation of all purchased items.
6. Overall system operation and maintenance instructions—including preventive maintenance and troubleshooting instructions.
7. For all system elements—building controller(s), application controllers, routers, and repeaters, provide BACnet Protocol Implementation Conformance Statements (PICS) as per ANSI/ASHRAE Standard 135-2010.
8. A list of all functions available and a sample of function block programming that shall be part of delivered system.

C. Project Management: The vendor shall provide a detailed project design and installation schedule with time markings and details for hardware items and software development phases. Schedule shall show all the target dates for transmission of project information and documents and shall indicate timing and dates for system installation, debugging, and commissioning.

1.09 WARRANTY

A. Warranty shall cover all costs for parts, labor, associated travel, and expenses for a period of one year from Substantial completion.

B. Hardware and software personnel supporting this warranty agreement shall provide on-site or off-site service in a timely manner after failure notification to the vendor. The maximum acceptable response time to provide this service at the site shall be 24 hours Monday through Friday, 48 hours on Saturday and Sunday.

C. This warranty shall apply equally to both hardware and software.

1.10 RELATED WORK IN OTHER SECTIONS

A. Refer to Division 0 and Division 1 for related contractual requirements

PART 2 – PRODUCTS

2.01 OPERATOR'S WORKSTATION

A. Integrate with existing Alerton Compass Operator Workstation. Contractor to coordinate. Provide programming and software implementation to seamlessly integrate all controls provided in this project into the existing Alerton Compass server software.

B. The Alerton Compass server shall be able to download and upload programming into all field controllers provided in this project over the BMS network.

C. Provide the latest software revisions or upgrades as needed to keep the existing workstation up to date.

2.02 BUILDING CONTROLLER

A. General Requirements:

1. Building Controller shall be of modular construction such that various modules may be selected to fit the specific requirements of a given project. Modules shall consist of a power supply module, a BACnet Ethernet-MS/TP module, a BACnet MS/TP only module and a modem module for telephone communication as a minimum. Those projects that require special interfaces may use Modbus modules as needed. However, all Ethernet communications and all controllers including central plant controllers, advanced application controllers and unitary controllers supplied by BMS manufacturer shall utilize the BACnet protocol standard.
2. Modules shall be selected to fit the particular project application. Up to 7 modules shall be powered by a single power supply module. All modules shall be panel mounted on DIN rail for ease of addition and shall be interconnected via simple plug in cable. A module in the middle shall be replaceable without removing any other modules.
3. All modules shall be capable of providing global control strategies for the system based on information from any objects in the system regardless if the object is directly monitored by the building controller module or by another controller. The software program implementing these strategies shall be completely flexible and user definable. All software tools necessary for programming shall be provided as part of project software. Any systems utilizing factory pre-programmed global strategies that cannot be modified by field personnel on-site, via a wide area network or downloaded via remote communications are not acceptable. Changing global strategies via firmware changes is also unacceptable.
4. Programming shall be object-oriented using control function blocks, supporting DDC functions, 1000 Analog Values and 1000 Binary Values. All flowcharts shall be generated and automatically downloaded to controller. Programming tool shall be supplied and be resident on workstation. The same tool shall be used for all controllers.
5. Provide means to graphically view inputs and outputs to each program block in real-time as program is executing. This function may be performed via the operator's workstation or field computer.
6. Controller shall have a memory needed to ensure high performance and data reliability. Battery shall provide power for orderly shutdown of controller and storage of data in nonvolatile flash memory. Battery back-up shall maintain real-time clock functions for a minimum of 20 days.
7. Global control algorithms and automated control functions shall execute via 32-bit processor.
8. Schedules:

a. Each building controller module shall support a minimum of 80 BACnet Schedule Objects and 80 BACnet Calendar Objects.
b. Building controller modules shall provide normal 7-day scheduling, holiday scheduling and event scheduling.

9. Logging Capabilities:
   a. Each building controller shall log as minimum 320 values. Any object in the system (real or calculated) may be logged. Sample time interval shall be adjustable at the operator's workstation.
   b. Logs may be viewed both on-site and off-site via WAN or remote communication.
   c. Building controller shall periodically upload trended data to networked operator's workstation for long term archiving if desired.
   d. Archived data stored in database format shall be available for use in third-party spreadsheet or database programs.
10. Alarm Generation:
   a. Alarms may be generated within the system for any object change of value or state either real or calculated. This includes things such as analog object value changes, binary object state changes, and various controller communication failures.
   b. Each alarm may be dialed out as noted elsewhere.
   c. Alarm log shall be provided for alarm viewing. Log may be viewed on-site at the operator's terminal or off-site via remote communications.
   d. Controller must be able to handle up to 320 alarm setups stored as BACnet event enrollment objects – system destination and actions individually configurable.
11. Demand Limiting:
   a. Demand limiting of energy shall be built a built in function that shall be user configurable. Each controller module shall support shedding of up to 200 loads using a minimum of two types of shed programs.
   b. Controls vendor shall coordinate load shedding program with Owner and program the equipment as part of this project.

B. Ethernet – MS/TP Module:
1. Ethernet – MS/TP Module shall support every function as listed under paragraph A, General Requirements, of this section and the following:
   a. All communication with operator workstation and all application controllers shall be via BACnet. Building controller Ethernet – MS/TP module shall incorporate as a minimum, the functions of a 2-way BACnet router. Controller shall route BACnet messages between the high-speed LAN (Ethernet 10/100MHz) and master slave token passing (MS/TP) LAN. Ethernet – MS/TP module shall also route messages from all other Building Controller modules onto the BACnet Ethernet network.
   b. MS/TP LAN must be software configurable from 9.6 to 76.8Kbps.
   c. The RJ-45 Ethernet connection must accept either 10Base-T or 100Base-TX BACnet over twisted pair cable (UTP).
2. BACnet Conformance:
   a. Ethernet – MS/TP module shall as a minimum support MS/TP and Ethernet BACnet LAN types. It shall communicate directly via these BACnet LANs as a native BACnet device and shall support simultaneous routing functions between all supported LAN types. Global controller shall be a BACnet conformance class 3 device and support all BACnet services necessary to provide the following BACnet functional groups:
      1) Clock Functional Group
      2) Files Functional Group
      3) Reinitialize Functional Group

4) Device Communications Functional Group
5) Event Initiation Functional Group

b. Please refer to Section 22.2, BACnet Functional Groups, in the BACnet standard for a complete list of the services that must be directly supported to provide each of the functional groups listed above. All proprietary services, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.

c. Standard BACnet object types supported shall include as a minimum: Analog Value, Binary Value, Calendar, Device, File, Group, Notification Class, Program and Schedule object types. All proprietary object types, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.

d. The Building Controller shall comply with Annex J of the BACnet specification for IP connections. This device shall use Ethernet to connect to the IP internetwork, while using the same Ethernet LAN for non-IP communications to other BACnet devices on the LAN. Must support interoperability on wide area networks (WANs) and campus area networks (CANs) and function as a BACnet Broadcast Management Device (BBMD).

C. MS/TP Module:

1. MS/TP Module shall support every function as listed under paragraph A, General Requirements, of this section and the following.
   a. Building Controller MS/TP module communications shall be via BACnet master slave token passing (MS/TP) LAN to all advanced application and application specific controllers. MS/TP module shall also route messages to Ethernet-MS/TP module for communication over WAN.
   b. MS/TP LAN must be software configurable from 9.6 to 76.8Kbps
   c. Configuration shall be via RS-232 connection.
2. BACnet Conformance:
   a. MS/TP module shall as a minimum support MS/TP BACnet LAN type. It shall communicate directly via this BACnet LAN as a native BACnet device and shall support simultaneous routing functions between all supported LAN types. Controller shall be a BACnet conformance class 3 device and support all BACnet services necessary to provide the following BACnet functional groups:
      1) Clock Functional Group
      2) Files Functional Group
      3) Reinitialize Functional Group
      4) Device Communications Functional Group
      5) Event Initiation Functional Group
   b. Please refer to Section 22.2, BACnet Functional Groups, in the BACnet standard for a complete list of the services that must be directly supported to provide each of the functional groups listed above. All proprietary services, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.
   c. Standard BACnet object types supported shall include as a minimum: Analog Value, Binary Value, Calendar, Device, File, Group, Notification Class, Program and Schedule object types. All proprietary object types, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.

D. Power Supply Module:

1. Power supply module shall power up to 7 Building Controller Modules. Input for power shall accept between 17 and 30 VAC, 47 to 65 Hz.
2. Power supply module shall include rechargeable battery for orderly shutdown of controller modules including storage of all data in flash memory and for continuous operation of real time clocks for minimum of 20 days.

E. Modbus Module:
1. Modbus Module shall support every function as listed under paragraph A, General Requirements, of this section and the following.
   a. Building Controller Modbus module communications shall be via one of three types of ports: EIA-485, EIA-422 or RS-232 connection. Modbus module shall convert Modbus data into BACnet objects. Modbus module shall also route messages to Ethernet-MS/TP module for BACnet Ethernet communication over WAN.
   b. Modbus Module shall support ASCII or RTU Modbus communication at 9600 or 4800 baud.
   c. EIA-422 and EIA-232 connection shall support one connection of Modbus unit.
   d. EIA-485 connection shall support connection of up to 247 Modbus units.
   e. Configuration shall be via RS-232 connection.
2. BACnet Translation.

F. All Modbus data shall be translated into BACnet objects by the Modbus module. All configuration tools shall be supplied to assure data is translated as necessary to the correct format and value.

G. Standard BACnet object types supported shall include as a minimum: Analog Value, Binary Value, Calendar, Device, File, Group, Notification Class, Program and Schedule object types. All proprietary object types, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.

2.03 EXPANDABLE CENTRAL PLANT AND AIR HANDLING UNIT CONTROLLERS

A. General:
1. Expandable application controller shall be capable of providing control strategies for the system based on information from any or all connected inputs. The program that implements these strategies shall be completely flexible and user definable. Any systems utilizing factory pre-programmed global strategies that cannot be modified by field personnel on-site via simple download are not acceptable. Changing global strategies via firmware changes is also unacceptable. Program execution of controller shall be a minimum of once per second.
2. Programming shall be object-oriented using control program blocks. Controller shall support a minimum of 500 Analog Values and 500 Binary Values. Each and every analog and binary value shall support standard BACnet priority arrays. Programming tool shall be provided with system and shall be the same tool that is used to program the Building Controller. All flowcharts shall be generated and automatically downloaded to controller. No re-entry of database information shall be necessary.
3. Provide means to graphically view inputs and outputs to each program block in real-time as program is executing. This function may be performed via the operator’s terminal or field computer.
4. Controller shall have adequate data storage to ensure high performance and data reliability. Battery shall retain static RAM memory and real-time clock functions for a

minimum of 1.5 years (cumulative). Battery shall be a field-replaceable (non-rechargeable) lithium type. Unused battery life shall be 10 years.

5. The onboard, battery-backed real time clock must support schedule operations and trend logs.
6. Global control algorithms and automated control functions should execute via 32-bit processor.
7. Controller shall include both on-board 10Base-T/100Base-TX Ethernet BACnet communication over twisted pair cable (UTP) and shall include BACnet IP communication. In addition, controller shall include BACnet PTP connection port.
8. The base unit of the controller shall host up to 8 expansion modules with various I/O combinations. These inputs and outputs shall include universal 12-bit inputs, binary triac outputs, and 8-bit switch selectable analog outputs (0-10V or 0-20 mA). Inputs shall support 3K and 10K thermistors, 0-5VDC, 0-10VDC, 4-20mA, dry contacts and pulse inputs directly.
9. All outputs must have onboard Hand-Off-Auto switches and a status indicator light. HOA switch position shall be monitored. Each analog output shall include a potentiometer for manually adjusting the output when the HOA switch is in the Hand position.
10. The position of each and every HOA switch shall be available system wide as a BACnet object. Expandable Central Plant Controller shall provide up to 176 discreet inputs/outputs per base unit.

B. BACnet Conformance:

1. Central Plant/AHU Controller shall as a minimum support Point-to-Point (PTP), MS/TP and Ethernet BACnet LAN types. It shall communicate directly via these BACnet LANs as a native BACnet device and shall support simultaneous routing functions between all supported LAN types. Building controller shall be a BACnet conformance class 3 device and support all BACnet services necessary to provide the following BACnet functional groups:
   a. Clock Functional Group
   b. Files Functional Group
   c. Reinitialize Functional Group
   d. Device Communications Functional Group
   e. Event Initiation Functional Group
2. Please refer to section 22.2, BACnet Functional Groups, in the BACnet standard for a complete list of the services that must be directly supported to provide each of the functional groups listed above. All necessary tools shall be supplied for working with proprietary information.
3. Standard BACnet object types supported shall include as a minimum: Analog Input, Binary Input, Analog Output, Binary Output, Analog Value, Binary Value, Device, File, Group, Event Enrollment, Notification Class, Program and Schedule object types. All necessary tools shall be supplied for working with proprietary information.
4. The Controller shall comply with Annex J of the BACnet specification for IP connections. This device shall use Ethernet to connect to the IP internetwork, while using the same Ethernet LAN for non-IP communications to other BACnet devices on the LAN. Must support interoperability on wide area networks (WANs) and campus area networks (CANs) and function as a BACnet Broadcast Management Device (BBMD).

C. Schedules: Each Central Plant/AHU controller shall support a minimum of 50 BACnet Schedule Objects.

D. Logging Capabilities:

1. Each controller shall support a minimum of 200 trend logs. Any object in the system (real or calculated) may be logged. Sample time interval shall be adjustable at the operator's workstation.
2. Controller shall periodically upload trended data to system server for long term archiving if desired.
3. Archived data stored in database format shall be available for use in third-party spreadsheet or database programs

E. Alarm Generation:
1. Alarms may be generated within the system for any object change of value or state either real or calculated. This includes things such as analog object value changes, binary object state changes, and various controller communication failures.
2. Alarm log shall be provided for alarm viewing. Log may be viewed on-site at the operator's terminal or off-site via remote communications
3. Controller must be able to handle up to 200 alarm setups stored as BACnet event enrollment objects – system destination and actions individually configurable.

2.04 TERMINAL UNIT APPLICATION CONTROLLERS (Heat Pumps, AC Units, Fan Coils)

A. Provide one native BACnet application controller for each piece of unitary mechanical equipment that adequately covers all objects listed in object list for unit. All controllers shall interface to building controller via MS/TP LAN using BACnet protocol. No gateways shall be used. Controllers shall include input, output and self-contained logic program as needed for complete control of unit.

B. BACnet Conformance:
1. Application controllers shall as a minimum support MS/TP BACnet LAN types. They shall communicate directly via this BACnet LAN at 9.6, 19.2, 38.4 and 76.8 Kbps, as a native BACnet device. Application controllers shall be of BACnet conformance class 3 and support all BACnet services necessary to provide the following BACnet functional groups:
   a. Files Functional Group
   b. Reinitialize Functional Group
   c. Device Communications Functional Group
2. Please refer to Section 22.2, BACnet Functional Groups in the BACnet standard for a complete list of the services that must be directly supported to provide each of the functional groups listed above. All proprietary services, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.
3. Standard BACnet object types supported shall include as a minimum–Analog Input, Analog Output, Analog Value, Binary Input, Binary Output, Binary Value, Device, File and Program Object Types. All proprietary object types, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.

C. Application controllers shall include universal inputs with 10-bit resolution that can accept 3K and 10K thermistors, 0–5 VDC, 4–20 mA, dry contact signals and a minimum of 3 pulse inputs. Any input on controller may be either analog or digital. Controller shall also include support and modifiable programming for interface to intelligent room sensor. Controller shall include binary outputs on board with analog outputs as needed.

D. All program sequences shall be stored on board controller in EEPROM. No batteries shall be needed to retain logic program. All program sequences shall be executed by controller 10 times

per second and shall be capable of multiple PID loops for control of multiple devices. Programming of application controller shall be completely modifiable in the field over installed BACnet LANs or remotely via modem interface. Operator shall program logic sequences by graphically moving function blocks on screen and tying blocks together on screen. Application controller shall be programmed using same programming tools as building controller and as described in operator workstation section. All programming tools shall be provided and installed as part of system.

E. Application controller shall include support for intelligent room sensor (see Section 2.09.B.) Display on room sensor shall be programmable at controller and include an operating mode and a field service mode. All button functions and display data shall be programmable to show specific controller data in each mode based on which button is pressed on the sensor. See sequence of operation for specific display requirements at intelligent room sensor.

2.05 TERMINAL BOX CONTROLLERS—SINGLE DUCT

A. Provide one native BACnet application controller for each terminal box that adequately covers all objects listed in object list for unit. All controllers shall interface to building controller via MS/TP LAN using BACnet protocol. No gateways shall be used. Controllers shall include on board CFM flow sensor, inputs, outputs and programmable, self-contained logic program as needed for control of units.

B. BACnet Conformance
   1. Application controllers shall as a minimum support MS/TP BACnet LAN types. They shall communicate directly via this BACnet LAN at 9.6, 19.2, 38.4 and 76.8 Kbps, as a native BACnet device. Application controllers shall be of BACnet conformance class 3 and support all BACnet services necessary to provide the following BACnet functional groups:
      a. Files Functional Group
      b. Reinitialize Functional Group
      c. Device Communications Functional Group
   2. Please refer to Section 22.2, BACnet Functional Groups, in the BACnet standard, for a complete list of the services that must be directly supported to provide each of the functional groups listed above. All proprietary services, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.
   3. Standard BACnet object types supported shall include as a minimum—Analog Input, Analog Output, Analog Value, Binary Input, Binary Output, Binary Value, Device, File and Program Object Types. All proprietary object types, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.

C. Application controllers shall include universal inputs with 10-bit resolution that can accept 3K and 10K thermistors, 0–5 VDC, and dry contact signals. Inputs on controller may be either analog or digital. Controller shall also include support and modifiable programming for interface to intelligent room sensor with digital display. Controller shall also include binary outputs on board. For applications using variable speed parallel fans, provide a single analog output selectable for 0-10 V or 0-20 mA control signals. Application controller shall include microprocessor driven flow sensor for use in pressure independent control logic. All boxes shall be controlled using pressure independent control algorithms and all flow readings shall be in CFM (LPS if metric).

D. All program sequences shall be stored on board application controller in EEPROM. No batteries shall be needed to retain logic program. All program sequences shall be executed by controller 10 times per second and shall be capable of multiple PID loops for control of multiple devices. Programming of application controller shall be completely modifiable in the field over installed BACnet LANs or remotely via modem interface. Operator shall program logic sequences by graphically moving function blocks on screen and tying blocks together on screen. Application controller shall be programmed using the same programming tool as Building Controller and as described in operator workstation section. All programming tools shall be provided as part of system.

E. Application controller shall include support for intelligent room sensor (see Section 2.07.G.) Display on room sensor shall be programmable at application controller and include an operating mode and a field service mode. All button functions and display data shall be programmable to show specific controller data in each mode based on which button is pressed on the sensor. See sequence for specific display requirements for intelligent room sensor.

F. On board flow sensor shall be microprocessor driven and pre-calibrated at the factory. Pre-calibration shall be at 16 flow points as a minimum. All factory calibration data shall be stored in EEPROM. Calibration data shall be field adjustable to compensate for variations in terminal box type and installation. All calibration parameters shall be adjustable through intelligent room sensor. Operator workstation, portable computers and special hand-held field tools shall not be needed for field calibration.

G. Provide duct temperature sensor at discharge of each terminal box that is connected to controller for reporting back to operator workstation.

2.06 DASHBOARD INTERFACE

A. General: EMCS supplier shall provide browser-accessed dashboard that can support up to 150 simultaneous users as part of standard installation for viewing of system data on a display, kiosk, or personal computer. The dashboard software shall reside on the EMCS BACnet network, and share the EMCS server for the control system.

B. Information Display
   1. The web-based dashboard information screens shall:
      a. Support displaying up to 50 buildings
      b. User shall be able to navigate by clicking on icons and/ or navigate via a touchscreen without the need for any additional configuration.
      c. The dashboard shall support auto rotation of pages to support display with no user interface (for example, touchscreen, mouse or keyboard). The pages to be displayed can be selected as a subset of all possible pages in the dashboard. The time to view each page and the order in the pages are cycled through shall be configurable.
      d. The dashboard application shall include the following pages at a minimum:
         1) Home page
         2) Consumption page
         3) Summary page
         4) Demand page
         5) Green facts page
         6) Weather page

e. The end user shall be able to compare measured data for one (1) entity against measured data for a second entity.
f. For each resource that is defined (e.g. water, gas, etc.) one (1) consumption page shall be used.
g. The end user shall be able to view current data on one of the following time scales:
    1) Cumulative data for today, displayed in hour increments.
    2) Cumulative data for the current week, displayed in daily increments
    3) Cumulative data for the current month, displayed in daily increments
    4) Cumulative data for the current year, displayed din monthly increments
h. The user shall be able to see:
    1) Today's data compared against the data for the same day last week.
    2) This week's data compared against the data for the same week last year.
    3) This month's data compared against the data for the same month last year.
    4) This year's data compared against the data for last year.
i. The end user shall be able to view historical data in one of the following time scales:
    1) Complete data for yesterday, displayed in hour increments
    2) Complete data for last week, displayed in daily increments
    3) Complete data for last month, displayed in daily increments
    4) Complete data for last year, displayed in monthly increments.

C. Dashboard Data
1. The database for the dashboard must be on the enterprise network and remotely hosted on a third-party network. The database should be on-site to maintain security and privacy.
2. Energy Dashboard data shall reside on site and shall remain in the EMCS.
3. The dashboard shall support Microsoft SQL database.
4. The dashboard shall allow for the importation of external data via CSV file format.

D. Browser Technology
1. The following browsers shall be supported:
    a. Microsoft Internet Explorer v9.0 or later
    b. Firefox 3.6.15
    c. Safari 4
    d. Google Chrome

E. Dashboard Licensing
1. The Energy Dashboard shall utilize software licensing that will run in perpetuity, without the need for additional service and/ or subscription fees.

F. Configuration
1. End users shall be able to connect remotely (including dashboard location) to the system to make changes to the configuration using a browser.
2. Energy Dashboard shall be maintainable by end-user staff with limited training and support common image files including JPEC and PNG.
3. User generated/ supplied content to include foreground images, background images, text, and icons.

4. Consumption pages for the resources defined – one (1) for each resource type for which he wishes to display consumption data. Consumption data is the total amount of a resource used over time, for example this is a kWh reading.
5. The system designer shall be able to configure:
    a. One of more home pages.
    b. One or more summary consumption pages. This page shows the total consumption for each configured entity within the system and a total for the entire enterprise.
    c. One or more current demand pages. This page shows the current demand for a given entity.
    d. One or more weather pages using weather station data from either NOAA or Google.
    e. One or more green facts pages. This page is intended to inform the user of relevant environmental information.
6. Support ability to add additional capacity (more buildings, more meters) without the need for additional hardware.

G. Security
1. Dashboard Ability to restrict data behind a firewall or within a DMZ.
2. Dashboard application shall no allow the user to update the system data. For example, the user shall not be allowed to update the present-value of an analog value.
3. The dashboard shall require a user authorization via user name and password to access the configuration screens.

2.07 SENSORS and MISCELLANEOUS DEVICES

A. Temperature Sensors:
1. All temperature sensors to be solid state electronic, factory-calibrated to within 0.5°F, totally interchangeable with housing appropriate for application. Wall sensors to be installed as indicated on drawings. Duct sensors to be installed such that the sensing element is in the main air stream. Immersion sensors to be installed in wells provided by control contractor, but installed by mechanical contractor. Immersion wells shall be filled with thermal compound before installation of immersion sensors. Outside air sensors shall be installed away from exhaust or relief vents, not in an outside air intake and in a location that is in the shade most of the day.

B. Thermowells:
1. Thermowells shall be pressure rated and constructed in accordance with the system working pressure. Thermowells and sensors shall be mounted in a threadolet or ½" NPT saddle and allow easy access to the sensor for repair or replacement. They shall be constructed of machined stainless steel, type 316. Manufacturer shall be BAPI Model BA/4"M316 or Engineer approved equal.

C. Averaging Duct Type Temperature Sensors:
1. BAPI or Engineer approved equal.
    a. Operating Temperature: -40 to 240°F
    b. Sensing Element: NTC 10K (Type II) Thermistor
    c. Accuracy: +/- 1°F.
2. Averaging duct temperature sensors with multiple sensing points shall be installed in ductwork that has a dimension greater than 48 inches and where air temperature stratification exists. Install complete with end cap, compression fittings, gaskets,

mounting flange, and required accessories. Provide capillary supports at the sides of the duct to support the sensing string.

D. Liquid Immersion Temperature Sensors:
   1. BAPI Model BA/10K or Engineer approved equal.
      a. Operating Temperature: -40 to 240°F
      b. Sensing Element: NTC 10K (Type II) Thermistor
      c. Accuracy at Calibration Temperature: +/- 1°F.
   2. All sensors measuring temperatures in pipes larger than 2 inches in diameter or in pressure vessels shall be supplied with wells properly fabricated for the service. Wells shall be non-corrosive to the medium being measured and shall have sufficient physical strength to withstand pressures and velocities to which they are subjected. Wells shall be installed in the piping at elbows where piping is smaller than the length of the well to affect proper flow across the entire area of the well.
   3. Stainless steel, Type 304, socket with minimum insertion length of 4 inches.

E. Duct Type Temperature Sensors:
   1. BAPI or Engineer approved equal.
      a. Operating Temperature: -40 to 240°F
      b. Sensing Element: NTC 10K (Type II) Thermistor
      c. Accuracy at Calibration Temperature: +/- 1°F.
   2. Sensors in ducts shall be mounted in locations to sense the correct temperature of the air only and shall not be located in dead air spaces, in close proximity to coils so as to display inaccurate temperatures, or positions obstructed by ducts, equipment, and so forth. Locations where installed shall be within the vibration and velocity limit of the sensing element.
   3. Duct mount sensors shall mount in an electronic box through a hole in the duct and be positioned so as to be easily accessible for repair or replacement. A neoprene grommet (Seal-lite fitting and mounting plate) shall be used on the sensor assembly to prevent air leaks.
   4. Duct sensors shall be insertion type and constructed as a complete assembly including lock nut and mounting plate. Duct sensors probe shall be constructed of 304/316 stainless steel.
   5. Duct sensors shall not be mounted within 36 inches of heating and cooling coils.
   6. For outdoor air duct applications, use a weatherproof mounting box with weatherproof cover and gasket.

F. Outdoor Air Temperature and Humidity:
   1. Vaisala HUMICAP Outdoor Humidity and Temperature Transmitter HMD60YO or Engineer approved equal.
      a. Humidity Operating Range: 0-100% RH
      b. Humidity Output Signal: 4 to 20mA, 0 to 100% linear, proportional
      c. Humidity Accuracy: +/- 2.0% RH, 0-90% RH.
      d. Humidity Sensing Element: HUMICAP 180
      e. Temperature Range: -40 to 140°F
      f. Temperature Output Signal: 4 to 20mA, 0 to 100% linear, proportional
      g. Temperature Accuracy: +/- 0.36°F
      h. Sensing Element: 1K-ohm Platinum RTD 1/3 Class B IEC 751

2. Outdoor installations shall be of weatherproof construction or in appropriate NEMA enclosures. These installations shall be protected from solar radiation and wind effects. They shall also be provided with a solar radiation shield.

G. Intelligent Room Sensor with LCD Readout:
1. Sensor shall contain a backlit LCD digital display and user function keys along with temperature sensor. Controller shall function as room control unit, and shall allow occupant to raise and lower setpoint, and activate terminal unit for override use—all within limits as programmed by building operator. Sensor shall also allow service technician access to hidden functions as described in sequence of operation.
2. The Intelligent Room Sensor shall simultaneously display room setpoint, room temperature, outside temperature, and fan status (if applicable) at each controller. This unit shall be programmable, allowing site developers the flexibility to configure the display to match their application. The site developer should be able to program the unit to display time-of-day, room humidity and outdoor humidity. Unit must have the capability to show temperatures in Fahrenheit or Centigrade.
3. Override time may be set and viewed in half-hour increments. Override time count down shall be automatic, but may be reset to zero by occupant from the sensor. Time remaining shall be displayed. Display shall show the word “OFF” in unoccupied mode unless a function button is pressed.
4. See sequence of operation for specific operation of LCD displays and function keys in field service mode and in normal occupant mode. Provide intelligent room sensors as specified in point list.
5. Field service mode shall be customizable to fit different applications. If intelligent room sensor is connected to terminal controller, terminal box shall be balanced and all air flow parameters shall be viewed and set from the intelligent room sensor with no computer or other field service tool needed.

H. Wall Sensor:
1. Standard wall sensor shall use solid-state sensor identical to intelligent room sensor and shall be packaged in aesthetically pleasing enclosure. Sensor shall provide override function, warmer/cooler lever for set point adjustment and port for plug-in of Field Service Tool for field adjustments. Override time shall be stored in controller and be adjustable on a zone-by-zone basis. Adjustment range for warmer/cooler lever shall also be stored in EEPROM on controller. All programmable variables shall be available to Field Service Tool through wall sensor port.

I. CO2 Sensors
1. Provide indoor air quality sensors to monitor Carbon Dioxide (CO2) levels. Manufacturer shall be Alerton as an integral component of room thermostat.
2. Sensors shall be of microprocessor-based photoacoustic type with heated stannic dioxide semiconductor, and have no more than 1% drift during the first year of operation.
3. Duct mounted sensors shall be provided with LED indicators in a dust proof plastic housing with transparent cover.
4. The sensor shall meet the following requirements:
   a. Operating voltage: 24 VAC +/- 20%
   b. Frequency: 50/60 Hz
   c. Power Consumption: max 6 VA
   d. CO2 measuring range: 0 – 2000 ppm
   e. Tolerance: +/- 100 ppm
   f. Output: 0 – 10 VAC

g. Calibration: none required

J. Air Differential Pressure Transmitters
1. Air differential pressure sensors shall be Setra Model 267 with LCD display transmitters or Engineer approved equal.
2. Pressure transmitters shall be constructed to withstand 100% pressure over-range without damage and to hold calibrated accuracy when subject to a momentary 40% over-range input.
3. Differential pressure transmitters used for flow measurement shall be sized to the flow-sensing device and shall be supplied with shutoff and bleed valves in the high and low sensing pick-up lines (3 valve manifolds).
4. Provide a minimum of a NEMA 1 housing for the transmitter. Locate transmitters in accessible local control panels wherever possible.
5. The pressure transmitter shall be capable of transmitting a linear electronic signal proportional to the differential of the room and reference static pressure input signals with the following minimum performance specifications.
   a. Span: Refer to Points List
   b. Accuracy: ±0.5% of full scale
   c. Non-Repeatability: ±0.05%
   d. Non-Linearity: ±0.35%
   e. Response: Less than one second for full span input.
   f. Temperature Stability: Less than 0.02%FS/°F change
   g. Output: 4 to 20 mA

K. Water Differential Pressure Transmitters
1. Water differential pressure sensors shall be Rosemont Model 2051 with three valve manifold or Engineer approved equal.
2. Pressure transmitters shall be constructed to withstand 100% pressure over-range without damage and to hold calibrated accuracy when subject to a momentary 40% over-range input.
3. Provide the following:
   a. NEMA 1 transmitter housing and locate in accessible local control panels wherever possible.
   b. Brass 3-valve manifold assembly with shut-off and shunt valves.
   c. Standard Viton/Silicone bleed screw seals.
   d. Calibration certificate.
4. The pressure transmitter shall be capable of transmitting a linear electronic signal proportional to the differential of the pressure input signals with the following minimum performance specifications:
   a. Span: Refer to points list.
   b. Accuracy: ± 0.25% of full scale.
   c. Non-Repeatability: 0.05%.
   d. Non-linearity: ± 0.20%
   e. Response: 30 to 50 ms
   f. Temperature Stability: Less than 0.20% FS/°F.
   g. Output: 4 to 20 mA.

L. Magnetic Flow Meters
1. Flow meter shall be Rosemont 8705 or Engineer approved equal with remote transmitter with display and keypad.

2. Provide remote transmitter with display and keypad.
3. Power 24VDC power supply as required.
4. BMS system shall monitor flow rates, pressure and temperature values.
5. Provide isolation valve kit to allow removal and servicing of meter while system is operating.
6. Provide flow meter that is pressure and temperature compensated and rated for chilled (40°F) and heating hot (200°F) service conditions.
7. Heating hot water flow meter shall be provided with ceramic lining.

M. THERMAL-ENERGY METERS

1. Onicon System 10-BAC-MS/TP BTU Meter or approved equal.

2. Provide system with flow sensor, temperature sensors, transmitter, indicator, and connecting wiring.

3. Electromagnetic insertion flow sensor (no moving parts) with corrosion-resistant-metal body and transmitter; for installing in piping.

   a. Design: Total thermal-energy measurement.

   b. Minimum pressure rating: 150 psig.

   c. Minimum Temperature Range: 15 to 250°F.

4. Temperature Sensors

   a. Solid-state sensors calibrated using NIST traceable temperature standards.

   b. Differential temperature accuracy ±0.15°F over calibrated range.

5. Indicator: Solid-state, integrating-type meter for wall mounting.

   a. Sixteen-character alphanumeric LCD display.

   b. Display Data: Total energy, total flow, energy rate, flow rate, supply temperature and return temperature.

6. Accuracy: Plus or minus 0.05 percent computing non-linearity.

7. Display: Visually indicates total energy, total flow, energy rate, flow rate, supply and return temperature.

8. Output Interface: BACnet MS/TP

N. Current Transformers

1. The current transformers shall be provided to be installed or removed without dismantling the primary bus or cables. The transformer shall be of a split core design.

2. The core and windings shall be completely encased in a UL approved thermoplastic rated 94VA. No metal parts shall be exposed other than the terminals.
3. The current transformers shall meet the following specifications.
   a. Frequency Limits: 50 to 400 Hz.
   b. Insulation: 0.6 KV Class, 10 KV BIL.
   c. Accuracy: ± 1 % at 5.0 to 25.0 VA accuracy class with U.P.F. burden.
   d. Provide a disconnect switch for each current transformer.

O. Current Switches
1. Current sensing switch shall be self-powered with solid-state circuitry and a dry contact output.
2. Current sensing switches shall consist of a solid state current sensing circuit, adjustable trip point, solid state switch, SPDT relay and an LED indicating the on or off status. A conductor of the load shall be passed through the window of the device. It shall accept over current up to twice its trip into range.

P. Power Meters
1. To be VERIS E50H2 or approved equal.
2. The power meter shall be fully electronic with multi-line backlit LCD display showing measured parameters as well as alarm functions and pulse output.
3. The power meter shall perform the following measurements:
   a. Accumulated Real Energy (kWh) for each phase and total of all phases
   b. Accumulated Reactive Energy (kVARh) and Apparent Energy (kVAh) totals for all phases
   c. Net Present Demand for Real (kW), Reactive (kVAR) and Apparent (kVA) Power over a user-specified interval (block or sliding window)
   d. Maximum (Peak) Real (kW), Reactive (kVAR) and Apparent (kVA) Demand Intervals
   e. Instantaneous Real (kW), Reactive (kVAR) and Apparent Power (kVA), by phase and in total
   f. Current (amps) for each phase and average of all phases
   g. Phase-to-phase voltage for each phase and average of all phase pairs
   h. Phase-to-neutral voltage for each phase pair and average of all phases
   i. Power factor for each phase and average of all phases
   j. AC frequency
4. The power meter shall communicate using the BACnet MS/TP protocol at speeds from 9600 to 115,200 baud (no parity). The meter shall provide a BACnet Device object, a set of writable Analog_Value objects for remote configuration, a set of Analog_Input objects to provide access to scaled 32-bit measurement values and their unit types, and a set of Binary_Input objects for indicating individual alarm conditions.
5. The meter shall be UL/CUL listed to the latest applicable safety standards.
6. Power meter models must be available to directly accept voltage input over the range of 90 to 600 VAC (50 or 60Hz).
7. The power meter shall accept either 0 to 0.333VAC or 0 to 1VAC input from up to three current transducers to 32000 amps.
8. The measured energy consumption shall be retained in non-volatile memory for the life of the product warranty.
9. The power meter shall have demand measurement programmable for up to 6 sub-intervals of 10 seconds to 546 minutes duration.
10. Meter shall be optionally available in an outdoor NEMA 4X enclosure.

11. The power meter shall operate from -30C to +70C.
12. The power meter shall have dimensions not exceeding 4.2” x 3.6” x 2.3”.
13. The power meter shall be Veris E50H2 or equivalent.
14. The power meter shall meet both ANSI C12.20 .5% and IEC 62053-22 Class .5S real power and energy accuracy specifications.
15. The power meter shall meet IEC 62053-22 Class 2 reactive power and energy accuracy specifications.
16. The power meter shall be configurable for operation on Single Phase (AN or AB), Split Phase (ABN), Delta (ABC), and Wye (ABCN) systems.
17. The power meter shall have automatic phase reversal compensation such that it is insensitive to the CT’s load orientation.
18. The power meter shall have separate control power inputs such that is may be powered from a different service than it measures.
19. The power meter shall have Phase Loss Alarm contacts with a user configurable phase loss threshold.
20. The power meter shall have a user-configurable Pulse Contact input to support measurement of other related energy (Gas, Water, Steam, etc.) via BACnet using a simple pulse-output transducer.
21. The power meter shall be configurable for use with Potential Transformers to 32000 volts.
22. The power meter shall support warnings for low power factor (phase current or voltage miss-wired), current over range, voltage over range, and frequency out of range.
23. The product shall have a 5-year warranty.

Q. Power Supplies and Line Filtering
1. Power Supplies. Control transformers shall be UL listed. Furnish Class 2 current-limiting type or furnish over-current protection in primary and secondary circuits for Class 2 service in accordance with NEC requirements. Limit connected loads to 80% of rated capacity.
    a. DC power supply output shall match output current and voltage requirements. Unit shall be full wave rectifier type with output ripple of 5.0 mV maximum peak-to-peak. Regulation shall be 1.0% line and load combined, with 100-microsecond response time for 50% load changes. Unit shall have built-in over-voltage and over-current protection and shall be able to withstand 150% current overload for at least three seconds without trip-out or failure.
    b. Unit shall operate between 32°F and 120°F. EM/RF shall meet FCC Class B and VDE 0871 for Class B and MILSTD 810C for shock and vibration.
    c. Line voltage units shall be UL recognized and CSA listed.
2. Power Line Filtering.
    a. Provide internal or external transient voltage and surge suppression for workstations and controllers. Surge protection shall have:
    b. Dielectric strength of 1000 V minimum
    c. Response time of 10 nanoseconds or less
    d. Transverse mode noise attenuation of 65 dB or greater
    e. Common mode noise attenuation of 150 dB or greater at 40-100 Hz

R. Field Service Tool:
1. Field service tool shall allow technician to view and modify all setpoints and tuning parameters stored in application controller. In addition, technician shall be able to view status of all inputs and outputs on digital readout. Each piece of data shall have a data code associated with it that is customizable.

2. Field service tool shall plug into wall sensor and provide all the functionality specified. Operator workstation shall include the capability to disable operation of the field service tool.

S. Network Connection Tool:
1. Network connection tool shall allow technician to connect a laptop to any MS/TP network or at any MS/TP device and view and modify all information throughout the entire BACnet network. Laptop connection to tool shall be via Ethernet or PTP.
2. Provide quick connect to MS/TP LAN at each controller. Tool shall be able to adjust to all MS/TP baud rates specified in the BACnet standard.

2.08 ELECTRONIC ACTUATORS AND VALVES

A. Quality Assurance for Actuators and Valves:
1. UL Listed Standard 873 and C.S.A. Class 4813 02 certified.
2. NEMA 2 rated enclosures for inside mounting, provide with weather shield for outside mounting.
3. Five-year manufacturer's warranty. Two-year unconditional and three-year product defect from date of installation.

B. Execution Details for Actuators and Valves:
1. Furnish a Freeze-stat and install "Hard Wire" interlock to disconnect the mechanical spring return actuator power circuit for fail-safe operation. Use of the control signal to drive the actuators closed is not acceptable.
2. Terminal box damper actuation shall be Floating type or Analog (2-10vdc, 4-20ma).
3. Booster-heat valve actuation shall be Floating type or Analog (2-10vdc, 4-20ma).
4. Primary valve control shall be Analog (2-10vdc, 4-20ma).

C. Actuators for Damper and Control Valves ½" to 6" shall be Electric unless otherwise specified, provide actuators as follows:
1. UL Listed Standard 873 and Canadian Standards association Class 481302 shall certify Actuators.
2. NEMA 2 rated actuator enclosures are. Use additional weather shield to protect actuator when mounted outside.
3. 5 year Manufacturers Warranty. Two-year unconditional + Three year product defect from date of installation.
4. Mechanical spring shall be provided when specified. Capacitors or other non-mechanical forms of fail-safe are not acceptable.
5. Position indicator device shall be installed and made visible to the exposed side of the Actuator. For damper short shaft mounting, a separate indicator shall be provided to the exposed side of the Actuator.
6. Overload Protection: Actuators shall provide protection against actuator burnout by using an internal current limiting circuit or digital motor rotation sensing circuit. Circuit shall insure that actuators cannot burn out due to stalled damper or mechanical and electrical paralleling. End switches to deactivate the actuator at the end of rotation are acceptable only for Butterfly Valve actuators.
7. A push button gearbox release shall be provided for all non-spring actuators.
8. Modulating actuators shall be 24Vac and consume 10VA power or less.
9. Conduit connectors are required when specified and when code requires it.

D. Damper Actuators:

1. Outside Air and Exhaust Air Damper Actuators shall be Mechanical Spring Return. Capacitors or other non-mechanical forms of fail-safe are not acceptable. The actuator mounting arrangement and spring return feature shall permit normally open or normally closed positions of the damper as required.
2. Economizer Actuators shall utilize Analog control 2-10 VDC, Floating control is not acceptable.
3. Electric damper actuators (including terminal box actuators) shall be direct shaft mounted and use a V-bolt and toothed V-clamp causing a cold weld effect for positive gripping. Single bolt or setscrew type fasteners are not acceptable.
4. One electronic actuator shall be direct shaft mounted per damper section. No connecting rods or jackshafts shall be needed. Small outside air and return air economizer dampers may be mechanically linked together if one actuator has sufficient torque to drive both and damper drive shafts are both horizontal installed.
5. Multi-section dampers with electric actuators shall be arranged so that each damper section operates individually. One electronic actuator shall be direct shaft mounted per damper section. (See below execution section for more installation details.)

E. Valve Actuators ½" to 6":
1. Mechanical spring shall be provided on all actuators for pre-heat coil and actuators for AHU heating or cooling coil when units are mounted outside. See plans for fail save flow function: Normal Open or Normal Closed. Capacitors or other non-mechanical forms of fail-safe are not acceptable.
2. All zone service actuators shall be non-spring return unless otherwise specified.
3. The valve actuator shall be capable of providing the minimum torque required for proper valve close off for the required application.
4. All control valves actuators shall have an attached 3-foot cable for easy installation to a junction box.
5. Override handle and gearbox release shall be provided for all non-spring return valve actuators.

F. Control Valves: The EMCS contractor shall furnish all specified motorized control valves and actuators. EMCS contractor shall furnish all control wiring to actuators. The Plumbing contractor shall install all valves. Equal Percentage control characteristic shall be provided for all water coil control valves.
1. Manufacturer shall be Belimo or Engineer approved equal.
2. Control Valves: Factory fabricated, of type, body material and pressure class based on maximum pressure and temperature rating of piping system, unless otherwise indicated.
3. Pressure Independent Characterized Control Valves:
   a. NPS 2 and Smaller: Forged brass body rated at no less than 400 PSI, chrome plated brass ball and stem, female NPT union ends, dual EPDM librated O-rings and a brass or TEFZEL characterizing disc.
   b. NPS 2-1/2 through 6: GG25 cast iron body according to ANSI Class 125, standard class B, stainless steel ball and blowout proof stem, flange to match ANSI 125 with a dual EPDM O-ring packing design, PTFE seats, and a stainless steel flow characterizing disc.
   c. Accuracy: The control valves shall accurately control the flow form 0 to 100% rated flow with an operating pressure differential range of 5 to 50 psi differential across the valve with a valve body flow accuracy of ±5 or ±10% total assembly error incorporating differential pressure fluctuation, manufacturing tolerances and valve hysteresis
   d. Flow Characteristics: equal percentage characteristic.

e. All actuators shall be capable of being electronically programmed in the field by use of external computer software or a dedicated handheld tool for the adjustment of flow.
f. The control valve shall require no maintenance and shall not include replaceable cartridges.
g. The operating temperature range shall be 0° to 250° F.

4. Globe valves ½" to 2" shall be used for steam control or water flow applications.
   a. Valves shall be bronze body, NPT screw type, and shall be rated for ANSI Class 250 working pressure.
   b. Valves 1/2 inch (DN15) through 2 inches (DN50) with spring return actuators shall close off against 50 psi pressure differential with Class III leakage (.1%).
   c. The operating temperature range shall be 20° to 280° F.
   d. Spring loaded TFE packing shall protect against leakage at the stem.
   e. Two-way valves shall have an equal percentage control port.
   f. Three-way valves shall a linear control and bypass port.
   g. Mixing and diverting valves must be installed specific to the valve design.
5. Globe Valve 2 ½ to 6":
   a. Valves 2-1/2 inch (DN65) through 6 inches (DN50) shall be iron body, 125 lb. flanged with Class III (.1%) close-off leakage at 50 psi differential.
   b. Valves with spring return actuators shall close off against 50 psi pressure differential with Class III leakage (.1%).
   c. Flow type for two-way valves shall be equal percentage. Flow type for three-way valves shall be linear.
   d. Mixing and diverting valves must be installed specific to the valve design.

G. Butterfly Valves:
1. Butterfly Valves shall be sized for modulating service at 60-70 degree stem rotation. Isolation valves shall be line-size. Design velocity shall be less than 12 feet per second when used with standard EPDM seats
   a. Body is Cast Iron.
   b. Disc is Aluminum Bronze standard.
   c. Seat is EPDM Standard.
   d. Body Pressure is 200 psi, -30F to 275F.
   e. Flange is ANSI 125/250.
   f. Media Temperature Range is –22F to 240F
   g. Maximum Differential Pressure is 200 psi for 2" to 6" size.

H. Butterfly Valve Industrial Actuators:
1. Actuators shall be approved under Canadian Standards Association or other Nationally Recognized Testing Laboratory to UL standards. CSA Class 4813 02 or equal. Enclosure shall be NEMA 4 (weatherproof) enclosure and will have an industrial quality coating.
   a. Actuator shall have a motor rated for continuous duty. The motor shall be fractional horsepower; permanent split capacitor type designed to operate on a 120 VAC, 1 pH, 60 Hz supply. Two adjustable cam actuated end travel limit switches shall be provided to control direction of travel. A self-resetting thermal switch shall be imbedded in the motor for overload protection.
   b. Reduction gearing shall be designed to withstand the actual motor stall torque. Gears shall be hardened alloy steel, permanently lubricated. A self-locking gear assembly or a brake shall be supplied.

c. Actuator shall have a 6 ft wiring harness provided for ease in field wiring (above 1500 in-lbs). Two adjustable SPDT cam-actuated auxiliary switches, rated at 250 VAC shall be provided for indication of open and closed position. Actuator shall have heater and thermostat to minimize condensation within the actuator housing.

d. Actuator shall be equipped with a hand wheel for manual override to permit operation of the valve in the event of electrical power failure or system malfunction. Hand wheel must be permanently attached to the actuator and when in manual operation electrical power to the actuator will be permanently interrupted. The hand wheel will not rotate while the actuator is electrically driven.

e. The actuator shall be Analog, floating, or two position as called out in the control sequence of operation. All Analog valves shall be positive positioning, and respond to a 2-10 VDC, 4-20 mA, or adjustable signal as required. Analog actuators shall have a digital control card allowing any voltage input for control and any DC voltage feedback signal for position indication.

2. Performance Verification Test:
   a. Control loops shall cause productive actuation with each movement of the actuator and actuators shall modulate at a rate which is stable and responsive. Actuator movement shall not occur before the effects of previous movement have affected the sensor.
   b. Actuator shall have capability of signaling a trouble alarm when the actuator Stop-Go Ratio exceeds 30%.
3. Actuator Mounting for Damper and Valve arrangements shall comply to the following:
   a. Damper Actuators: Shall not be installed in the air stream.
   b. A weather shield shall be used if actuators are located outside. For Damper Actuators use clear plastic enclosure.
   c. Damper or valve actuator ambient temperature shall not exceed 122 degrees F through any combination of medium temperature or surrounding air. Appropriate air gaps, thermal isolation washers or spacers, standoff legs, or insulation shall be provided as necessary
   d. Actuator cords or conduit shall incorporate a drip leg if condensation is possible. Water shall not be allowed to contact actuator or internal parts. Location of conduits in temperatures dropping below dew point shall be avoided to prevent water from condensing in conduit and running into actuator.
   e. Damper mounting arrangements shall comply to the following:
      1) The ventilation subcontractor shall furnish and install damper channel supports and sheet metal collars.
      2) No jack shafting of damper sections shall be allowed.
      3) Multi-section dampers shall be arranged so that each damper section operates individually. One electronic actuator shall be direct shaft mounted per section.
   f. Size damper sections EMCSed on actuator manufacturers specific recommendations for face velocity, differential pressure and damper type. In general:
      1) Damper section shall not exceed 24 ft-sq. with face velocity £ 1500 FPM.
      2) Damper section shall not exceed 18 ft-sq. with face velocity £ 2500 FPM.
      3) Damper section shall not exceed 13 ft-sq. with face velocity £ 3000 FPM.
   g. Multiple section dampers of two or more shall be arranged to allow actuators to be direct shaft mounted on the outside of the duct.
   h. Multiple section dampers of three or more sections wide shall be arranged with a 3-sided vertical channel (8'' wide by 6" deep) within the duct or fan housing and between adjacent damper sections. Vertical channel shall be anchored at the top

and bottom to the fan housing or building structure for support. The sides of each damper frame shall be connected to the channels. Holes in the channel shall allow damper drive blade shafts to pass through channel for direct shaft mounting of actuators. Open side of channel shall be faced down stream of the airflow, except for exhaust air dampers.

i. Multiple section dampers to be mounted flush within a wall or housing opening shall receive either vertical channel supports as descried above or sheet metal standout collars. Sheet metal collars (12" minimum) shall bring each damper section out of the wall to allow direct shaft mounting of the actuator on the side of the collar.

4. Valve Sizing for Water Coil
   a. On/Off Control Valves shall be line size.
   b. Modulating Control Valve Body Size may be reduced at most two pipe sizes from the line size or not less than ½ the pipe size. The EMCS contractor shall size all water coil control valves for the application as follows:
      1) Booster-heat valves shall be sized not to exceed 4-9psi differential pressure. Size valve for 50% Valve Authority. Valve design pressure drop is equal to the sum of coil drop plus the balance valve drop.
      2) Primary valves shall be sized not to exceed 5-15psi differential pressure. Size valve for 50% Valve Authority. Valve design pressure drop is equal to the sum of coil drop plus the balance valve drop.
      3) Butterfly valves shall be sized for modulating service at 60-70 degree rotation. Design velocity shall be 12 feet per second or less when used with standard EPDM seats.
   c. Valve Mounting arrangements shall comply to the following:
      1) Unions shall be provided on all ports of two-way and three-way valves.
      2) Install three-way equal percentage Characterized Control valves in a mixing configuration with the "A" port piped to the coil.
      3) Install 2½ inch and above, Three-Way globe valves, as manufactured for mixing or diverting service to the coil. .

2.09 IDENTIFICATION

A. Automatic Control Valve Tags
   1. For valves, etc., use metal tags with a 2-inch minimum diameter, fabricated of brass, stainless steel or aluminum. Attach tags with chain of same materials. For lubrication instructions, use linen or heavy duty shipping tag.
   2. Tag valves with identifying number and system. Number valves by floor level, column location and system served.
   3. Prepare lists of all tagged valves showing location, floor level, and tag number, use. Prepare separate lists for each system. Include copies in each maintenance manual.

B. Wire Tags
   1. All multi-conductor cables in all pull boxes and terminal strip cabinets shall be tagged.
   2. Provide wire Tags as per Division 26.

C. Conduit Tags
   1. Provide tagging or labeling of conduit so that it is always readily observable which conduit was installed or used in implementation of this Work.

D. Miscellaneous Equipment Identification

1. Screwed-on, engraved black lamicoid sheet with white lettering on all control panels and remote processing panels. Lettering sizes subject to approval.
2. Inscription, subject to review and acceptance, indicating equipment, system numbers, functions and switches. For panel interior wiring, input/output modules, local control panel device identification.

2.10 ENCLOSURES

A. All controllers, power supplies and relays shall be mounted in enclosures.

B. Enclosures may be NEMA 1 when located in a clean, dry, indoor environment. Indoor enclosures shall be NEMA 4 when installed in other than a clean environment.

C. Enclosures shall be NEMA 3R when installed outdoors or near potential water leakage.

D. Enclosures shall have hinged, locking doors.

E. Provide laminated plastic nameplates for all enclosures in any mechanical room or electrical room. Include location and unit served on nameplate. Laminated plastic shall be 1/8” thick sized appropriately to make label easy to read.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Prior to starting work, carefully inspect installed work of other trades and verify that such work is complete to the point where work of this Section may properly commence.

B. Notify the owners' representative in writing of conditions detrimental to the proper and timely completion of the work.

C. Do not begin work until all unsatisfactory conditions are resolved.

3.02 INSTALLATION (GENERAL)

A. Install in accordance with manufacturer's instructions.

B. Provide all miscellaneous devices, hardware, software, interconnections installation and programming required to ensure a complete operating system in accordance with the sequences of operation and point schedules.

3.03 LOCATION AND INSTALLATION OF COMPONENTS

A. Locate and install components for easy accessibility; in general, mount 48 inches above floor with minimum 3'-0" clear access space in front of units. Obtain approval on locations from owner’s representative prior to installation.

B. All instruments, switches, transmitters, etc., shall be suitably wired and mounted to protect them from vibration, moisture and high or low temperatures.

C. Identify all equipment and panels. Provide permanently mounted tags for all panels.

D. Provide stainless steel or brass thermowells suitable for respective application and for installation under other sections—sized to suit pipe diameter without restricting flow.

3.04 INTERLOCKING AND CONTROL WIRING

A. Provide all interlock and control wiring. All wiring shall be installed neatly and professionally, in accordance with Specification Division 26.

B. All wiring to be installed in conduit.

C. Provide wiring as required by functions as specified and as recommended by equipment manufacturers, to serve specified control functions. Provide shielded low capacitance wire for all communications trunks.

D. Control wiring shall not be installed in power circuit raceways. Magnetic starters and disconnect switches shall not be used as junction boxes. Provide auxiliary junction boxes as required. Coordinate location and arrangement of all control equipment with the owner's representative prior to rough-in.

E. Provide auxiliary pilot duty relays on motor starters as required for control function.

F. Provide power for all control components from nearest electrical control panel or as indicated on the electrical drawings—coordinate with electrical contractor.

G. All control wiring in the mechanical, electrical, telephone and boiler rooms to be installed in raceways.

H. Control power supply shall be from emergency power source for all equipment connected to emergency power.

3.05 120V POWER

A. Provide 120V power to control panels from the nearest 208/120V receptacle or mechanical panel shall be provided by Electrical Contractor under Division 26. Coordinate with the Electrical Contractor for spare circuit, and provide information to be included on the Electrical Contractor’s As-Built red-line drawings.

B. Electrical installation shall be done per Division 26 specifications.

3.06 DDC OBJECT TYPE SUMMARY

A. Provide all database generation.

B. Displays: System displays shall show all analog and binary object types within the system. They shall be logically laid out for easy use by the owner. Provide outside air temperature indication on all system displays associated with economizer cycles.

C. Run Time Totalization: At a minimum, run time totalization shall be incorporated for each

monitored supply fan, return fan, exhaust fan, hot water and chilled water pumps. Warning limits for each point shall be entered for alarm and or maintenance purposes.

D. Trend log: All binary and analog object types (including zones) shall have the capability to be automatically trended.

E. Alarm: All analog inputs (High/Low Limits) and selected binary input alarm points shall be prioritized and routed (locally or remotely) with alarm message per owner's requirements.

F. Database Save: Provide back-up database for all stand-alone application controllers on disk.

3.07 FIELD SERVICES

A. Prepare and start logic control system under provisions of this section.

B. Start-up and commission systems. Allow sufficient time for start-up and commissioning prior to placing control systems in permanent operation.

C. Provide Owner's Representative with spare parts list. Identify equipment critical to maintaining the integrity of the operating system.

3.08 AS BUILT DOCUMENTATION

A. After completion of the project, insert final approved shop drawings include the following information:
1. An operator’s manual including detailed man-machine interface.
2. An operator’s reference table listing the addresses of all connected input points and output points. Show settings where applicable.
3. A programmer’s manual including all information necessary to perform the programming function.
4. A language manual including a detailed description of the language used and all routines, modules, etc., used by the system.
5. Flow charts of the software programs utilized in the system.
6. Complete program listing file, and parameter listing file for all programs.

B. Provide two (2) AutoCad (latest version) CD and one (1) full size reproducible of each control diagram and equipment schedule reflecting the “as-built” condition. Size shall be the same as the construction document drawings.

3.09 TRAINING

A. Provide application engineer to instruct owner in operation of systems and equipment.

B. Provide system operator’s training to include (but not limited to) such items as the following: modification of data displays, alarm and status descriptors, requesting data, execution of commands and request of logs. Provide this training to a minimum of 3 persons.

C. Provide on-site training above as required, up to 16 hours as part of this contract.

3.10 DEMONSTRATION

A. Upon completion of the installation, start up the system and perform all necessary testing, debugging and calibration of each component in the entire system. Perform an acceptance test in the presence of the Owner's Representative. When the system performance is deemed satisfactory in whole or in part of the by the Owner's Representative, the part(s) of the system will be accepted.

B. Provide certificate stating that control system has been tested and adjusted for proper operation.

C. Final system acceptance shall be contingent upon completion of final review and correction of all deficiencies. Satisfactory completion of the operational tests which shall demonstrate compliance with all performance and requirements of the Contract Documents.

PART 4 - SEQUENCE OF OPERATIONS

4.01 GENERAL

A. See control drawings.

PART 5 - COMMISSIONING

5.01 COMMISSIONING REQUIREMENTS UNDER DDC CONTRACTOR

A. Management:
1. The Commissioning Agent (CA) is hired directly by the College.
2. The CA directs and coordinates the commissioning activities and the reports to the College's Representative.
3. All members work together to fulfill their contracted responsibilities and meet the objectives of the Contract Documents.
4. All contractors shall include the cost of commissioning in the contract price. The contractors should be prepared to provide commissioning assistance and follow through until all the commissioned systems have been signed off by the commissioning provider and the College Representative.
5. In each purchase order or subcontract written, include requirements for submittal data, commissioning documentation, O&M data and training

B. Commissioning requires the participation of Division 23 Instrumentation and Controls contractor to ensure that all systems are operating in a manner consistent with the Design Intent.
1. The general commissioning requirements and coordination are detailed in Division 1 and Division 23.
2. Contractor shall be familiar with all parts of Division 1 and Division 23 and the commissioning plan issued by the Commissioning Authority and shall execute all commissioning responsibilities assigned to them in the Contract Documents.

C. The Test and Balance contractor is responsible for assisting the commissioning agent throughout the entire commissioning process. The work is not complete until the commissioning agent and the College Representative have signed off on the commissioned systems.

5.02 COMMISSIONING RESPONSIBILITIES

A. Controls Contractor: The commissioning responsibilities applicable to the controls contractor are as follows (all references apply to commissioned equipment only):

1. All contractors shall include the cost of commissioning in the contract price. The contractors should be prepared to provide commissioning assistance and follow through until all the commissioned systems have been signed off by the commissioning provider and the College Representative.
2. In each purchase order or subcontract written, include requirements for submittal data, commissioning documentation, O&M data and training.
3. General Contractor shall attend a commissioning kickoff meeting and other meetings necessary to facilitate the commissioning process.
4. General Contractor shall provide the Commissioning Provider with normal cut sheets and shop drawing submittals of commissioned equipment.
5. General Contractor shall provide additional requested documentation, prior to normal O&M manual submittals, to the Commissioning Provider for development of start-up and functional testing procedures.
    a. Typically, this will include detailed manufacturer installation and start-up, operating, troubleshooting and maintenance procedures. In addition, the installation, start-up and checkout materials that are actually shipped inside the equipment and the actual field checkout sheet forms to be used by the factory or field technicians shall be submitted to the Commissioning Provider.
    b. The Commissioning Provider may request further documentation necessary for the commissioning process.
6. General Contractor shall provide a copy of the O&M manuals and submittals of commissioned equipment, through normal channels, to the Commissioning Provider for review.
7. Sub-Contractors and design engineers shall assist in clarifying the operation and control of commissioned equipment in areas where the specifications, control drawings or equipment documentation is not sufficient for writing detailed testing procedures.
8. General Contractor shall provide limited assistance to the Commissioning Provider in preparing the specific functional performance test procedures. Sub-Contractors shall review test procedures to ensure feasibility, safety and equipment protection and provide necessary written alarm limits to be used during the tests.
9. General Contractor shall develop a full start-up and initial checkout plan using manufacturer's start-up procedures and the pre-functional checklists from the Commissioning Provider for all commissioned equipment. Submit to Commissioning Provider for review prior to startup.
10. During the startup and initial checkout process, execute the mechanical and electrical-related portions of the pre-functional checklists for all commissioned equipment.
11. Perform and clearly document all completed startup and system operational checkout procedures, providing a copy to the Commissioning Provider.
12. Address current Engineer of Record punch list items before functional testing. Air and water TAB shall be completed with discrepancies and problems remedied before functional testing of the respective air- or water-related systems.
13. Provide skilled technicians to execute starting of equipment and to execute the functional performance tests. Ensure that they are available and present during the agreed upon schedules and for sufficient duration to complete the necessary tests, adjustments and problem-solving.
14. Provide skilled technicians to perform functional performance testing under the direction of the Commissioning Provider. Assist the Commissioning Provider in interpreting the monitoring data, as necessary.
15. Correct deficiencies (differences between specified and observed performance) as interpreted by the Commissioning Provider, College's Representative and Engineer of Record and retest the equipment.
16. Prepare O&M manuals according to the Contract Documents, including clarifying and updating the original sequences of operation to as-built conditions.

17. During construction, maintain as-built red-line drawings for all drawings and final CAD as-builts for contractor-generated coordination drawings. Update after completion of commissioning.
18. Provide training of the College Representative's operating staff using expert qualified personnel, as specified.
19. Coordinate with equipment manufacturers to determine specific requirements to maintain the validity of the warranty.
20. Execute any deferred functional performance testing, witnessed by the Commissioning Provider, according to the specifications.
21. Correct deficiencies and make necessary adjustments to O&M manuals and as-built drawings for applicable issues identified in any seasonal testing.

B. Controls Contractor. The commissioning responsibilities of the controls contractor, during construction and acceptance phases in addition to those listed in (A) are:
1. Sequences of Operation Submittals. The Controls Contractor's submittals of control drawings shall include complete detailed sequences of operation for each piece of equipment, regardless of the completeness and clarity of the sequences in the specifications. They shall include:
    a. An overview narrative of the system (1 or 2 paragraphs) generally describing its purpose, components and function.
    b. All interactions and interlocks with other systems.
    c. Detailed delineation of control between any packaged controls and the building automation system, listing what points the EMCS monitors only and what EMCS points are control points and are adjustable.
    d. Written sequences of control for controlled equipment. (Equipment manufacturers' stock sequences may be included, but will generally require additional narrative).
    e. Start-up sequences.
    f. Warm-up mode sequences.
    g. Normal operating mode sequences.
    h. Unoccupied mode sequences.
    i. Shutdown sequences.
    j. Capacity control sequences and equipment staging.
    k. Temperature and pressure control: setbacks, setups, resets, etc.
    l. Detailed sequences for all control strategies, e.g., economizer control, optimum start/stop, staging, optimization, demand limiting, etc.
    m. Effects of power or equipment failure with all standby component functions.
    n. Sequences for all alarms and emergency shut downs.
    o. Seasonal operational differences and recommendations.
    p. Initial and recommended values for all adjustable settings, set-points and parameters that are typically set or adjusted by operating staff; and any other control settings or fixed values, delays, etc. that will be useful during testing and operating the equipment.
    q. Schedules, if known.
    r. To facilitate referencing in testing procedures, all sequences shall be written in small statements, each with a number for reference. For a given system, numbers will not repeat for different sequence sections, unless the sections are numbered.
2. Control Drawings Submittal.
    a. The control drawings shall have a key to all abbreviations.
    b. The control drawings shall contain graphic schematic depictions of the systems and each component.

c. The schematics will include the system and component layout of any equipment that the control system monitors, enables or controls, even if the equipment is primarily controlled by packaged or integral controls.
d. Provide a full points list with at least the following included for each point:
    1) Controlled system
    2) Point abbreviation
    3) Point description
    4) Display unit
    5) Control point or setpoint (Yes / No)
    6) Monitoring point (Yes / No)
    7) Intermediate point (Yes / No)
e. The Controls Contractor shall keep the Commissioning Provider informed of all changes to this list during programming and setup.

3. An updated as-built version of the control drawings and sequences of operation shall be included in the final controls O&M manual submittal.
4. Assist and cooperate with the Testing, Adjusting and Balancing (TAB) contractor in the following manner:
    a. Meet with the TAB contractor prior to beginning TAB and review the TAB plan to determine the capabilities of the control system toward completing TAB. Provide the TAB any needed unique instruments for setting terminal unit boxes and instruct TAB in their use (handheld control system interface for use around the building during TAB, etc.).
    b. For a given area, have all required pre-functional checklists, calibrations, startup and selected functional tests of the system completed and approved by the Commissioning Provider prior to TAB.
    c. Provide a qualified technician to operate the controls to assist the TAB contractor in performing TAB, or provide sufficient training for TAB to operate the system without assistance.
5. Assist and cooperate with the Commissioning Provider in the following manner:
    a. Using a skilled technician who is familiar with this building, execute the functional testing of the controls system. Assist in the functional testing of all equipment to be commissioned. Provide two-way radios during the testing.
    b. Execute all control system trend logs required in the construction documents and required by the commissioning provider.
6. The controls contractor shall prepare a written plan indicating in a step-by-step manner, the procedures that will be followed to test, checkout and adjust the control system prior to functional performance testing. At minimum, the plan shall include for each type of equipment controlled by the automatic controls:
    a. System name.
        1) List of devices.
        2) Step-by-step procedures for testing each controller after installation, including:
        3) Process of verifying proper hardware and wiring installation.
        4) Process of downloading programs to local controllers and verifying that they are addressed correctly.
        5) Process of performing operational checks of each controlled component.
        6) Plan and process for calibrating valve and damper actuators and all sensors.
        7) A description of the expected field adjustments for transmitters, controllers and control actuators should control responses fall outside of expected values.
        8) A copy of the log and field checkout sheets that will document the process. This log must include a place for initial and final read values during

calibration of each point and clearly indicate when a sensor or controller has "passed" and is operating within the contract parameters.

9) A description of the instrumentation required for testing.
10) Indicate what tests on what systems should be completed prior to TAB using the control system for TAB work. Coordinate with the Commissioning Provider and TAB contractor for this determination.
11) Provide a signed and dated certification to the Commissioning Provider and College's Representative upon completion of the checkout of each controlled device, equipment and system prior to functional testing for each piece of equipment or system, that all system programming is complete as to all respects of the Design Intent and Contract Documents, except functional testing requirements.
12) As well as the control points necessary to execute all documented control sequences, provide monitoring, control and virtual points for all commissioned equipment communicating with the EMCS, including mechanical, electrical, and plumbing equipment.

C. List and clearly identify on the as-built duct and piping drawings the locations of all static and differential pressure sensors (air, water and building pressure).

END OF SECTION

DIVISION 26
ELECTRICAL

SECTION 26 05 00 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.01 SUMMARY

A. This Section specifies the basic requirements for electrical installations and includes requirements common to more than one section of Division 26. It expands and supplements the requirements specified in sections of Division 01.

B. Related Requirements:

1. Division 01 – General Requirements.
2. Section 03 30 00 – Cast-in-Place Concrete.
3. Section 09 90 00 – Painting and Coating.
4. Division 14 – Conveying Equipment.
5. Division 23 – HVAC.
6. Division 26 – Electrical.
7. Division 27 – Communications.
8. Division 28 – Electronic Safety and Security.
9. Division 31 – Earthwork.
10. Division 33 – Site Improvements.

C. Related Industry Standards: The most current version of the following industry standards.

1. ASTM D 709 – Laminated Thermosetting materials.
2. ANSI/NEMA FB-1 – Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable.
3. ANSI/NEMA 250 – Enclosures for Electrical Equipment (1000 Volts Maximum).
4. California Electrical Code (CEC).
5. IEEE C57.12.28 – Standard for Pad-Mounted equipment Enclosure Integrity.
6. IEEE 1584 – Performing Arc-Flash Hazard Calculations.
7. UL/ANSI 1 – Standard for Flexible Metal Conduit.
8. UL/ANSI 1242 – Standard for Electrical Intermediate Metal Conduit.
9. UL/ANSI 506 – Standard for Specialty Transformers.
10. UL/ANSI 6 – Electrical Rigid Metal Conduit-Steel.

11. UL/ANSI 6A – Electrical Rigid Metal Conduit-Aluminum, Red Brass, and Stainless Steel.

12. UL 797 – Electrical Metallic Tubing-Steel.

13. UL/ANSI 870 – Standard for Wireways, Auxiliary Gutters, and Associated Fittings.

14. UL/ANSI 891 – Standard for Safety Switchboards.

1.02 BASIC ELECTRICAL REQUIREMENTS

A. Quality Assurance:

1. Work shall be performed by CONTRACTOR'S personnel possessing the skills and experience obtained in performing work of similar scope and complexity.

2. Refer to related division(s) specifications for other requirements.

B. Drawings and Specifications Coordination:

1. For purposes of clearness and legibility, Drawings are essentially diagrammatic, and the size and location of equipment is indicated to scale whenever possible. Verify conditions, dimensions, indicated equipment sizes, and manufacturer's data and information as necessary to install the Work of this Division. Coordinate location and layout with other Work.

2. Verify final locations for rough-in with field measurements and with the requirements of the equipment to be connected.

3. Drawings indicate required size and points of termination of conduits, number and size of conductors, and diagrammatic routing of conduits. Install conduits with minimum number of bends to conform to structure, avoid obstructions, preserve headroom, keep openings and passageways clear, and comply with applicable code requirements.

4. Routing of conduits may be changed provided that the length of any conduit run is not increased more than 10 percent of length indicated on the Drawings.

5. Outlet locations shall be coordinated with architectural elements prior to start of construction. Locations indicated on the Drawings may be distorted for clarity; CONTRACTOR shall coordinate in the field prior to rough-in work.

6. Coordinate electrical equipment and materials installation with building components and the Work of other trades.

7. Equipment disconnects shall be readily accessible and free of obstructions.

8. When extending or intercepting existing electrical facilities, CONTRACTOR shall Coordinate and verify existing conditions.

C. Terminology:

1. Signal Systems: Applies to clock, bell, fire alarm, annunciator, sound, public address, buzzer, telephone, television, inter-communication, elevator access controls, lighting control systems and security systems.

2. Low Voltage: Applies to signal systems operating at 120 volts and less, and power systems operating at less than 600 volts. Medium voltage: Applies to power systems operating at more than 600 volts.

3. UL: Underwriter's Laboratories Inc, Nationally Recognized Testing Laboratory (NRTL), or equal.

D. Regulations: Work shall comply with the requirements of authorities having jurisdiction and the California Electrical and Building Codes. Material shall conform to regulations of the National Board of Fire Underwriters for electrical wiring and apparatus. Materials shall be new and listed by UL, or another NRTL.

E. Structural Considerations for Conduit Routing:

1. CONTRACTOR shall provide DSA approved calculations and drawings as necessary for any construction and/or alterations requiring conduits to pass through or interfere with any structural members, or where notching, boring or cutting of the structure is necessary, or where special openings through walls, floors, footings, or other buildings elements, or where notches and bored holes in wood or steel are required. All work shall conform to CBC, Part 2, Title 24 requirements.

2. Concrete encasement for underground conduits that abuts a foundation wall or underground structure shall rest on a haunch integral with wall or structure, or shall extend down to footing projection, or shall be doweled into structure unless otherwise indicated. Underground structures shall include maintenance holes; pull boxes, vaults, and buildings.

F. Electrically Operated Equipment and Appliances:

1. Furnished Equipment and Appliances:

a. Work shall include furnishing and installing wiring enclosures and complete connections of electrically operated equipment, appliances and electrical control devices, which are specified to be furnished and installed in this or other sections of the Specifications. Wiring enclosures shall be concealed except where exposed work is indicated on the drawings.

b. Provide all connections necessary for installation of equipment. Equipment shall be tested for proper operation, including proper rotation of motorized equipment. If outlets are of incorrect electrical characteristics, or any specified equipment fails to operate properly, CONTRACTOR shall repair and/or replace the outlet and/or equipment.

2. Equipment and Appliances Furnished by Others:

a. Equipment and appliances indicated on Drawings as "Not In Contract" (NIC), "furnished by others," or "furnished by the OWNER," will be delivered to the Project site. Required electrical connections shall be performed for such equipment and appliances. Motorized equipment will be furnished factory-wired to a control panel or junction box unless otherwise indicated. Appliances will be furnished equipped with portable cord and cap. Provide disconnect switches where required.

b. Connections to equipment furnished under this Division shall be part of the Work of this section. Work shall include internal wiring, installation, connection and

adjustment of bolted drive motors in which the motor is supplied as a separate unit, and connections only for equipment furnished with factory installed internal wiring, except as further limited by Drawings and this Specification. Work shall include furnishing and installing suitable outlets, disconnecting devices, starters, push-button stations, selector switches, conduit, junction boxes, and wiring necessary for a complete electrical installation. Work shall also include furnishing and installing conduit and boxes for HVAC control systems, furnished under Division 23. Devices and equipment furnished shall be of same type used elsewhere on the Work or as specified.

c. Electrical equipment furnished under other sections, for installation and connection under Work of this section, will be delivered to the Project site ready for installation.

d. Mechanical equipment furnished under other sections, and requiring electrical connection under this section, will be set in place as part of the Work of the section furnishing such equipment unless noted otherwise.

e. Suitability and condition of equipment furnished under other sections shall be determined in advance of installation. Immediate notice of damage, unsuitability, or lack of parts shall be given to the entity providing such equipment.

G. Power Distribution System Reports: For fault current, coordination and Arc-Flash system report requirements refer to applicable electrical distribution equipment sections. for specific requirements.

H. Protection of Materials:

1. Protect materials and equipment from damage and provide adequate and proper storage facilities during progress of the Work. Damaged materials and/or equipment shall be replaced.

I. Cleaning:

1. Exposed parts of Work shall be left in a neat, clean, usable condition. Finished painted surfaces shall be unblemished and metal surfaces shall be polished.

2. Thoroughly clean parts of apparatus and equipment. Exposed parts to be painted shall be thoroughly cleaned of cement, plaster, and other materials. Remove grease and oil spots with solvent. Such surfaces shall be wiped, and corners and cracks scraped out. Exposed rough metal shall be smooth, free of sharp edges, carefully steel brushed to remove rust and other spots, and left in proper condition to receive finish painting.

3. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

J. WARRANTIES

1. Provide one-year warranty on all material and labor performed, unless noted otherwise in specific sections.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.01 GENERAL REQUIREMENTS

A. Advise the Inspector before starting the Work of this Division.

B. Exposed conduits shall be painted to match the surfaces adjacent to installation.

C. Salvaged materials removed from buildings shall be removed from the Project site as required by the OAR.

D. Trenches outside of barricade limits shall be backfilled and paved within 24 hours after being inspected by the Inspector. Provide traffic plates during the time that trenches are open in traffic areas and in areas accessible to students and staff.

E. Where existing structural walls are cored for new conduit runs, separation between cored holes shall be three inches edge to edge from new or existing holes, unless otherwise required by the Architect. All coring to be laid out and reviewed by Architect prior to drilling. CONTRACTOR to verify location of structural steel, rebar, stress cabling or similar prior to lay out.

F. Electrical equipment shall be braced and anchored for CBC Seismic Design requirements, or as otherwise indicated on the Drawings.

3.02 DELIVERY STORAGE AND HANDLING

A. Deliver products to project site with proper identification, which shall include names, model numbers, types, grades, compliance labels, and similar information needed for District identification; all products and materials shall be adequately packaged and protected to prevent damage during shipment, storage, and handling.

B. Coordinate deliveries of electrical materials and equipment to minimize construction site congestion.

3.03 CUTTING AND PATCHING

A. Cutting and patching of electrical equipment, components, and materials shall include the removal and legal disposal of selected materials, components, and equipment.

B. Do not endanger or damage installed Work through procedures and processes of cutting and patching.

C. Repair or restore other work or surfaces damaged as a result of the work performed under this contract.

3.04 CLEANUP

A. Remove rubbish, debris and waste materials and legally dispose off the Project site.

B. Remove equipment and implements of service, and leave entire work area neat and clean, to the satisfaction of the Owner Authorized Representative (OAR).

3.05 PROTECTION

A. Protect the Work of this section until Substantial Completion.

END OF SECTION

SECTION 26 05 13 - BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Boxes, enclosures, keys and locks.
2. Receptacles and switches.
3. Identifications and signs.

B. Related Requirements:

1. Division 01 - General Requirements.
2. Division 26 – Electrical.
3. Division 27 – Communications.
4. Division 28 - Electronic Safety and Security.

PART 2 - PRODUCTS

2.01 BOXES, ENCLOSURES, KEYS AND LOCKS

A. Outlet Boxes and Fittings:

1. Outlet boxes installed in concealed Work shall be galvanized steel, pressed, or welded type, with knockouts.
2. In exposed Work, where conduit runs change direction or size, outlet boxes and conduit fittings shall be cast metal with threaded hubs cast integral with box or fitting.
3. Fittings shall be cast metal and non-corrosive. Ferrous metal fittings shall be cadmium-plated, or zinc galvanized. Castings shall be true to pattern, smooth, straight, with even edges and corners, of uniform thickness of metal, and shall be free of cracks, gas holes, flaws, excessive shrinkage, and burnt-out sand.
4. Covers for fittings shall be galvanized steel or non-corrosive aluminum and shall be designed for particular fitting installed.
5. Light fixture outlets shall be 4-inch octagon, 4-inch square, 2 1/8-inch deep or larger, depending upon number of conductors or conduits therein. Plaster rings shall be furnished with round opening with two ears drilled 2 23/32 inches center to center.

6. For local device outlets provide 4-inch square 2 1/8-inch deep, boxes for single gang, 5-inch square boxes for two-gang, and special solid gang boxes with gang plaster ring for more than two switches.

7. For TV outlets, and horns and strobes provide manufacturer's supplied back box as needed. For television outlets, provide 4-gang deep boxes and 4-gang plaster rings.

8. Plaster rings shall be provided on flush-mounted outlet boxes except where otherwise indicated or specified. Plaster rings shall be same depth as finished surface. Install approved ring extension to obtain depth to finish surface.

9. In existing plywood wall or drywall construction, and where flexible steel conduit is fished into walls, single-gang and 2-gang outlets for wiring devices may be sectional steel boxes with plaster ears. Boxes shall be fastened to plywood with flat-head screws in each plaster ear screw hole. Boxes fastened to gypsum board shall be Raco, Appleton, Cooper, Bowers, or equal.

10. Factory made knockout seals shall be installed to seal box knockouts, which are not intact.

11. Where flexible conduit is extended from flush outlet boxes, provide and install weatherproof universal box extension adapters.

B. Junction and Pull boxes:

1. Junction and pull boxes, in addition to those indicated, shall only be used in compliance with codes, recognized standards, and Contract Documents.

2. Interior and non-weatherproof boxes shall be constructed of blue or galvanized steel with ample laps, spot welded, and shall be rigid under torsion and deflecting forces. Boxes shall be furnished with auxiliary angle iron framing where necessary to ensure rigidity.

3. Covers shall be fastened to box with enough machine screws to ensure continuous contact all around. Flush type boxes shall be drilled and tapped for cover screws if boxes are not installed plumb. Surfaces of pull and junction boxes and covers shall be labeled in black marker ink designating system, panelboard and circuit designation contained in box. In exposed Work, designation shall be installed on inside of pullbox or junction box cover.

4. Weatherproof NEMA 3R pull and junction boxes shall conform to foregoing for interior boxes with following modifications:

   a. Cover of flush mounting boxes shall be furnished with a weather-tight gasket cemented to, and trimmed even with, cover all around.

   b. Surface or semi-flush mounting pull and junction boxes shall be UL, or another Nationally Recognized Testing Laboratory (NRTL) listed as rain-tight and shall be furnished complete with threaded conduit hubs.

c. Exposed portions of boxes shall be galvanized and finished with one prime coat and one coat of baked-on gray enamel, unless already furnished with factory baked-on finish.

5. Junction and pull boxes shall be rigidly fastened to structure and shall not depend on conduits for support.

6. Underground Concrete Pull Boxes:

a. Pre-cast concrete pull boxes. Concrete pull boxes shall be traffic type, reinforced for H-20 wheel loading, pre-cast concrete. Pull boxes with inside dimensions of 2 feet by 3 feet by 3 feet deep shall consist of a base section, top ring, and cover. Base section shall be furnished with 2 knockouts measuring 10 inches by 10 inches in each 3 feet side, and one 20 inches by 20 inches knockout in each 2-foot side. Pull boxes with inside dimension 4 feet by 4 feet by 4 feet deep shall consist of a base section, midsection, topping, and cover. Base section shall be furnished with 2 knockouts measuring 8-inch by 16-inch on each of two opposite sides, and one 20-inch by 20-inch knockout on each of other two opposite sides. Pull boxes shall be furnished with a minimum of 6-inch diameter sump knockout and one-inch diameter ground rod knockout. In pull boxes, furnish and install cable racks on walls. Racks shall be furnished with 3 porcelain cable holders on vertical steel mounting bars. Pull boxes shall be furnished with 3/4-inch diameter pull irons. Covers shall be traffic-type consisting of steel safety plate bolted to frame. Covers shall be marked as electrical, power, or signal as required.

b. Provide end bells in duct entrances. Terminate each metal conduit with insulated bushing provided with a grounding terminal.

c. Install pulling irons on opposite walls and below horizontal centerlines of ducts and bricked-up openings, and in bottom. Install pulling irons with each end hooked around a reinforcing bar.

d. Remove floor drain knockout and provide a depth of 24 inches of crushed rock below box extending a minimum of 12 inches beyond on all sides.

e. Permanently and effectively ground metal equipment cases, cable racks, and similar items in pull boxes to site grounding electrode system. Provide grounding conductor in compliance with CEC Article 250.

f. Provide 6-inch deep sand base under pull boxes.

g. Identify power and signal cables by tagging in manholes and pull boxes. Tie securely to cables with nylon cord.

h. Top of steel plate shall provide a minimum coefficient of static friction of 0.5 for either wet or dry locations, when tested for any shoe sole material. Test shall comply with ASTM D 1047 or F 489 or F 609 standards. Submit manufacturer’s test results for Architect’s review as part of materials and equipment submittals.

i. The use of underground extension boxes shall be limited to not more than 1 times the original depth of pull box.

j. Approved Products: Oldcastle Precast, Jensen Precast, Kistner, Western Precast, or OWNER approved equal.

7. Underground utility boxes shall be reinforced concrete with non-setting shoulders to prevent settlement following installation. Boxes shall be furnished with cast iron cover with finger hole, size as indicated on Drawings. Utility boxes shall be as manufactured by Oldcastle, Jensen, Kistner, Western Precast, or equal.

8. Manholes, vaults, and pull boxes required by a utility company, and installed as part of this Contract, shall meet requirements of servicing utility company.

C. Floor Outlets:

1. Floor Outlets (except for extension outlets) shall be cast iron, watertight floor boxes with flush brass floor plates, and shall be set to finish flush with finish floor covering, whether it be carpeted, wood, resilient floor covering, or other finish materials.

a. Floor boxes shall be used in offices, classrooms, and in library areas only.

b. Approved Products: Harvey Hubbell Inc. B-2503, Thomas & Betts 640 series, Legrand Omnibox, or OWNER approved equal.

2. Telephones above floor outlets, where not subject to water, shall be provided with Harvey Hubbell Inc. SC-3098 pedestals with SC309T plates. Refer to other Division 26 sections. Floor boxes shall be used in offices, classrooms and in Library areas only.

a. Approved Products: Legrand 525 series, Thomas & Betts FPT-400 Series, or OWNER approved equal

3. Plugs above floor outlets where not subject to water shall be provided with pedestal s and device plates. Refer to other Division 26 sections. Floor boxes shall be used in offices, classrooms, and library areas only.

a. Approved products: Pedestals shall be Legrand 525 series, Thomas & Betts FPT-400 Series, Harvey Hubbell Inc. SC-3098; Device plates shall be Hubbell SS309D, or District approved equal.

4. Two gang and single box pedestal boxes shall be listed for wet locations where subject to water. Provide required cover plates.

a. Floor outlets shall be used in Cafeteria, Cafeteria serving areas, or any areas where floors are subjected to water.

b. Approved products: Single gang boxes - Hubbell SA-6687. Two gang boxes shall be Hubbell SA-6885, or OWNER approved equal.

5. Extension floor outlets shall be cast iron with cast iron covers, and 1/2-inch offset entries for above-floor conduit extensions; Boxes shall be designed to permit access to wiring without disturbing above-floor extensions and shall be set flush with finish floor.

6. Above floor service fittings for data outlets and surge suppression receptacles shall be faceplate interchangeable, die cast aluminum.

a. Approved products: Hubbell SC3098 with cover plates SS309DS, Legrand 525 series, Thomas & Betts FPT-400 Series, or OWNER approved equal.

D. Floor Pockets – Plugging Boxes:

1. Three-Gang floor lighting pockets shall be flush floor type recess floor mounted enclosure, with cast iron floor plate and hinged cast iron door notched for cables.

a. Each floor pocket shall be provided with three 20-amp, 3 wire, 125-volt receptacles with matching caps.

b. Approved products: Legrand or Hubbell Recessed Floor Boxes, C.W. Cole TLS 353-6, or equal, for wood floors and C.W. Cole TLS-353-6-C, or OWNER approved equal for concrete slabs.

2. Single Gang:

a. Receptacle floor pockets shall be single gang, flush floor type, with cast iron floor plate, hinged cast iron door notched for cable and cast-iron box. Provide each pocket with a standard, single grounding type receptacle unless otherwise indicated.

1) Approved Products: C.W. Cole TLA-362-1-FE, or OWNER approved Legrand or Hubbell recessed floor box, or OWNER approved equal. For wood floors provide C.W. Cole TLS-362-1, or OWNER approved equal.

b. Microphone or projector floor pockets shall be single gang flush floor type with cast iron floor plate, hinged cast iron door, notched for cable and cast-iron box.

1) Approved Products: Legrand or Hubbell recessed floor box, C.W. Cole TLA-362-3-FE, C.W. Cole TLS-362-3, in wood floors, or OWNER approved equal.

E. Keys and Locks:

1. Provide two keys with furnished door locks, including cabinet door locks and switchboard locks, two keys for lock switches on switchboards or control panels, and two keys with interlocks or other furnished lock switches. Deliver keys to OAR.

2. Special keys and locks shall only be provided where specified. Locks shall be keyed to Corbin No. 60 or 70 as follows:

a. Access to operate equipment shall be keyed to Corbin 60.

b. Access to service areas shall be keyed to Corbin 70.

2.02 RECEPTACLES AND SWITCHES

A. Receptacles:

1. Duplex receptacles shall be heavy-duty specification grade, grounding type. Terminal screws shall be wired on the side and back with internal screw pressure plates. Mounting strap shall feature heavy-duty brass construction. Receptacle back body shall be PVC. Receptacle face shall be ivory, impact resistant nylon. Receptacles shall have triple wipe brass power contacts.

   a. Approved products:

NEMA #	Pass & Seymour	Hubbell	Leviton
(20 amps) NEMA 5-20	PS5362-I	HBL5362-I	5362-I
(15 amps) NEMA 5-15	PS5262-I	HBL5262-I	5262-I

   Equal products approved by OWNER may be acceptable.

2. Duplex receptacles on circuits supplied by panel boards with integral surge suppression shall be Pass & Seymour model number PS5262BL (blue), Hubbell DRUBTVSS15, Leviton 5262-SBU, 15-amps, 120-volts, or OWNER approved equal.

3. Single receptacles shall be heavy-duty specification grade, grounding type. Terminal screws shall be back and side wire with internal screw pressure plates. Mounting strap shall feature heavy-duty brass construction. Receptacle back body shall be thermoplastic. Receptacle face shall be ivory, impact resistant nylon. Receptacles shall have triple wipe brass power contacts. For circuits consisting of one single receptacle only, ampere rating of receptacle shall be same as circuit breaker or fuse.

   a. Approved products:

NEMA #	Pass & Seymour	Hubbell	Leviton
(20 amps) NEMA 5-20R	5361-I	HBL5361-I	5361-I
(15 amps) NEMA 5-15R	5261-I	HBL5261-I	5261-I

   Equal products approved by OWNER may be acceptable.

4. Single 15 and 20-amps receptacles on circuits supplied by panel boards with integral surge suppression shall be blue in color.

   a. Approved products: Pass & Seymour NEMA 5-20R model number 5361-BL (blue), NEMA 5-15R model number 5261-BL (blue), or OWNER approved equal.

5. Kiln and range receptacles, provide 3-pole, 4-wire, grounding type, rated 50 amps or as indicated on plans. Receptacle shall be rated 125/250 volts NEMA 14-50R. Provide 2-gang, stainless steel plates.

   a. Approved products:

NEMA #	Pass & Seymour	Hubbell	Leviton
NEMA 14-50R	3894	HBL9450A	279
WALL PLATE	SS703	S703	84026

   Equal products approved by OWNER may be acceptable.

6. Dryer receptacles. Provide 3-wire, non-grounding type, rated 30 amps at 125/250 volts, NEMA 10-30R, with 2-gang stainless steel plates. Coordinate location of junction box with the work of Section 10 2815, Hand and Hair Dryers.

a. Approved Products:

NEMA #	Pass& Seymour	Hubbell	Leviton
NEMA 10-30R	3860	HBL9350	5207
WALL PLATE	SS703	S703	84026

Equal products approved by OWNER may be acceptable.

7. Provide specification grade ground-fault circuit interrupter (GFCI) type receptacles in accordance with 2010 UL standards. GFCI receptacles shall have a trip indication light. Receptacle terminal screws shall be back and side wire with internal screw pressure plates. Test and reset buttons shall match device body and shall be ivory. GFCI receptacles shall be manufactured in standard configuration for installation with stainless steel smooth plates. Exterior mounted receptacles shall be mounted inside weatherproof enclosure.

a. Approved products:

NEMA #	Pass & Seymour	Hubbell	Leviton
NEMA 5-20R	2095-I	GFR5352-IA	7899-I
NEMA 5-15R	1595-I	GFR5252-IA	8598-I

Equal products approved by OWNER may be acceptable.

8. Provide weatherproof receptacles, except where otherwise indicated or specified, consisting of GFCI receptacles, as specified herein, and metal plates with die-cast lockable hinged lids and weatherproof mats;

Tamper-resistant receptacles with thermoplastic dual mechanism shutter system to help prevent insertion of foreign objects. Receptacles shall have extra heavy-duty brass, one-piece mounting strap with integral ground. Receptacles shall be ivory color, impact resistant nylon face and back body.

a. Approved products:

NEMA #	Pass & Seymour	Arrow Hart	Leviton
NEMA 5-20R	TR63-I	TR8300V	8300SGI
NEMA 5-15R	TR62-I	TR8200V	8200SGI

Equal products approved by OWNER may be acceptable.

9. Provide transient voltage surge suppression (TVSS) receptacles offering metal oxide varistors (MOVs) protecting normal and common modes, (L-N, L-G, N-G) with 500V suppressed voltage. TVSS devices shall offer 3-mode equal protection with 210 joules minimum per mode of energy absorption and 13,000-amp maximum surge capability. TVSS devices shall have 3 thermal fuses and two over-current protection fuses. TVSS devices shall have LED visual only surge status indicator to alert user to surge suppression circuit condition. Visual indicator will be illuminated (red) when power is on and surge suppression circuit is fully functional. Visual indicator will not be illuminated when power is off or unit experiences loss of surge suppression protection. Terminals shall be back and side wire including ground terminal. Color shall be blue.

a. Approved Products

NEMA #	Pass& Seymour	Hubbell	Leviton

NEMA 5-20R	5352BLSP	HBL5360SA	5380B
NEMA 5-15R	5252BLSP	HBL5260SA	5280B

Equal products approved by OWNER may be acceptable.

B. Switches

1. Local Switches:

a. Local switches shall be high strength thermoplastic toggle, industrial grade, rated 20 amps at 120-277 volts AC only, with plaster ears, external screw pressure plate back and side wired, and standard size composition cups which fully enclose mechanism. Switches shall be approved for installation at currents up to full rating on resistive, inductive, tungsten filament lamp and fluorescent lamp loads, and for up to 80 percent of rating for motor loads. Switches shall have oversized silver alloy contacts for long life and better heat dissipation. Provide switches as single pole, double pole, 3-way, 4-way, non-lock type. Provide non-lock type switches with ivory handles;

	Pass & Seymour	Hubbell	Leviton
Single pole	PS20AC1I	HBL1221I	1221-2I
Double pole	PS20AC2I	HBL1222I	1222-2I
Three-way	PS20AC3I	HBL1223I	1223-2I
Four-way	PS20AC4I	HBL1224I	1224-2I

Equal products approved by OWNER may be acceptable.

b. Lock type switches shall be specification industrial grade, 20 amp, 120-277 volts with metal or nylon key guides with on/off indication, and operable by same key. Key shall be District standardized vertically oriented, tamper resistant, forked key with two each 5/16-inch long forks, 5/32-inch spacing between forks and 5/16-inch width overall.

1) Approved products:

	Pass & Seymour	Arrow Hart
Single pole	PS20AC1L w/#500 Key-2L	1221L w/1201LK Key
Double pole	PS20AC2Lw/#500 Key	1222L w/1201LK Key
Three-way	PS20AC3L w/#500 Key	1223L w/1201LK Key
Four Way	PS20AC4L w/#500 Key	1224L w/1201LK Key

Equal products approved by OWNER may be acceptable.

c. Rotary lock switches shall incorporate a tumbler type lock to prevent unauthorized operation. Lock shall be tumbler type by Corbin, keyed to a HH41 key. Lock switch to be installed with pin tumblers facing downward. Key shall be removable in all positions. Each device shall be complete with 2 keys. Keys shall be delivered only to the OAR. Switches shall be rated at 20 amps, 120-volt or 277-volt AC. Switch plates shall be of stainless steel, engraved with on and off positions indicated.

1) Approved products:

	Arrow Hart
Single pole	AH1191N
Double pole	AH1192N
Three-way	AH1193N

Equal products approved by OWNER may be acceptable.

d. Pilot light switches shall be rated 20 amps and shall conform to specifications for local switches. Switches shall be furnished with red, Lexan handles that are lighted by LED lamps. Pilot light shall light when load is on. Pilot light 120-volt switches

1) Approved products:

	Pass& Seymour	Hubbell	Leviton
Single pole	PS20AC1-RPL	HBL1221-PL	1221-PLR
Double pole	PS20AC2-RPL	HBL1222-PL	1222-PLR
Three-way	PS20AC3-RPL	HBL1223-PL	1223-PLR

Equal products approved by OWNER may be acceptable.

2) 20 amps, 277 volts rated pilot light switches shall be single pole and shall conform to specifications for local switches, and the requirements of paragraph d above.

a) Approved Products:

Pass & Seymour	Leviton	Hubbell
PS20AC1-RPL	1221-7PR	HBL1221-PL7

e. Provide remote control switches for mechanically held contactors arranged for 3-wire control, toggle type, momentary contact, single pole, 3-position with center off position, rated 20 amps at 120-277 volts AC only, with plaster ears, binding screws for side wiring, standard size composition cups which fully enclose mechanism, and ivory handles.

1) Approved products:

Pass & Seymour	Hubbell	Leviton
1251-I	HBL1557-I	1285-I

Equal products approved by OWNER may be acceptable.

f. Provide remote control switches for magnetically held contactors arranged for 3-wire control, toggle type, maintained contact, single pole, 3-position with center off position, rated 20 amps at 120-277 volts AC only, with plaster ears, binding screws for side wiring, standard size composition cups which fully enclosed mechanism, and ivory handles.

1) Approved products:

Pass and Seymour	Hubbell	Leviton
1225-I	HBL 1385	1285-I

Equal products approved by OWNER may be acceptable.

g. Momentary Contact locking key type switch. 20A 120/277V center off. Key shall be District standardized vertically oriented, tamper resistant, forked key with two each 5/16” long forks, 5/32” spacing between forks and 5/16” width overall.

1) Approved products:

Arrow Hart AH1995L w/ AH2000 key
Equal products approved by OWNER may be acceptable.

h. Momentary Contact switch low voltage 1 pole 3A 24VAC 3 position center off. Key for locking switch shall be District standardized vertically oriented, tamper resistant, forked key with two each 5/16" long forks, 5/31" spacing between forks and 5/16" width overall.

1) Approved products:

Pass and Seymour Toggle 1081I, Locking 1081KGRY w/#500 Key
Equal products approved by OWNER may be acceptable.

2. Time Switches and Photoelectric Controls.

a. Provide time switches with a 7-day, solid-state, electronic type capable of fully automatic or manual operation and housed in a sheet steel enclosure unless built into a panel or switchboard. Resistive or inductive contacts rated for 25-amps, each pole 240-VAC; 5-amps tungsten or 277-VAC pilot duty, each pole 240-VAC. Time switches to contain a non-volatile clock and non-volatile memory with a built-in rechargeable super capacitor power carry-over system. Battery carryover is not acceptable. Provide a minimum of 15 on/off set points per week. Timing to be in one-minute increments with a minimum on or off time of one minute. Time switch digital displays to indicate days of week, hours, and minutes. Display to contain a load status light to indicate when equipment is in operation.

b. Required :

1) Liquid crystal display panel.

2) Holiday scheduling: Up to 40 dates may be assigned special holiday schedules, up to one year in advance.

3) Automatically adjusts to and from daylight savings time and for leap year.

4) Contact ratings: 10 amp at 240 VAC.

5) Safety override switch for each circuit to either provide shut down of circuit or to override on.

6) Selective review: All or part of schedule shall be displayed at touch of a key.

7) Super Capacitor for power carry-over system.

8) Supply voltage: 120/277-Volt.

9) 365-day advance scheduling.

c. Approved products: Tork Model EW 101B series, Intermatic ET90000 series, or OWNER approved equal.

d. Photoelectric control: Shall be rated 2,000 watts, 120V with single pole, single throw, normally closed contact, enclosed in a die-cast aluminum gasketed enclosure with 1/2-inch conduit fitting,

1) Approved products: Tork series 2100, or OWNER approved equal.

3. Emergency Lighting Control Unit

a. The Emergency Lighting Control Unit shall provide all required functionality to allow a standard lighting control device to control emergency lighting in conjunction with normal lighting in any area within a building.

b. The emergency lighting control unit shall allow control of emergency lighting fixture in tandem with normal lighting in an area while ensuring that emergency lighting will turn on immediately to full brightness upon loss of normal power supplying the control device. Emergency lighting operation shall be independent for each controlled area and shall not require a generalized power failure for proper operation.

c. The device shall have normally closed dry contacts capable of switching 10-amp emergency ballast loads at 120-277 VAC, 60 Hz., 2-amp tungsten loads at 120 VAC, 60Hz., LED loads at 120-277V VAC, 60 Hz

d. The device shall have universal rated voltage inputs provided for normal power sense and normal switched power at 120-277 VAC, 60 Hz.

e. The device shall provide separate LEDs to indicate the presence of normal and emergency power sources. The LEDs shall indicate the unit's current operational mode (normal or emergency)

f. The device's normal power input terminal shall be connected to the line side of the control device such that any upstream fault causing a loss of power, including the tripping of the branch circuit breaker, will force the unit into the emergency mode and turn on the emergency lighting.

g. The unit shall automatically switch emergency lighting on and off as normal lighting is switched. When normal power is not available, the unit shall force and hold emergency lighting on regardless of the state of any external control device until normal power is restored.

h. Approved products: WattStopper ELCU-100 Emergency Lighting Control Unit, LVS #EPC-PM Series, Lighting Control Design #GR 2001 series, or OWNER approved equal.

4. School Main Entrance Intercom Station: Refer to specification section 28 1000 – Access Control System.

2.03 IDENTIFICATION AND SIGNS

A. Identification Plates:

1. Provide identification plates for the following unless otherwise specified, for switchboards, unit substations, motor control centers, control panels, push-button stations, time switches, contactors, motor starters, motor switches, panelboards, and terminal cabinets.

2. Identification plates shall be of plastic stock and shall adequately describe function, voltage and phase of identified equipment. Where identification plates are detailed or described on Drawings, inscription and size of letters shall be as indicated. For lighting and power panels, identification plates shall indicate panel designation, voltage, and phase of panel. For terminal cabinets, identification plates shall indicate system contained in terminal cabinet.

3. Identification plates shall be black-and-white nameplate stock of bakelite with characters cut through black exposing white. Plates shall be furnished with beveled edges and shall be securely fastened in place with No. 4 Phillips-head, cadmium-plated steel, self-tapping screws. Characters shall be 3/16 inch high, unless otherwise indicated.

B. Markings:

1. Install identification markings to surface-mounted starters, switches, disconnect switches, contactors, and other devices controlling motors and appliances. Provide abbreviations required along with an identifying number. Markings to be provided with locking type stencils using paint of a contrasting color. Figures shall be 3/8 inch high unless otherwise indicated. Dymo Industries Inc., self-sticking plastic labels, with embossed characters made with a typewriter may be installed instead of stencils and paint; p-touch self adhesive plastic, or Brother P-Touch self sticking laminated plastic labels may be installed.

2. High Voltage: High voltage switchboards, cabinets, boxes, and conduits exposed in accessible locations, including under buildings and in attics, are required to be marked "WARNING-HIGH VOLTAGE – ABOVE 600 VOLTS". Markings for switchboards shall consist of 18 gage steel, porcelain enamel sign of standard manufacture. Markings for boxes, cabinets, and conduits shall be by means of stenciling or printed self-adhesive markers, Westline Tel-A-Pipe, or equal. Provide letters of black on orange background and not less than 1-7/8 inches high. On conduit runs, install markings at intervals not exceeding 10 feet in any individual area. Markings shall be installed after other painting Work is complete.

C. Warning Signs:

1. Provide a warning sign on outside of each door or gate to rooms or enclosures containing high voltage equipment. Signs required reading, "WARNING - HIGH VOLTAGE - KEEP OUT". Provide 2-inch high lettering.

2. Provide a warning sign on each high-voltage non-load break disconnect and fused cutout (not oil filled). Signs required reading, "DO NOT OPEN UNDER LOAD". Provide 2-inch-high lettering.

3. Provide signs of standard manufacture, 18 gage steel, with porcelain enamel finish. Provide red lettering on a white background.

PART 3 - EXECUTION

3.01 INSTALLATION AND SUPPORT OF BOXES

A. Install outlet boxes flush with finished surface of wall or ceiling. Install plumb and securely fastened to structure, independent of conduit. Except where otherwise indicated, provide factory-fabricated adjustable attachment bar hangers between studs to support outlet boxes. When installation is performed in fire rated walls, maintain the wall's rating integrity by means of approved fire stop methods.

B. Outlet boxes installed in suspended or furred ceilings with steel runner or furring channels shall be supported, except where otherwise indicated, by a Unistrut P-4000 Tessco A1200HS-10, Cooper B-Line B22s-HG, or OWNER approved equal channel spanning main ceiling runner channels. Each box shall be supported from its channel by a 3/8-inch 16 threaded steel rod with a Unistrut P-4008, Fastenal #48604, Copper B-Line 78101140346 or OWNER approved equal; nut and a Tomic No. 711-B Adapta-Stud, or OWNER approved equal. Rod shall be tightened to a jamb fit with channel and its nut. Box shall be locked to rod by means of a 1/2-inch locknut on stud and a 3/8-inch 16 hex nut locking stud to rod.

C. Heights of outlets and equipment indicated on Drawings shall govern. In absence of such indications, following heights shall be maintained with heights measured to centerline unless otherwise noted:

1. Install wall-mounted switches at 48 inches above finished floor.

2. Outlet boxes for fire alarm pull stations shall be mounted at a mounting height above finished floor that ensures that the operating handle of the initiating device is no higher than 48 inches from finished floor.

3. Wall mounted fire alarm strobe or horn/strobe devices shall be mounted such that the entire lens is not less than 80 inches above finished floor. If ceiling heights allow, wall mounted appliances shall have bottom of lens a minimum of 80 inches but not more than 96 inches to the top of lens.

4. Install outdoor fire alarm audible devices or fire alarm sprinkler flow bells at least 10 feet but not more than 12 feet above finished floor to center. Provide STI or other OWNER approved protective covers as required in plans.

5. Voice evacuation speakers mounted indoors shall be mounted in ceiling space or if mounted on wall shall not be less than 10 feet to center above finished floor.

6. Install clocks and speakers, in classrooms and offices, 8 feet above finished floor. Unless otherwise indicated.

7. In rooms other than places of assembly such as, but not limited to, multipurpose rooms, auditoriums, and libraries, clock outlets and speakers in classrooms and offices shall be mounted 8 feet above finished floors. Other assembly areas such as gymnasiums shall be mounted 10 to 12 feet above finished floor. Provide STI, or equal protective covers for clocks when required.

8. Install fire alarm strobe lights 80 inches to bottom of light above finished floor.

9. Install outside bells and yard light outlets 4 feet above second floor level for 2 or more story buildings, 12 inches below top plate level for one story buildings without covered porch or arcade, and 12 inches below covered porch and arcade ceilings.

10. Install desk telephones, power receptacle outlets, and data outlets 15 inches above finished floor.

11. Install panelboards and terminal cabinets 6 feet 6 inches from finish floor to top of cabinet.

12. Install television outlets at a height corresponding to location of television monitor, or as indicated on plans.

13. The use of extension boxes shall be limited to not more than 1 times the original depth of junction box.

3.02 COVER PLATES

A. Provide a plate on each switch, plug, pilot light, data, interphone, public telephone, and television outlet, and on existing and reset outlets where so indicated or required. Plates shall be of stainless steel unless otherwise specified.

B. Flush wiring device and signal system outlets indicated to be blank covered, shall be covered with blank stainless-steel plates. Flush lighting outlets to be blanked shall be covered with Wiremold 5736 steel covers, or equal, painted to match surrounding finish. Provide stainless steel covers to blank indicated or required surface-mounted outlets.

C. In the following cases, and at required locations. Switch and receptacle plates shall be engraved with the device(s), or fixtures being controlled, or as indicated:

1. Three-gang and larger gang switches in locations other than classrooms.

2. Lock switches.

3. Pilot switches.

4. Switches so located that operator cannot see fixtures, or items of equipment controlled while his hand is on the switch.

5. Switches not in same room with fixtures or items of unit heaters, air curtains, fly fans, etcetera.

6. Receptacles operating at other than 120 V shall be identified with the operating voltage.

7. Switches operating on 277 V shall be identified with the operating voltage.

8. Where indicated on Drawings.

D. Designations shall be as indicated on Drawings or as specified by Architect.

E. Standard GFI cover plates shall be Pass & Seymour 4600, Raco 5028-0, or equal. GFI cover plates shall be provided with a CAM lock mechanism with two keys or a padlock hasp that does

not protrude through the face of the cover and will allow the shank of locks keyed Corbin No. 60 keys.

3.03 IDENTIFICATION OF CIRCUITS AND EQUIPMENT

A. Provide descriptive nameplates or tags permanently attached to switchboards, motor control centers, transformers, panelboards, circuit breakers, disconnect switches, starters, pushbutton control stations and other apparatus installed for operation or control of circuits, appliances, fire alarm control panel(s), fire alarm annunciator(s), power supplies, terminal cabinets, energy management control units, and Information technology system backbone and distribution equipment points.

B. Provide nameplates of engraved laminated plastic, or etched metal. Submit Shop Drawings denoting dimensions and format to Architect before installation. Fasten to equipment with escutcheon pins, rivets, self-tapping screws, or machine screws. Self-adhering or adhesive backed nameplates are not permitted.

C. Fasten tags to feeder wiring in conduits at every point where runs are broken or terminated, including pull wires in empty conduits. Indicate circuit, phase, and function. Tag branch circuits in panel boards and motor control centers. Tags may be manufactured of pressure-sensitive plastic or embossed self-attached stainless steel or brass ribbon.

D. Provide circuit identification cards and cardholders in all panel boards. Cardholders shall consist of metal frame retaining a clear plastic cover permanently attached to inside of panel door. List of circuits shall be typewritten on a card. Circuit description shall include name or number of circuit’s area and connected load.

E. Junction and pull boxes shall have covers stenciled with box number when indicated on Drawings, or circuit numbers according to panel schedules. Data shall be lettered in a conspicuous manner with a color contrasting with finish.

F. Name shall be correctly engraved, with a legend indicating function or areas, when required by codes or indicated on Drawings.

3.04 PROTECTION

A. Protect Work of this section until Substantial Completion.

3.05 CLEANUP

A. Remove rubbish, debris, and waste materials and legally dispose of off Project site.

END OF SECTION

SECTION 26 05 16 -MEDIUM-VOLTAGE CABLES, SPLICES AND TERMINATIONS

PART 1 - GENERAL

1.01 SUMMARY

A. This section specifies the furnishing, installation, and connection of medium-voltage cables, indicated as cable or cables in this section, and medium-voltage cable splices and terminations.

B. Single conductor 15,000 volt shielded copper power cable insulated with ozone and discharge resistant flexible, rubber like thermosetting dielectric for medium-voltage applications, suitable for use in wet and dry locations in conduit and underground ducts.

C. Related Requirements:

1. Division 01 – General Requirements.
2. Section 26 05 00 – Common Works Results for Electrical.
3. Section 26 05 13 – Basic Electrical Materials and Methods.
4. Section 26 05 26 – Grounding and Bonding.
5. Section 26 08 00 – Electrical Systems Commissioning.
6. Section 26 12 00 – Medium Voltage Transformer.
7. Section 26 13 16 – Medium Voltage Metal Enclosed Load Interrupter.

D. Applicable Standards. The most current version of the standard applies:

1. ANSI C84.1 – Electric Power Systems and Equipment - Voltage Ratings (60 Hertz).
2. ANSI/ICEA S97-682 – Standard for Utility Shielded Power Cables Rated 5 through 46 KV.
3. ANSI/ICEA S97-649 – Concentric Neutral Cables Rated 5 Through 46 KV.
4. California Electrical Code.
5. IEEE 48 – Standard for Test Procedures and Requirements for Alternating-Current Cable Terminations Used on Shielded Cables Having Laminated Insulation Rated 2.5 kV through 765 kV or Extruded Insulation Rated 2.5 kV through 500 kV
6. IEEE 141 – Recommended Practice for Electric Power Distribution for Industrial Plants.
7. IEEE 242 – IEEE Protection and Coordination of Industrial and Commercial Power Systems.
8. IEEE – Standard for Separable Insulated Connector Systems for Power Distribution Systems Rated 2.5 KV Through 35 KV.

9. IEEE 404 – Standard for Extruded and Laminated Dielectric Shielded Cable Joints Rated 2.5 kV to 500 kV.

10. UL 1072 – Standard for Medium-Voltage Power Cables.

1.02 SUBMITTALS

A. Provide submittals in accordance with Division 01.

B. Submit layout drawings and diagrams of cabling system configuration for Architect/Engineer's review.

C. Submit three 36 inches long pieces of the proposed cable for OWNER's inspection, evaluation and approval.

D. Submit manufacturer's cut sheets and description of products' components.

E. Submit a third-party certified test report per The Association of Edison Illuminating Companies (AEIC) CS-8 from the factory to the Project Inspector, and Architect/Engineer before installation, for each length of cable delivered to the Project site. This report shall certify compliance with the requirements of Insulated Cable Engineers Association (ICEA); the report shall include all required test data.

F. High voltage cable shall not be installed until cable and test report have been reviewed by the Architect/Engineer. Submit five copies of the report.

1.03 QUALITY ASSURANCE

G. The cable manufacturer shall have a minimum of 15 years manufacturing EPR insulated cables.

H. Cables shall be tested for corona discharge and shall comply with AEIC requirements. A copy of the original x-y plot showing discharge levels shall be included as part of the certified test reports. Submit test report for Architect/Engineer and Project's Inspector review prior to installation.

I. Tests shall be performed in accordance with (NETA Specification) ANSI/ICEA S-97-682, S-97-649 and UL Standard 1072; the tests could be performed by a UL or another approved equal Nationally Recognized Testing Laboratory (NRTL).

J. CONTRACTOR shall ensure that applicable sections of IEEE standards 141 and 242 are followed in the evaluation and installation.

K. Reels of furnished cable shall be newly manufactured of not more than 12 months old, and shall bear tags containing name of manufacturer, CEC designation, and year of manufacture.

1.04 WARRANTY

A. The following warranties are required:

1. Five-year material warranty from the manufacturer.

2. Two-year installation.

PART 2 - PRODUCTS

2.01 CABLE

A. Cables shall be insulated, shielded and jacketed, and shall be listed for wet and dry locations, sunlight resistant, and for cable tray and conduit use.

B. Medium-voltage cable shall be furnished where line-to-line operating voltage exceeds 600 volts.

C. Cables shall be 15 KV, single conductor, 133 percent insulation rating, ethylene propylene rubber insulated, shielded, PVC jacket Type MV-105.

D. Conductors shall be Class B stranded annealed, uncoated copper.

E. Insulation system conductor screens, insulation and insulation screens shall be capable of continuous operation at conductor temperatures of 120^{o} Centigrade, and emergency overload temperatures of 140 degrees C.

F. Cables shall be identified indicating manufacturer, size, insulation type, voltage rating, year manufactured, and UL, or other Nationally Recognized Testing Laboratory designations.

PART 3 - EXECUTION

3.01 CABLE INSTALLATION

A. Installation of cable, including joints, splices, taps, bends, connections, terminations, and method of pulling cable into conduit shall be performed in accordance with manufacturer's recommendations.

B. In manholes, handholes and vaults CONTRACTOR shall provide cable(s) loop(s) to allow for future splicing and extensions. Cables shall be wrapped in fireproofing tape and properly supported per applicable codes and standards.

C. Stress cones shall be installed on cable at joints, splices, and terminations as recommended by the cable manufacturer and industry standards; the most stringent shall apply. Minimum bending radius of cable shall be in strict accordance with manufacturer’s recommendations.

D. Cable splicing shall be performed by a Certified Cable Splicer with minimum experience of five years, CONTRACTOR shall provide copy of Cable Splicer employee certification.

E. Use only environmentally safe pulling compound, approved by the OWNER’S Office of Environmental Health and Safety.

F. Cables shall be identified (labeled) at points of termination and points where conduit run is broken, as to phase leg and feeder designation. This requirement applies at man-holes, switchboards, pull boxes, and like items. Markers shall be E-Z Code, Brady Perma-Code, or equal. ID tags shall be water proof and one inch in size.

G. Each cable shall be subjected to a high potential DC test in the presence of the Inspector, Architect/Engineer, and Commissioning Agent. CONTRACTOR shall provide no less than

two working days' notice of proposed time for test. Hi-Pot test shall be NETA Acceptance Values.

1. Test shall be performed with equipment specifically designed for this type of test and in a manner recommended by cable manufacturer. Copies of test report shall be submitted to the Architect/Engineer for review.

2. Test voltage shall be raised gradually in steps to final voltage recommended by ICEA, which shall be applied for five minutes. Current readings shall be taken at each step after leakage current has stabilized and readings shall be plotted on graph paper. If breakdown is indicated during test by a sudden increase in current, discontinue tests and provide replacements necessary to correct defective Work.

H. Cables not meeting test minimum requirements shall be replaced with new. Segmented replacement is not acceptable. Perform splices and terminations necessary for replacement of cable(s). Replace splices and terminations where test results indicate to be defective Work.

3.02 CABLE TERMINATIONS

A. Provide termination kits capable of proper termination of 15 KV class single conductor cables. Kits shall meet Class I requirements and be design proof tested in accordance with IEEE 48. Kits shall accommodate common forms of cable shielding and construction without the need for special adapters or accessories, and shall accommodate a range of cable sizes. Kits shall be capable of proper installation on out-of-round cable in accordance with ICEA and AEIC standards. Kits shall accommodate commercially available environmentally sealed connectors.

B. Terminations for single conductor shielded cables shall consist of heat shrinkable stress control and other required non-tracking insulation tubing or tapes. Kits shall also contain high relative permittivity stress relief mastic for insulation shield cutback treatment with a heat-activated sealant for environmental sealing.

C. Cable Terminator(s) shall demonstrate actual field experience and suitable accelerated and real-time testing of weathering resistance. Test reports, which verify device stability with time, temperature, and electrical stress variations, shall be submitted for review.

3.03 CABLE SPLICES

A. Splices shall be factory engineered kits that rebuild the cable insulation to that of the cable. Splices shall contain necessary components to reinstate the cable's primary insulation, metallic shielding and grounding systems, and an outer jacket.

B. Splices shall be capable of passing the electrical test requirements of IEEE-404 and water immersion tests of ANSI/IEEE 386.

C. Splices shall be of uniform cross-section, heat shrinkable polymeric construction utilizing an impedance layer stress control tube and high dielectric strength insulating layers. Outer insulating layer shall be bonded to a conducting layer for shielding. The splice shall be re-jacketed with a heat shrinkable adhesive-lined sleeve to provide a waterproof seal, or factory approved taping kit such as Scotch 5717, or equal.

D. Splices shall accommodate a range of cable sizes and be completely independent of cable manufacturer tolerances. Splices shall be capable of being properly installed on out of

round cable in accordance with ICEA and AEIC standards. Kits shall accommodate commercially available connectors.

E. Splices, which consist of three or more cables, shall be performed with 600 AMP Elastamold T Bodies, Hubbell, Cooper or equal. The splice shall be capable of removing or adding a conductor and restoring the connection in an electrically safe and waterproof condition. Installation of 200 AMP T Bodies is not permitted.

3.04 CLEANUP

A. Remove rubbish, debris and waste materials and legally dispose of off the Project site.

3.05 PROTECTION

A. Protect the Work of this section until Substantial Completion.

END OF SECTION

SECTION 26 05 19 - LOW-VOLTAGE WIRES (600 VOLT AC)

PART 1 - GENERAL

1.01 SUMMARY

A. Provisions of Division 01 apply to this section.

B. Section Includes: Low-voltage wire, splices, terminations and installation.

1.02 SUBMITTALS

A. Provide in accordance with Division 01.

B. List of Materials: Submit a complete list of proposed materials.

C. Shop Drawings: Provide detailed and dimensioned Shop Drawings indicating kind, weight and thickness of materials, insulation type, resistivity, conductivity, impedance, and conductance. Drawings shall contain sufficient information to assemble and install equipment at the Project site without further instructions.

D. Prior to start of construction; provide letter from wiring and electrical cables manufacturer certifying that the products are qualified/ listed as low electromagnetic field products.

1.03 SUBSTITUTIONS

A. Deviations/Substitutions from these requirements shall not be accepted without written approval from OWNER'S Design Standards Section and Maintenance and Operations Technical Unit. When deviating are proposed the following information shall be submitted:

1. Substitution request form stating reasons and benefits to OWNER.

2. OWNER'S approval shall be obtained for any equipment or materials substitutions.

3. Proposed substitutions requests shall provide proof of compliance with OWNER'S requirements and applicable standards.

B. Submittals must comply with contract general provisions.

1.04 QUALITY ASSURANCE

A. Components and materials shall be listed and approved for the intended application by Underwriter's Laboratories (UL), or other Nationally Recognized Testing Laboratory (NRTL), and in compliance with applicable industry standards and codes.

B. Wiring installation shall be performed under the supervision of state certified electricians. Contractor or Installer's electricians shall be certified in accordance with Labor Code sections 3099, and 3099.2 and section 209.0 of the California Code of Regulations.

C. Contractor shall have adequate experience installing systems of similar size and complexity.

1. Qualifications of Installer: Minimum five years of experience installing products and systems of similar scope and complexity.

2. Installer shall have completed at least five projects of equivalent scope and complexity.

3. Contractor shall have completed and commissioned a minimum of five service agreements that provide similar support services to those needed for this project.

4. System startup and testing shall be performed under direct observation of the Project Inspector and OAR.

D. The Project Inspector will observe installation of feeder cables. Notify the Project Inspector not less than two working days in advance of the proposed time of feeder installation.

1.05 WARRANTY

A. Provide a one year labor warranty.

B. Provide material warranty of no less than 10 years.

C. Warranty period begins at substantial completion or project acceptance for beneficial occupancy.

D. CONTRACTOR shall warranty all products and materials. Multiple warranty sources is not acceptable.

PART 2 - PRODUCTS

2.01 WIRES

A. Pressure cable connectors shall be pre-insulated 3M Scotchlok, Ideal Wing Nut, O-Z/Gedney or equal.

B. Wires shall be single conductor type THHN or THWN insulated with polyvinyl chloride and covered with a protective sheath of nylon, rated at 600 volts. Wires may be operated at a maximum continuous conductor temperature in dry locations of 90 degrees C. and 75 degrees C. in wet locations. Wires and cables shall be listed by Underwriter's Laboratories (UL) Standard 83 for thermoplastic insulated wires and listed for installation in accordance with Article 310 of the California Electrical Code (CEC).

C. Conductors shall be solid copper for 12 AWG and smaller conductors, and stranded copper for 10 AWG and larger conductors.

D. Conductors shall be insulated with PVC and sheathed with nylon.

E. Wires shall be identified by surface markings indicating manufacturer's identification, conductor size and metal, voltage rating, UL symbol, type designations and optional rating. Indentations for lettering are not permitted.

F. Wires shall be tested in accordance with the requirements of UL standard for types THWN and THHN.

G. Conductors shall be solid Class B or stranded Class C annealed uncoated copper in accordance with UL standards, or another Nationally Recognized Testing Laboratory (NRTL).

2.02 STANDARDS

A. THWN/THHN wires shall comply with the following standards:

1. UL 83 for thermoplastic insulated wires.

2. UL 1063 for machine tool wires and cables.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Wires shall not be installed until debris and moisture is removed from conduits, boxes, and cabinets. Wires stored at site shall be protected from physical damage until they are installed and walls are completed.

B. Wire-pulling compounds furnished as lubricants for installation of conductors in raceways shall be compounds approved and listed by UL, NRTL, or equal. Oil, grease, graphite, or similar substances are not permitted. Pulling of 2 AWG or larger conductors shall be performed with a cable pull machine. Any runs shorter than 50 feet are exempt. When pulling conductors, do not exceed manufacturer’s recommended values

C. At outlets for light, power, and signal equipment, pigtail splices with 8-inch circuit conductor leads for connection to fixtures, equipment, and devices.

D. Pressure cable connectors, Yellow, Red, or Blue spring-loaded twist-on type, may be furnished in splicing number 8 AWG or smaller wires for wiring systems. Listed Push-in spring clamp wire connectors, Ideal In-Sure, or equal may be used in luminaires for fixture wiring.

E. Joints, splices, taps, and connections to switchboard neutral, bonding or grounding conductors, conductors to ground busses, and transformer connections for wires 6 gage and larger shall be performed with high-pressure cable connectors approved for installation with copper conductors. Connectors shall be insulated with heavy wall heat shrink WCSM, or cold-applied roll-on sleeve RVS. Insulation level shall be a minimum of 600V and joints, splices, and taps shall be qualified to ANSI C 119.1, UL, NRTL, or equal listed mechanical pressure connections.

F. Connections to any bussing and high-press cable connectors shall be securely bolted together with corrosion-resistant plated carbon steel, minimum grade five machine screws secured with constant pressure-type locking devices.

G. Connection of any bonding or grounding conductors shall be securely bolted together with corrosion-resistant plated carbon steel, minimum grade five machine screws secured with constant pressure-type locking devices.

H. Wire switchboards, panel cabinets, pull boxes, and other cabinets except public address, shall be neatly grouped and tied in bundles with nylon ties at 10-inch intervals. In switchboards, panels and terminal blocks, wires shall be fanned out to terminals. If bundles are longer than 24 inches, a maximum of nine current carrying conductors may be bundled together.

I. Install conductor lengths with a minimum length within the wiring space. Conductors must be long enough to reach the terminal location in a manner that avoids strain on the connecting lug.

J. Maintain the conductor required bending radius.

K. Neutral conductors larger than 6 gage, which are not color identified throughout their entire length, shall be taped, painted white or natural gray, or taped white where they appear in switchboards, cabinet, gutters or pull boxes. Neutral conductors 6 gage and smaller shall be white color identified throughout their entire length.

L. Fire alarm and clock wiring shall be continuous from terminal cabinets or from equipment to each device. Splices are not permitted between devices and/or terminal cabinets at junction and pull boxes. Wiring shall be terminated at terminal blocks or devices only.

M. Wiring systems shall be free from short circuits and grounds, other than required grounds. The contractor shall be responsible for the testing of feeder and branch circuit conductor's insulation resistance. The insulation of the conductors shall be tested prior to connections to any panelboards, switchboards, variable frequency drives, lighting control systems, ballasts, and wiring devices such as but not limited to GFI receptacles, TVSS receptacles, or equipment. Insulation testing of panelboards and switchboards shall be independently performed from the insulation testing of any conductors as specified in other sections of this specification.

1. Utilize the services of an approved independent testing laboratory to perform megger time-resistance insulation testing of feeder conductors. Tests must be conducted with wires disconnected at both ends.

    a. Provide calibration program records to assure the testing instrument to be within rated accuracy. The test equipment accuracy shall be in accord with the requirements stated by the National Institute of Standards and Technology (NIST).

    b. Test equipment shall be provided with a label stating the date of last calibration. As a minimum the equipment shall have been calibrated within the past 12 months.

    c. Test reports shall include the following:

        1) Identification of the testing organization.

        2) Equipment identification.

3) Ambient conditions.

4) Identification of the testing technician.

5) Summary of project.

6) Description of equipment being tested.

7) Description of tests.

8) Test results.

9) Analysis, interpretation and recommendations.

2. Utilize the services of an approved independent testing laboratory or a qualified contractor's employee (Technician certified in accordance with ANSI/NETA ETT-2000 Standard for Certification of Electrical Testing Personnel) to perform megger time-resistance insulation testing of branch circuit conductors. Tests must be conducted with wires disconnected at both ends.

   a. Test equipment and report requirements stipulated under paragraph 3.01.N.1 apply to branch circuit testing.

3. Tests shall be performed in the presence of the Project Inspector.

4. Insulation resistance shall not be less than 100 mega-ohms.

3.02 COLOR CODES

A. General Wiring:

1. For phase and neutral conductors 6 gage or larger, permanent plastic-colored tape may be furnished to mark conductor end instead of coded insulation. Tape shall cover not less than 2 inches of conductor insulation within enclosure.

2. Color code conductor insulation as follows:

SYSTEM VOLTAGE		
Conductor	208Y/120	480Y/277
Phase A	Black	Brown
Phase B	Red	Orange
Phase C	Blue	Yellow
Neutral	White	Natural Gray

Neutrals shall be colored-distinguished if circuits of two voltage systems are used in the same raceway.

3. Where two voltage systems are combined in an enclosure; CONTRACTOR shall apply a permanent color code label where the circuits originate.

B. Signal Systems: Wires for signal systems shall be color-coded and installed under observation of the Project Inspector. Also, refer to Div. 27 & Div. 28 for specific requirements of the systems. Except where otherwise specified, color-coding shall be as follows:

SYSTEM	COLOR CODE
Clocks	Pink, Gray and Orange
Program Bells (some existing elementary schools)	White (Common)Black
Initiating Devices (Non-Addressable)	Red (+) and Black (-)
Program Bells (some existing secondary schools)	White (120 volt, common) Black (C.R. program) Blue (Shop program) Brown (Gym program) Yellow (Auditorium fire alarm)
Fire Alarm Horns	Pink (+) and Gray (-)
Fire Alarm Strobes	Orange (+) and Blue (-)
Un-Interruptible 24 Volt Power (Annunciator, Water Flow, and Audible Device)	Yellow (+) and White (-) Note: A single white wire may be common to both
Interruptible 24 Volt Power (4 wire smoke detectors, duct detectors)	Brown (+) and White (-) Note: A single white wire may be common to both
Switch-Leg Sprinkler Bell (Between water flow and audible device)	Violet (+) and White (-)
Door Holding Magnets (Non Power Limited)	Black (+) and White (-)

3.03 FEEDER IDENTIFICATION

A. Feeder wires and cables shall be identified at each point the conduit run is broken by a cabinet, box, gutter, etc. Where terminal ends are available, identification shall be by means of heat shrink wire markers, which provide terminal strain relief. Markers shall be by Tyco Electronics, Panduit, Brady Perma-Sleeve, or equal. Identification in other areas shall be by means of wrap-around tape markers from Tyco Electronics, Panduit, Brady Perma-Code or equal. Markers shall include feeder designation, size, and description.

3.04 TAPE AND SPLICE KITS

A. Splices, joints, and connectors joining conductors in dry and wet locations shall be covered with insulation equivalent to that provided on conductors. Free ends of conductors connected to energized sources shall be taped. Voids in irregular connectors shall be filled with insulating compound before taping. Thermoplastic insulating tape approved by UL, NRTL, or equal for installation as sole insulation of splices shall be furnished and shall be installed according to manufacturer's printed specifications.

3.05 PROTECTION

A. Protect the Work of this section until Substantial Completion.

3.06 CLEANUP

A. Remove rubbish, debris and waste materials and legally dispose of off the Project site.

END OF SECTION

SECTION 26 05 26 - GROUNDING AND BONDING

PART 1 - GENERAL

1.01 SUMMARY

A. Provide and install an effective grounding and bonding system.

B. Related Requirements:

1. Refer to related sections for their system grounding requirements.
2. Division 01 - General Requirements.
3. Division 26 – Electrical.
4. Division 27 – Communications.
5. Division 28 - Electronic Safety and Security.

1.02 QUALITY ASSURANCE

A. Reference Standards:

1. IEEE 142 Green Book.
2. Underwriter's Laboratories (UL).
3. California Electrical Code.
4. Building Industry Consultant Services International (BICSI).
5. EIA/TIA (Signal and power).
6. Nationally Recognized Testing Laboratory (NRTL).

1.03 SYSTEM DESCRIPTION

A. Equipment, components, or materials that enclose electrical conductors, or are likely to be energized by electrical currents shall be effectively grounded.

B. Metal equipment parts such as switchboards, panelboards, metal enclosures, raceways, equipment grounding conductors, and earth grounding electrodes shall be effectively bonded into a continuous grounding path.

C. Metallic systems or electrically conductive materials shall be effectively bonded to the building’s grounding electrode system.

D. A separately derived AC system shall be grounded to the equipment grounding conductor and to a separate “made” electrode of building grounding electrode system.

E. Provide effective electrical equipment bond continuity to all metal raceways and enclosures. Grounding shall be achieved through a code sized green insulated grounding conductor provided within each raceway.

1. Each flexible conduit over six feet in length shall be provided with a green insulated grounding conductor of required size.

2. Provide code sized equipment grounding conductor in all flexible conduits as required by CEC.

3. The length of flexible conduit installations shall not be less than six feet.

4. Effectively ground metal raceways and enclosures at each end.

F. Cold water, or other utility piping systems, shall not be utilized as grounding electrodes. In addition to bonding to cold water pipe provide at least one of the following made grounding electrodes:

1. A dedicated “made” electrode, fabricated of at least 20 feet of uncoated galvanized 1/2 inch diameter rebar encased by at least two inches of concrete, and placed next to the bottom of a concrete foundation, or footing in direct contact with earth A welded extended portion shall surface at the location of the common grounding electrode bus bar and be extended by a 3/0 exothermic welded bare copper cable, or be welded directly to the bus. The exothermic weld shall be at least four inches above finished floor in a dry location. The main grounding electrode and associated grounding conductors shall be in an enclosure and in conduit.

3. Concrete enclosed electrode, fabricated of at least 20 feet of No. 2 AWG, minimum size, bare copper conductor, encased by at least two inches of concrete, located within or near bottom of a concrete foundation, or footing, which is in direct contact with earth. Footing rebar shall be connected to copper wire with approved connectors.

4. An external grounding electrode, as specified hereafter or as required by the CEC shall be installed and connected to foundation or footing rebar.

G. Non-current carrying metal parts of high-voltage (1000 Volts or more) equipment enclosures, signal and power conduits, switchboard and panelboard enclosures, motor frames, equipment cabinets, and metal frames of buildings shall be permanently and effectively bonded to the grounding system. Provide a CEC sized equipment grounding conductor in every raceway.

H. Metallic or semi-conducting shields and lead sheaths of cables operating above 1000 Volts shall be permanently and effectively grounded at each splice and termination.

I. Neutral of service conductors shall be grounded as follows:

1. Neutral shall be solidly grounded at only one point within the Project site for that particular service. Preferable location of grounding point shall be at the service switchboard, or main switch.

2. Equipment and conduit grounding conductors shall be bonded to that grounding point.

3. If other buildings or structures on the Project site are served from a switchboard or panelboard in another building, power supply is classified as a feeder and not as a service.

4. Equipment grounding conductor shall be installed from switchboard to each individual building. At building, grounding conductor shall be bonded with power equipment enclosures, metal frames of building, etc., to “made” electrode for that building.

5. Feeder neutrals shall be bonded at service entrance point only; neutrals of separately derived systems shall be bonded at the source only.

J. If there is a distribution transformer at a building the secondary neutral conductor shall be grounded to “made” electrode serving the building.

K. Within every building, the main switchboard or panelboard, shall be bonded to the cold water line. Metallic piping systems such as gas, fire sprinkler, or other systems shall be bonded to the cold water line.

1.04 SUBMITTALS

A. Provide in accordance with Division 01.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Furnished yard boxes shall be precast concrete and shall be approximately 14 inches wide by 19 inches long by 12 inches deep or larger.

a. Boxes shall be furnished with bolt-down, checkered, cast iron covers and cast-iron frames cast into the yard boxes.

b. Provide yard boxes with hinged Frame Locking Cover.

c. Approved products include Brooks No. 36 HFL, Jensen Precast, Oldcastle Precast, Western Precast, Kistner, or equal.

B. External ground electrodes shall be copper-clad steel ground rods, minimum 3/4-inch diameter by ten feet long.

C. Clamps and fittings used in ground boxes below grade shall be listed for direct burial.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Grounding electrodes shall be installed in the nearest suitable planting area, where not otherwise indicated on Drawings, and each electrode shall terminate within a concrete yard box installed flush with finish grade. In planting areas, finish elevation of concrete yard boxes shall be two inches above planting surfaces.

B. If concrete enclosed electrode is provided, grounding wire shall be terminated to a suitable copper plate with grounding lugs and must be enclosed in a raceway or box.

C. Grounding rods shall be driven to a depth of not less than eight feet. Permanent ground enhancement material, (GEM) as manufactured by Erico Electrical Products, Loresco

Powerset, Tessco Ultrafil or equal, shall be installed at each ground rod to improve grounding effectiveness. Install in accordance with manufacture's installation instructions.

D. Grounding electrodes shall provide a resistance to ground of not more than 25 ohms.

E. When installing grounding rods, if resistance to ground exceeds 25 ohms, two or more rods connected in parallel, or coupled together shall be provided to meet CEC grounding resistance requirements.

F. Ground rods shall be separated from one another by not less than ten feet.

G. Parallel grounding rods shall be bonded together with listed fittings and grounding conductors in galvanized rigid steel conduit, buried not less than 12 inches below finish grade.

3.02 TESTING

A. Provide the services of an approved independent testing laboratory to test grounding resistance of “made” electrodes, ground rods, bonding of building steel, water pipes, gas pipes and other utility piping. Tests shall be performed as follows:

1. Visually and mechanically examine ground system connections for completeness and adequacy.

2. Perform fall of potential tests on each ground rod or ground electrode where suitable locations are available per IEEE Standard No. 81, Section 8.2.1.2. Where suitable locations are not available, measurements will be referenced to a known dead earth or reference ground.

3. Perform the two-point method test per IEEE No. 81, Section 8.2.1.1 to determine ground resistance between ground rod and building steel, and utility piping - such as water, gas and panelboard grounds. Metal hand railings at building entrances and at handicapped ramps shall also be tested.

4. Test shall be performed in the presence of the Inspector.

B. Submit 3 copies of test results to the Architect. Test results shall be submitted on an official form from the independent testing laboratory recording Project location, test engineer, test conditions, test equipment data, ground system layout or diagram, and final test results.

3.03 PROTECTION

A. Protect the Work of this section until Substantial Completion.

3.04 CLEANUP

A. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

END OF SECTION

SECTION 26 05 33 -RACEWAYS, BOXES, FITTINGS, AND SUPPORTS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Raceways and wire ways.
2. Conduit installation.
3. Underground requirements.

B. Related Requirements:

1. Section 26 05 00: Common Work Results for Electrical.
2. Section 26 05 13: Basic Electrical Materials and Methods.
3. Division 27: Communications.
4. Division 28 - Electronic Safety and Security.

C. Applicable Standards and Codes.

1. EIA/TIA 569 Standards.
2. National American Standards Institute (ANSI).
3. National Electrical Manufacturer’s Association (NEMA).
4. Nationally Recognized Testing Laboratory (NRTL).
5. California Electrical Code (CEC).
6. Uniform Building Code (UBC).
7. Underwriters Laboratory (UL).

1.02 SUBMITTALS

A. Materials List: Provide in accordance with Division 01.

PART 2 - PRODUCTS

2.01 RACEWAYS

A. Conduit Materials:

1. Metallic conduit, and tubing shall be manufactured under the supervision of an UL, or another NRTL factory inspection and label service program. Each ten-foot length of conduit and tubing shall bear the UL or another NRTL label and manufacturer's name.
2. Rigid metallic conduit shall be rigid steel, heavy wall, mild steel, zinc-coated, with an inside and outside protective coating manufactured in accordance with ANSI C 80.1. Couplings, elbows, bends, conduits, bushings and other fittings shall be the same materials and finish as the rigid metallic conduit. Fittings, connectors, and couplings shall be threaded type, manufactured in accordance with ANSI C 80.1 and UL 6.

3. Electrical metallic tubing shall be steel tubing, zinc-coated with a protective enamel coating inside, manufactured in accordance with NEMA C 80.3. Fittings, couplings, and connectors shall be gland compression type, set screw couplings and connectors not permitted. All parts shall be manufactured in accordance with NEMA C80.3 and UL 6A Electrical metallic tubing is designated hereinafter as EMT. Steel and rain tight fittings shall be approved and listed for the intended application.

4. Flexible steel conduit shall be of flexible interlocking strip construction with continuous zinc coating on strips, manufactured in accordance with UL 1.

   a. Connectors and couplings shall be required fittings of the type, which threads into convolutions of flexible conduit.

5. Liquid-tight flexible metal conduit shall be galvanized heavy wall, flexible locked steel strip construction, UV rated, with smooth moisture and oil-proof, abrasion-resistant, extruded plastic jacket. Connectors shall be as required for installation with liquid-tight flexible conduit and shall be installed to provide a liquid-tight connection.

6. Non-metallic conduit shall be rigid PVC electrical conduit extruded to schedule 40 dimensions of Type II. Grade 1 high impact, polyvinyl chloride, sweeps, couplings, reducers and terminating fittings shall be listed under the UL, or another NRTL, and shall bear the manufacturer's listed marking.

7. Multi-cell raceway shall be four inch PVC, Type 40, UL or another NRTL listed for underground use with optical fiber and signal system cables. Raceway shall be furnished with 3-1/2 inch factory installed inner ducts with required internal spacers, and required couplers, sweeps, and end bells. Multicell raceway shall be Carlon Multigard, or District approved equal.

8. Metal Clad (MC) cable system is not allowed.

B. Sleeves for Conduits: Sleeves shall be adjustable type by Carlon, U.S. Plastic, PEP Plastic or equal.

C. Where conduit enters a building through a concrete foundation below grade, or ground water level, or where it is necessary to seal around a conduit where it passes through a concrete floor or wall, provide O-Z/Gedney Type FSK Thru Wall and Floor Seal, equivalent Cooper Crouse Hinds Thru-Wall, Legrand Thru-Wall, or equal.

D. Expansion Joints-Seismic Separations between building(s) and other locations as indicated on drawings:

1. Provide Thomas & Betts XJG-TB, O-Z/Gedney. type AX with bonding strap and clamps, Cooper XJGD or equal. At exterior locations, provide Thomas & Betts XJG-TB, O-Z/Gedney type EX, Cooper XJGD, or equal. Provide O-Z/Gedney type AXDX, or equal combination deflection/expansion fittings at all seismic separations. Provide manufacture’s internal and external bonding jumpers at all locations. Liquid-tight metal conduit or flexible metal conduit shall not be approved at expansion joints, separations between buildings or seismic separations.

2. Provide expansion fittings at intervals not exceeding 100 feet in conduits exposed to direct sunlight. Fittings may be installed in the conduit run or where conduit attaches to junction or pull boxes. OZ/Gedney type AX, TX or EXE series, or equivalent by Thomas and Betts, Crouse-Hinds or approved equal.

E. Conduit Seal Fittings:

1. Provide conduit seal fittings where indicated on the Drawings. Conduit seals shall be of rigid galvanized steel. Seals in horizontal conduit installations shall be Thomas & Betts EYS, Appleton Type ESU, Crouse Hinds Type EYS, or equal. Seals in vertical conduit installations shall be Thomas & Betts EYD, Appleton Type SF, Crouse Hinds Type EYD, or equal, with continuous drain. When installing conduit seals make provision for percent fill space reduction in accordance with CEC.

2. Install sealing compound after wire has been installed. Ensure drain is not blocked in vertical seals when installing compound. Where conduit seals are installed in hazardous area applications, there shall be no conduit coupling, fitting, etc., between seal and boundary of hazardous area.

F. Penetration in Fire-Rated Structures: Provide 3M, or equal, sealant and fire barriers for installing fire-rated seals around penetrations through floors, walls, and elevator hoistways. Fire stop system must be UL, or another NRTL listed, and classified for through-penetration applications of metallic conduits and busways.

G. Pull Wires: Install 1/8 inch polypropylene cords in empty or spare conduits.

PART 3 - EXECUTION

3.01 CONDUIT INSTALLATION

A. General Requirements:

1. Provide complete and continuous systems of rigid metallic conduit, outlet boxes, junction boxes, fittings and cabinets for systems of electrical wiring including lighting, power, and signal systems, except as otherwise specified.

2. EMT may be installed in interior concealed applications and in areas approved by owner. EMT shall not be installed in concrete, directly buried underground, outdoors, in boiler rooms, elevator pits, or where subject to damage.

3. Within buildings, flexible steel conduit may be installed instead of rigid steel conduit where permitted by code. Flexible steel conduit shall be installed:

   a. For continuous lengths not exceeding more than 50 feet between pull points (pull boxes, outlet boxes, etcetera).

   b. With no maximum total raceway length located within a building interior when the flex is located in concealed locations.

4. Flexible Steel conduit shall not exceed 1-1/2 inches in size.

5. Liquid-tight flexible steel conduit shall only be installed, except where otherwise specified, for final connection of motor terminal boxes, shop equipment, cafeteria equipment, HVAC equipment and other equipment, or for frequent interchange, and shall be of sufficient length, not exceeding 36 inches, to permit full travel or adjustment of motor on its base. Liquid-tight flexible conduit shall not be used for equipment not requiring adjustment or frequent interchange.

6. Connectors for flexible metal conduit shall be made of steel, and of the types which threads into convolutions of conduit. Connectors for watertight flexible metal conduit shall be as required for installation and shall be installed to provide a watertight connection.

7. Exposed conduit shall be installed vertically and horizontally following the general configuration of the equipment, using cast threaded hub conduit fittings where required and shall be clamped to equipment with suitable iron brackets and one hole pipe strap.

8. If connection is from a flush wall-mounted junction box, install an approved extension box.

9. Underground feeder distribution conduits for systems may be non-metallic conduit instead of rigid conduit except where otherwise specified or indicated.

10. Conduit shall be concealed unless otherwise indicated. Conduits exposed to view, except those in attic spaces and under buildings, shall be installed parallel or at right angles to structural members, walls, or lines of building. Conduits shall be installed to clear access openings.

11. Bends or offsets will not be permitted unless absolutely necessary. Radius of each conduit bend or offset shall be as required by ordinance. Bends and offsets shall be performed with standard industry tools and equipment or may be factory fabricated bends or elbows complying with requirements for radius of bend specified. Heating of metallic conduit to facilitate bending is not permitted. Public telephone conduit bends and offsets shall be provided with a radius which is not less than ten times trade size of conduit unless otherwise permitted. Refer to underground installation, specified in this section, for radius of bends and offsets required for underground installations.

12. Running threads are not permitted. Provide conduit unions where union joints are necessary. Conduit shall be maintained at least six inches from covering of hot water and steam pipes and 18 inches from flues and breechings. Open ends of conduits shall be sealed with permitted conduit seals during construction of buildings and during installation of underground systems.

13. Expansion Joints/Seismic Separations/Separations between buildings/Locations Indicated: Provide Thomas & Betts XJG-TB, O-Z Electrical Mfg. Co. Inc. Type AX with bonding strap and clamps. Crouse Hinds XJGD, or equal. At exterior locations, provide Thomas & Betts XJG-TB, O-Z Electrical Mfg. Co. Inc. Type EX, Crouse Hinds XJGD, or equal. Provide Crouse Hinds, Thomas & Betts, or O-Z Electrical Mfg. Co. Type AXDX, or equal Combination Deflection/Expansion Fittings at all seismic separations. Provide manufactures internal and external Bonding Jumpers at all locations. Liquid-tight flexible conduit shall not be approved at expansion joints or seismic separations.

14. Where conduits are terminated in groups at panelboards, switchboards, and signal cabinets, etc., provide templates or spacers to fasten conduits in proper position and to preserve alignment. Conduits terminating at signal cabinets shall only enter cabinets in the following locations:

    a. Conduits entering top, side, and bottom of cabinets shall be aligned in a single row, centered two inches from rear of cabinet.

    b. Conduits entering back of cabinet shall be aligned in a single row centered two inches from top of cabinet.

    c. Conduits shall not be spaced closer than three inches on centers.

15. Conduits above metal lath ceilings shall be rigidly suspended with pipe hangers or pipe racks or shall be secured to superstructure with factory fabricated pipe straps. Conduits in metal lath or steel stud partitions shall be tied to furring channels or studs. In ceiling spaces and in partitions, tie wires shall be spaced not more than 5 feet apart, shall

fasten conduit tight against channels and studs at point of tie and shall not support any of conduit weight. Tie wire shall be 16 gage galvanized double annealed steel.

16. Where auxiliary supports, saddles, brackets, etc., are required to meet special conditions, they shall be fastened rigid and secure before conduit is attached.

17. Conduit in ceiling spaces, stud walls, and under floors, shall be supported with factory fabricated pipe straps or shall be suspended with pipe hangers or pipe racks. Pipe straps shall be attached to and shall fasten conduit tight at point of support against ceiling and floor joists, rafters, and wall studs, or 2” X 4” headers fitted between joists or wall studs.

18. Conduits installed on exposed steel trusses and rafters shall be fastened with factory fabricated conduit straps or clamps, which shall fasten conduit tight against supporting member at point of support.

19. Conduits installed under buildings shall be strapped with factory fabricated conduit straps to underside of concrete floor or joists, or wood floor joists, or shall be suspended with pipe hangers or pipe racks. Conduits under building are not permitted to be placed directly on grade; they shall be suspended from building or shall be buried below surface or ground. 1-1/4 inch and larger conduits under buildings shall be installed with conduit hangers or racks.

20. Pipe hangers for individual conduits shall be factory fabricated. Steel rods shall be 3/8 inch for two-inch conduit hangers and smaller and shall be 1/2 inch for 2 ½-inch conduit hangers and larger.

21. Pipe racks for groups of parallel conduits and for supporting total weights not exceeding 500 pounds shall be trapeze type and shall consist of a cross channel, Steel City Kindorf B-900, Unistrut P-1000, equivalent Cooper B-Line or equal, suspended with a 3/8 inch minimum diameter steel rod at each end. Rods shall be fastened with nuts, top and bottom to cross-channel and with square washers on top of channel. Conduits shall be clamped to top for cross-channel with conduit clamps, Steel City Kindorf C-105 or Unistrut P-1111 through P-1124, equivalent Cooper B-Line, or equal. Conduits shall not be stacked one on top of another, but a maximum of two tiers may be on same rack providing an additional cross-channel is installed. Where a pipe rack is to be longer than 24 inches, or if the supported weight exceeds 500 pounds, submit Shop Drawings of installation to the Architect for review.

22. Conduits suspended on rods more than two feet long shall be rigidly braced to prevent horizontal motion or swaying. Installation shall meet zone 4 seismic requirements.

23. Factory fabricated pipe straps shall be one or two-hole formed galvanized clamps, heavy-duty type, except where otherwise specified.

24. Hangers, straps, rods, or pipe supports under concrete shall be attached to inserts set at time concrete is placed, or with approved concrete anchors. Under wood, install bolts, lag bolts, or lag screws; under steel joists or trusses, install beam clamps. Contractor shall submit size of anchors, bolts, screws, and installation method to Architect for approval prior to start of any work.

25. Conduits shall be supported at intervals required by code, but not to exceed ten feet. One inch and smaller exposed conduits shall be fastened with one-hole malleable iron straps. Perforated straps and plumber's tape is not permitted for the support of conduits.

26. Conduits stubbed up through a roof or an arcade shall be flashed with a waterproof flashing. Refer to Division 07 for additional requirements.

27. Bushings and locknuts for rigid steel conduit shall be steel threaded insulating type. Setscrew bushings are not permitted.

28. Flex conduits shall be cut square and not at an angle.

29. Routing of conduits may be changed providing length of any conduit run is not increased more than ten percent of the length indicated on Drawings.

B. Underground Requirements:

1. Conduits and multicell raceways installed underground shall be entirely encased in three inch thick concrete on all sides, except where otherwise specified. Provide required spacers to prevent any deflection when concrete is placed and to preserve position and alignment. Conduits and raceways shall be tied to spacers. Anchors shall be installed to prevent floating of conduits and raceways during placing of concrete. Provide red colored concrete to encase conduits of systems operating above 600 volts.

2. Underground conduits and raceways shall be buried to a depth of not less than 24 inches below finished grade to top of the concrete envelope, unless otherwise specified.

3. Assemble sections of conduit with required fittings. Cut ends of conduit shall be reamed to remove rough edges. Joints in conduits shall be provided liquid-tight. Bends at risers shall be completely below surface where possible.

4. Conduits and raceways in a common trench shall be separated by at least three inches of concrete. Electrical power and/or lighting conduit runs installed in a common trench with conduits containing signal system wiring such as public address, telephone, intrusion detection, fire alarm, television, computer networking, and clock systems shall maintain a separation of a minimum of six inches from these types of signal system conduits and raceways. Electrical power, lighting and signal conduits and raceways installed in a common trench with other utility lines such as gas, water, sewer and storm lines shall maintain 12 inches separation from these types of utility lines.

5. The Inspector will observe underground installations before and during concrete placement. A mandrel shall be drawn through each run of conduit in presence of the Inspector before and after placing concrete. Mandrel shall be six inches in length minimum, and have a diameter that is within 1/4 inches of diameter of conduit to be tested.

6. Non-metallic conduit installations shall comply with following additional requirements. Joints in PVC conduit shall be sealed by means of required solvent-weld cement supplied by conduit manufacturer. Non-metallic conduit bends and deflections shall comply with requirements of applicable electrical code, except that minimum radius of any bend or offset for conduits sized from 1/2 inch to 1 ½-inch inclusive shall not be less than 24 inches. Bends at risers and risers shall be PVC-coated rigid steel conduit. Radius of curve of bends or offsets in non-metallic conduit for public telephone system shall be not less than ten times trade size of conduit, unless otherwise specifically permitted.

7. Furnish and install a six-inch wide, polyethylene, red underground barrier type 12 inches above full length of concrete reading, "CAUTION ELECTRIC LINE BURIED BELOW".

8. Underground conduit systems provided for utility companies shall be furnished to meet the requirements of the utility companies requiring service.

9. Protect inside of conduit and raceway from dirt and rubbish during construction by capping openings.

10. Add bell-end bushings for conduit stub-up including underground entries to pull boxes, and manholes. Under floor standing switchboards and motor control centers provide a four-inch galvanized nipple with ground bushing.

11. Underground conduit for systems operating above 600 volts shall be a minimum size of four inches.

12. At portable classroom all stub ups shall be installed with a coupling flush to finish grade.

13. Underground conduits and raceways shall be swabbed prior to wire pull.

C. Rooftop conduit shall be supported from channels, stands, clamps, trapezes, rollers, or structures mounted on 100% rubber, UV resistant rooftop supports with reflective strips, Dura-Blok, or equal. Roller type supports shall be provided below and above conduit to prevent its dislodgement. Bottom of conduits shall clear the roof surface by 10 inches.

1. At PVC roofing provide walk tread, polyester reinforced, UV resistant, with surface embossment at rooftop supports. Heat welding of walk pads shall only be done by manufacturer certified installers.

a. Sika-Sarnafil and Carlisle: Walk tread shall be no more than one inch larger than the plan area of the pipe support blocks and adhered to the roof membrane with Sika 1A or Carlisle Universal Single-Ply sealant, as applicable.

b. Johns Manville: Walk tread shall be installed under the pipe support blocks and adhered to the blocks, if possible, and left loose laid on top of the PVC roof system. Walk-pad shall have a minimum of 4 inches of material past perimeter on all 4 sides of block.

2. Built-up roofing: Provide APP granulated modified torch-down at each pipe support block. Torch-down shall extend 2 to 4 inches beyond the edges of the block and adhered by torch application over existing cap sheet membrane. This work shall be performed by a certified roofer.

D. General Installation Requirements for Computer Network System Conduits:

1. Location of outlet boxes and equipment on Drawings is approximate, unless dimensions are indicated. Drawings shall not be scaled to determine position and routing of wireways, drops, and outlet boxes. Location of outlet boxes and equipment shall conform to architectural features of the building and other Work already in place and must be ascertained in the field before start of Work.

2. The maximum pulling tensions of the specified cables shall not be exceeded and proper radius of cable bends shall be maintained.

3. For computer network wiring, conduit types shall be limited to rigid metal conduit, electrical metallic tubing, schedule 40 PVC, multi-cell raceways, and flexible metallic conduit for lengths less than six feet.

4. Interior section of conduit run shall be not longer than 100 feet and shall not contain more than two bends of 90 degrees between pull points or pull boxes.

5. The inside radius of a conduit bend shall be at least six times the internal diameter of the conduit. When the conduit size is greater than two inches, the inside radius shall be

at least ten times the internal diameter of the conduit. For fiber-optic cable, the inside radius of a conduit bend shall be at least ten times the internal diameter of the conduit.

6. Conduit shall be sized in accordance with Table 4.4-1 of EIA/ TIA 569 standard.

7. Splicing or terminating cables in pull boxes is not permitted.

8. For indoor application, a pull box shall be provided in conduit run where:

   a. The length is over 100 feet.

   b. There are more than two bends of 90 degrees.

   c. There is a reverse bend in the run.

9. Boxes shall be provided in a straight section of conduit and shall not be installed in lieu of a bend. The corresponding conduit ends are to be aligned with each other. Conduit fittings shall not be installed in place of pull boxes.

10. Where a pull box is provided with raceways, pull box shall comply with the following:

    a. For straight pull-through, provide a length of at least eight times the trade-size diameter of the largest raceway.

    b. For angle and U-pulls:

       1) Provide a distance between each raceway entry inside the box and the opposite wall of the box of at least six times the trade-size diameter of the largest raceway, this distance being increased by the sum of the trade-size diameters of the other raceways on the same wall of the box.

       2) Provide a distance between the nearest edges of each raceway entry enclosing the same conductor of at least:

          a) Six times the trade-size diameter of the raceway; or

          b) Six times the trade-size diameter of the larger raceway if they are of different size.

          c) For a raceway entering the wall of a pull box opposite to a removable cover, provide a distance from the wall to the cover of not less than the trade-size diameter of the largest raceway plus six times the diameter of the largest conductor.

11. Drawings generally indicate Work to be installed, but do not indicate all bends, transitions of special fittings required to clear beams, girders or other Work already in place. Investigate conditions where conduits and wireways are to be installed, and furnish and install required fittings.

E. Slabs on Grade:

1. Unless specifically reviewed by the Architect and DSA, conduits 1 ¼-inches and larger are not permitted to be installed in structural concrete slabs. Where conduits are permitted, and are installed in concrete slabs on grade, slabs shall be thickened at bottom where conduits occur to provide three inches of concrete between conduit and earth. Required excavation shall be part of the Work of this section.

2. If concrete slab is five inches or more in thickness with a moisture barrier plastic sheet between earth and slab, one inch and smaller conduits shall be installed in the slab with a minimum of one inch concrete between earth and conduit.

F. Concrete Walls, Beams, and Floors: Provide sleeves where conduits pierce concrete walls, beams, and floors, except floor slabs on grade. Sleeves shall provide 1/2 inch clearance around conduits. Sleeves shall not extend beyond exposed surfaces of concrete and shall be securely fastened to forms. Where conduits pass through walls below grade, seal with required sealant and backer materials between conduit and sleeve to provide a watertight joint. Sealant shall be as indicated in Section 07 9200: Joint Sealants.

3.02 STUBS

A. Panelboard: Install two one inch conduits from each flush mounted panelboard to access under floor space and to access above ceiling space where these conditions occur. Cap conduits with standard galvanized pipe caps.

B. Floor: At points where floor stubs are indicated in open floor areas, for connections to machines and equipment, conduits shall be terminated with couplings, tops flush with finished floor. Stubs shall extend above couplings the indicated distance. Where capped stubs are designated, couplings shall be closed with cast iron plugs with screw drive slots.

C. Underground:

1. Underground conduit stubs shall be terminated at locations indicated, and shall extend five feet beyond building foundations, steps, arcades, concrete walks and paving. Rigid metallic conduit stubs and non-metallic conduit stubs shall be capped by installing a coupling flush in end wall of concrete encasement and plugging with a permitted plug. Project record drawings shall indicate location of ends of underground conduit stubs fully dimensioned and triangulated with reference to buildings or permanent landmarks. These dimensions, including depth below finished grade, shall be marked on project record drawings in presence of the Inspector before backfilling trench. Where extending existing concrete encased stubs, clean, chip and wire brush end of existing concrete and brush on a heavy coat of neat cement paste or epoxy bonding agent.

2. Over ends of individual underground conduit stubs or groups of conduit stubs, install four-inch by 18-inch deep PVC filled with concrete, flush with finished grade in asphaltic concrete or lawns, and two inches above finished grade in planting areas. Cast a three-inch by three-inch brass plate engraved "ELECT" flush in top of concrete. Secure plate to concrete with brass dowels or as indicated on drawings.

3.03 PROTECTION

A. Protect the Work of this section until Substantial Completion.

3.04 CLEANUP

A. Remove rubbish, debris and waste materials and legally dispose of off the Project site.

END OF SECTION

SECTION 26 05 86 - MOTORS AND DRIVES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Furnishing and installation of electric motors, machinery drives, and equipment as indicated. Sizes, capacities, and operating conditions shall be as tabulated on equipment schedules.

C. Related Requirements:

1. Division 01 - General Requirements.

2. Section 23 05 48: Mechanical Sound, Vibration and Seismic Control.

3. Section 23 80 00: Mechanical Equipment.

1.02 ELECTRICAL REQUIREMENTS

A. Except where modified by specific requirements of an individual mechanical section, the following electrical Work required by Division 23 is included under Division 26, 27 and 28, and as indicated on Drawings:

1. Motor starters and disconnect switches for motors.

2. Line voltage wiring and conduit to motors, motor starters and controls.

3. Installation of line voltage wall-mounted electric controls.

B. Power Supply: Provide necessary power supplies for the intended operation and application as indicated on the Drawings. Verify indicated power supplies with Architect/Engineer prior to ordering equipment.

C. Pre-wired Control Panels: Where pre-wired control panels or equipment are provided under Division23, internal wiring shall extend neatly to a terminal strip which shall have same designation for terminals that are indicated on wiring diagrams. Pre-wired panels shall be listed and labeled by UL, or other Nationally Recognized Testing Laboratory (NRTL).

D. Workmanship: Where Work of Division 23 includes either factory or field wiring, materials and workmanship shall conform to requirements of Division 26, 27 and 28 Specifications and governing codes.

1.03 SUBMITTALS

A. Provide in accordance with Division 01 and 23 05 00: Mechanical Common Work.

B. Manufacturer's Data

1. Complete material list of items proposed to be provided under this section.

2. Manufacturer's specifications and other data required to demonstrate compliance with specified requirements.

3. Shop Drawings indicating complete system layout, diagrams, and schedules.

4. Manufacturer's recommended installation procedures.

C. Manufacturer's recommended installation procedures, when reviewed by the Architect, will become basis for inspecting actual installation procedures.

1.04 QUALITY ASSURANCE

A. Manufacturer and Installer Qualifications: Comply with provisions stated under Section 23 05 00: Mechanical Common Work.

1. Qualifications of Manufacturers: Products furnished for the Work of this section shall be produced by manufacturers regularly engaged in manufacture of similar items and with a five-year history of successful production.

1.05 PRODUCT HANDLING

A. Protection, Replacement, Delivery, and Storage: Comply with provisions stated under Section 23 05 00: Mechanical Common Work.

PART 2 - PRODUCTS

2.01 EQUIPMENT

A. Electrical Motors: Motors shall provide adequate starting torque to bring driven equipment up to rated speed in the stipulated time intervals:

1. In general, motors 1/2 horsepower and larger shall be squirrel cage induction type for 208V, 3-phase, 60 cycle power supply or higher voltage.

2. Motors below 1/2 horsepower shall be capacitor start, induction run type or split-phase type for 120V, 1-phase, 60 cycle power supply.

B. Motors Furnished with Equipment: Where motors are an integral part of equipment, motors shall be as recommended by the equipment manufacturer.

C. Motor Operation Criteria:

1. Motors that are not directly exposed to weather, and are located in non-hazardous spaces, shall be furnished with drip-proof enclosures and shall be continuous duty rating of 100 degrees F.

2. Motors installed unprotected in outdoor locations shall be totally enclosed, fan-cooled, and continuous duty rating at 130 degrees F.

3. Single phase motors shall be furnished with built-in overload protection. Overload protectors shall be single pole automatic reset type, except where frequent start/stop may constitute a hazard, reset shall be manual.

4. Hermetic polyphase motors shall be furnished with built-in hermetic thermostatic protection devices, which shall interrupt the control circuit to protect the motor from overheating.

5. Motors shall be furnished with UL, or other NRTL approved terminal boxes. All motors including mountings and shaft sizes, shall be built to NEMA standard dimensions; except where integral with hermetic equipment

6. Where application is unique, or location is contaminated or hazardous, high starting torque totally enclosed or explosion-proof motors shall be provided.

7. Where Drawings schedule 3-phase for motors smaller than 1/2 horsepower or single phase for motors larger than 1/2 horsepower, specifically verify schedule with the Architect before ordering motors.

8. Two-speed motors shall be separately wound if speeds required are not a two-to-one ratio. If two-to-one speed ratio is required, motors shall be single wound. Two-speed motors shall be furnished with variable horsepower.

9. Motors shall be furnished with sealed lifetime lubricated ball bearings.

10. Motors shall be energy efficient complying with NEMA standards.

D. Machinery Drives:

1. Couplings: Where couplings are specified for direct drive, non-lubricated types shall be furnished and rating shall be at least 125 percent motor horsepower rating.

2. Belt Drives: Where V-belt drive is required, provide for overload in accordance with manufacturer's recommendations, but not for less than 150 percent of motor horsepower.

   a. Drive selection shall provide not less than 95 percent efficiency.

   b. Fan drives smaller than 25 horsepower shall be furnished with adjustable pitch drive sheaves.

   c. Other drives shall be machined cast iron or steel fixed pitch.

E. Machinery Accessories:

1. Lubricating Devices: Provide level gages, oil pressure gages, grease cups, and grease gun fittings as required by the equipment. Extend lubricating fittings to readily accessible locations.

2. Guards: Rotating equipment shall be provided with guards to protect operating and/or maintenance personnel.

   a. Belt guards shall enclose belts, pulleys and sheaves. They shall be constructed of galvanized expanded sheet steel, installed in an angle frame with angle or channel supports.

   b. Couplings guards shall completely enclose rotating couplings and shall be constructed of galvanized sheet steel, installed to eliminate vibrations.

   c. Guards shall be readily removable to provide access to belt drives and couplings.

   d. Provide opening at shaft end for revolution counter.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install equipment as indicated on Drawings and in compliance with manufacturer's recommendations, with vibration isolation, mounting pads or foundations as specified in other sections.

3.02 PROTECTION

A. Protect the Work of this section until Substantial Completion.

3.03 CLEANUP

A. Remove rubbish, debris and waste materials and legally dispose of off the Project site.

END OF SECTION

SECTION 26 08 00 - ELECTRICAL SYSTEMS COMMISSIONING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Section Includes:

1. General requirements for Commissioning (Cx) of lighting systems components, lighting controls and HVAC systems line voltage interconnection components, including installation, start-up, testing and documentation according to construction documents and Commissioning Plan (CxP).

2. Standard procedures for the execution of commissioning work shall be in conformance with Division 1, Section 01 91 13 General Commissioning Requirements. Coordinate work with the Commissioning Services Provider (CxSP).

1.02 RELATED REQUIREMENTS

A. Division 01 - General Requirements.

B. Section 01 91 13: General Commissioning Requirements.

C. Section 01 79 00: Maintenance and Operations Staff Demonstration and Training.

D. Section 23 80 00: Mechanical Equipment.

E. Section 23 08 00: Mechanical Systems Commissioning.

F. Section 23 09 23: Mechanical Environmental Control and Energy Management Systems.

G. Section 23 08 13: Mechanical Environmental Controls and Energy Management System Commissioning.

H. Section 26 05 00: Common Work Results for Electrical.

I. Section 26 05 13: Basic Electrical Materials and Methods.

J. Section 26 05 26: Grounding and Bonding.

K. Section 26 05 19: Low Voltage Wires (600 Volt AC).

L. Section 26 05 86: Motors and Drives.

M. Section 26 24 19: Motor Control Center and Motor Control Devices.

N. Section 26 50 10: Solid State Lighting.

O. Section 26 09 23: Lighting Control Systems.

1.03 REFERENCES

A. Applicable codes, standards, and references: inspections and tests shall be in accordance with the following applicable codes and standards:

1. National Electrical Testing Association – NETA.

2. National Electrical manufacturer’s Association – NEMA.

3. American Society for Testing and Materials – ASTM.

4. Institute of Electrical and Electronic Engineers – IEEE.
5. American National Standards Institute – ANSI.
6. National Electrical Safety Code – NESC.
7. California Building Code – CBC.
8. California Electrical Code – CEC.
9. California Green Building Standards Code (CalGreen).
10. Conglomerate for High Performance Schools (CHPS).
11. Insulated Power Cables Engineers Association – IPCEA.
12. Occupational Safety and Health Administration – OSHA.
13. National Institute of Standards and Technology – NIST.
14. National Fire Protection Association – NFPA.
15. California Electrical Code.
16. ANSI/NFPA 70B – Electrical Equipment Maintenance.
17. NFPA 70E – Electrical Safety Requirements for Employee Work Places.
18. ANSI/NFPA 101– Life Safety Code.

1.04 SUBMITTALS

A. Submittals shall include the following:

1. Submit required Cx submittals in accordance with Division 1 Specification Sections.
2. Copy of the Architect's reviewed and accepted submittals to the CxSP via the OAR.
3. List of team members who will represent the CONTRACTOR in the Pre-functional Equipment Checks and Functional Performance Testing, at least two weeks prior to the start of Pre-functional Equipment Checks.
4. Detailed manufacturer installation and start-up, operating, troubleshooting and maintenance procedures, checklist documentation and field checklist forms to be used by factory or field technicians, and a copy of full details of OWNER-contracted tests, full factory testing reports, if any, and Warranty information, including responsibilities of OWNER to keep Warranty in force, clearly defined.
5. Detailed manufacturer's recommended procedures and schedules for Pre-functional Equipment Checks, supplemented by CONTRACTOR's specific procedures, and Pre-functional Tests, at least four weeks prior to the start of Pre-functional Performance Tests.
6. After facility's commission is complete, submit completed Pre-functional Equipment Checklists and Functional Performance Test checklists organized by system and by subsystem. Bind information in a single package. The results of failed tests shall be included along with a description of the corrective actions taken.

1.05 MEETINGS, SEQUENCING AND SCHEDULING

A. Meetings: Attend (Cx) meetings as required under Section 01 91 13 and the Cx Plan.

B. Sequencing and Scheduling: The work described in this Section shall begin only after work required in related Division 26 Sections has been successfully completed, and tests, inspection reports and Operation and Maintenance manuals required in Division 26 Sections have been submitted and approved. The start-up and Pre-functional Equipment Checklists shall be completed and submitted to the OWNER's Authorized Representative (OAR) prior to the functional performance tests. Refer to the project's Cx Plan for more details.

1. Coordinate electrical work with the work of other trades prior to scheduling of any Cx procedures.
2. Coordinate the completion of electrical testing, inspection, and calibration prior to start of Cx activities.
3. Cx activities shall be scheduled in accordance with project's Cx plan.

1.06 QUALITY CONTROL

A. Comply with OWNER's Quality Control Specifications, Sections 01 45 16 – 01 45 19, as applicable.

B. Incorporate manufacturer's recommended Cx procedures for the systems and equipment to be commissioned under this Section.

PART 2 - PRODUCTS

2.01 TEST EQUIPMENT

A. Equipment to be utilized in the commissioning process shall meet the following requirements:

1. Provide test equipment as necessary for the equipment and systems to be commissioned.
2. Provide testing equipment and accessories that are free of defects and certified for use.
3. Provide testing equipment with current calibration labels per NIST Standards.
4. Testing equipment shall be UL Listed.

PART 3 – EXECUTION

3.01 COMMISSIONING PROCESS REQUIREMENTS

A. Work to be performed prior to commissioning:

1. Complete all phases of the work so the system(s) can be started, tested, adjusted, balanced, and otherwise commissioned.
2. Start-up services required to bring each system into full operational state and ready for functional performance testing:
   a. Completion of authorized manufacturer representative's start-up procedures and recommendations.
      1. Provide Manufacture's start-up completed forms.
   b. Completion of pre-functional checklists.
   c. Copy of required manufacturer and field testing.
   d. Motor rotation check.

e. Control sequences of operation.

f. Full and partial load performance.

3. If modifications or corrections to the installed systems are required to bring the system(s) to acceptance levels due to CONTRACTOR's incorrect installation or defective materials, such modifications or corrections shall be made at no additional cost to the OWNER.

4. Functional tests shall not start until each system is complete and the above items have been documented and submitted to the Engineer of Record, Cx Services Provider and OWNER for review.

B. Pre-commissioning Responsibilities: Inspection, calibration and testing of the equipment and devices necessary to commission the following systems:

1. Electrical Lighting Systems.

2. Lighting Controls.

3. HVAC line voltage electrical components.

4. Line voltage interface of Environmental Controls and Energy Management System with other systems.

5. Photovoltaic Systems.

C. Commissioning Process Requirements: Refer to Section 01 91 13 General Commissioning Requirements, related sections and Cx Plan for information on meetings, start-up plans, Pre-Functional and Functional Performance Testing (FPT), operations and maintenance data, and other Commissioning activities.

3.02 PREPARATION

A. Provide certified electricians and/or qualified personnel as required with adequate tools and equipment necessary to perform Cx activities.

B. Provide all equipment required for the commissioning of equipment and systems indicated in article 3.01.B.

C. Provide certified testing agency personnel or report(s) as required in the Cx Plan.

3.03 TESTING

A. Testing documentation shall include the following minimum information:

1. Test number.

2. Equipment used for the test, with manufacturer and model number and date of last calibration.

3. Date and time of the test.

4. Indication of whether the record is the first commissioning test, or a retest following correction of a previously identified issue.

5. Identification of the system, subsystem, assembly, or equipment.

6. Conditions under which the test was conducted, including (as applicable) ambient conditions, set points, override conditions, and status and operating conditions that impact the results of the test.

7. Systems and assemblies test results, performance and compliance with contract requirements.

8. Issue number and description of corrected issue that prompted retesting.

9. Name and signature(s) of witnesses and the person(s) who performed the test(s).

B. Test lighting and controls systems to verify performance, operation, functionality, light levels, energy usage, and compliance with construction documents.

1. Start up, test and document results under the observation of the CxSP.

2. Execute the Functional Performance Test (FPT) under the observation of the CxSP.

3. Provide completed and signed FPTs to CxSP for inclusion in the commissioning report.

4. Functions and Testing Conditions:

a. Occupancy sensors and timer controls for lighting:

1) Verify that specified functions and features are set up, debugged and fully operable at time of test.

2) Verify that occupant override feature functions as intended in the contract documents.

3) Verify that sensors response times/durations are set properly.

4) Test the sequence of operation for features and modes and confirm that adjustable times match the design specifications and contract documents.

5) Verify that sensors are located per manufacturer's recommendations.

b. Electric lighting dimming, photocells and controls:

1) Test the dimming controls during daytime when conditions are such that controls should be dimming electric lighting.

2) Verify that amperage changes in light fixtures are proportional to external light changes. Verify that dimmed light levels uniformity at the specified work plane remain within specified limits.

3) Verify that delays and ramp times are set and functioning so that the speed of change of light fixture output is slow enough to not bother occupants, and in compliance with the specifications.

4) Verify that dimming does not cause lower than specified light levels in adjacent "non-dimmed" spaces.

5) Verify that the controls and sensors cannot be easily overridden or disabled by occupants.

6) Verify that dimming systems in places of assembly are interfaced with the Central Fire Alarm system.

7) Verify that dimmed lighting in these areas shall come back to full bright during a fire alarm or emergency condition.

c. Illumination Levels, Night Conditions:

1) Verify that lighting throughout the building is operating automatically.

2) Test with doors closed (to simulate actual occupancy) and after finishes are complete.

d. Illumination Levels, Day Conditions:

1) Verify that lighting levels comply with average maintained foot-candle levels shown on plans.

2) Verify that lighting throughout the building is operating automatically.

2) Test with doors closed (to simulate actual occupancy), after finishes are complete, and room is furnished.

3) Test at different times during the day, or under OWNER-approved simulated conditions, to ensure proper system response and to determine that lighting levels are within specified requirements.

4) In classrooms and educational spaces test the system for the different pre-determined settings. Quiet time, AV mode, all on/off, up/down dimming, and standard operations.

e. Lighting Power Density: Verify building lighting power density. Perform the test with interior lighting turned on and any manual or automatic controls temporarily overridden. Provide statement of compliance with 100% design energy report. Measurements shall be taken at least one minute after lights are turned on.

f. Emergency Lighting System: Verify that the system operates automatically under any condition, without human intervention, and that it resets back to normal operations after the power failure or emergency condition is over or cleared.

5. Acceptance Criteria:

a. Lighting Controls: For the conditions, sequences and modes tested; dimming, occupancy, photocell, and timing controls, integral components and related equipment shall respond to changing conditions and parameters defined in the Contract Documents.

b. Illumination Levels: Average light levels in the tested space at the work plane elevation shall be in the range of plus or minus 10% of the specified light level range for the space.

c. Lighting Power Density: Average instantaneous lighting power density shall be within plus or minus ten percent of that indicated in the Construction Documents.

d. Power factors on lighting circuits shall be greater or equal to 0.95, or as required by lighting fixture specifications.

e. Electrical system total harmonic distortion shall be smaller than 20%.

f. Electrical equipment AIC ratings shall be as indicated in construction drawings.

g. Feeders % voltage drop. Flag feeders with voltage drop greater than 3%.

6. Sampling Strategy for Identical Units:

a. Lighting Controls: Test all automatic interior lighting controls.

b. Illumination Levels: Test all spaces, zones and rooms to verify as proper light levels.

C. HVAC Electrical Component Testing

1. Document HVAC Division 23 electrical components using the startup procedure submitted by CONTRACTOR and accepted by the CxSP.

2. Complete and submit Start-up, Pre-functional, and Functional Checklists.

3. Verify the following information prior to HVAC system equipment startup.

   a. Voltage.

   b. Phase.

   c. Motor Size.

   d. Lock Rotor Amperage.

   e. Full Load Amperage.

   g. Minimum and Maximum Circuit Ampacity.

   h. Feeder protection or branch circuit protection, breaker or fuse size as applicable.

4. Coordinate and check corresponding unit electrical protection.

3.04 ADJUSTING

A. Incorrect installations, including improper adjustments may result in additional work being required for Cx acceptance.

1. Perform work required to correct installations not meeting contract requirements at no additional cost to the OWNER.

B. Corrective work shall be completed in a timely manner to permit completion of the Cx process.

1. Refer to the Cx Plan for retesting requirements necessary to achieve required system performance.

2. If the systems' Cx deadline, as defined in the Cx Plan, goes beyond the scheduled completion of commissioning without resolution of the problem, the OWNER reserves the right to obtain supplementary services or equipment to resolve the problem.

   a. The cost of additional and/or supplementary services inquired by OWNER as a result of CONTRACTOR's lack of performance, or inability to resolve identified issues will be solely the responsibility of the CONTRACTOR.

3.05 TRAINING

A. Provide training and documentation as required in construction documents.

END OF SECTION

SECTION 26 09 23 - LIGHTING CONTROL SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Low-voltage lighting control system.

B. Related Requirements:

1. Division 01 - General Requirements.
2. Section 26 05 00 – Common Work Results for Electrical.
3. Section 26 05 13 – Basic Electrical Materials and Methods.
4. Section 26 05 19 – Low-Voltage Wires (600 Volt AC).
5. Section 26 05 33 – Raceways, Boxes, Fittings, and Supports.
6. Section 26 08 00 – Electrical Systems Commissioning.
7. Section 26 24 16 – Panelboards and Signal Terminal Cabinets.
8. Section 26 50 00 – Lighting.

1.02 SUBMITTALS

A. Provide in accordance with Division 01.

B. Submit a complete one-line diagram of the proposed system configuration for Architect/Engineer’s review. The riser diagram shall identify but not be limited to wiring, equipment, components, interconnection with other systems, and location and type of raceways.

C. Manufacturer's Data: Submit catalog cuts and description of each system component.

D. Provide wiring diagrams and installation details for lighting control equipment.

E. Provide a complete sequence of operation and system interface requirements with fire alarm, and other applicable systems as depicted in construction documents.

F. Shop Drawings: Submit a complete set of detailed Shop Drawings for the entire lighting control system; the shop drawings shall include but not be limited to relay panels with designations and dimensions, day light sensor locations based on manufacturer’s recommendations, and system components with manufacturer’s part numbers.

G. Installation Instructions: Submit manufacturer's written installation instructions, wiring diagrams. Instructions shall include recommendations for handling of equipment and parts, and protection and storage requirements.

H. Software flow diagram of and complete sequence of operation.

I. Software licenses and electronic keys, and list of assigned passwords.

J. Supplemental local or factory training schedule for post warranty support.

K. A complete list of recommended spare parts with pricing for the OWNER’s use in keeping the environmental control system downtime to a minimum.

1.03 QUALITY ASSURANCE

A. Components shall be listed and labeled by Underwriter's Laboratories (UL), or another Nationally Recognized Testing Laboratory (NRTL).

B. Lighting control system and peripheral devices with IP addresses shall be UL listed in compliance with UL-2900 – Cyber Security Network Connected Systems.

C. Lighting Control Systems shall comply with the state of California Building and Electrical Codes, and Title 24 energy requirements in effect at time of submittal for building permit.

D. Conduct a coordination meeting with the lighting control contractor, electrical contractor, EOR, Manufacturer Representative, Commissioning Agent, and the OAR to validate the location of lighting control system components, including daylight, vacancy, motion sensors. Sensors shall be located based on manufacturer’s recommendations.

E. Systems components shall be Title 24 compliant and listed as California Energy Commission approved products.

1.04 WARRANTY

A. Manufacturer shall provide a three-year material warranty.

B. Installer shall provide a two-year installation warranty.

1.05 TRAINING

A. Provide a competent instructor who is factory trained and has comprehensive knowledge of system components and operations to provide full instructions to designated personnel in the system operation, maintenance, and programming. Training shall be specifically oriented to installed equipment and systems.

B. Training shall include system overview, time schedules, override commands, emergency operation, and programming and report generation for school based non-technical personnel.

C. Provide an eight hours OWNER’s personnel and Maintenance and Operations technical employees training session; this training session shall cover and provide the following:

1. As-built drawings of System layouts and point to point connection diagrams.

2. System components cut sheets.

3. Operations and maintenance data.

4. Programmer and maintenance training: database entry; trend logs application programs, diagnostic routines, reporting, failure recovery and calibration, and expose the trainees to system's features, components, system architecture, operations, programming, report generation, communications, reading and interpreting alarms, and any other pertinent information required for the operations and maintenance of the system.

5. Training sessions shall accommodate a minimum of 20 persons and be facilitated at CONTRACTOR's training facility, which should be no more than 50 miles from the Project Site.

6. Obtain OWNER's approval for training locations exceeding 50 miles. In such cases, the CONTRACTOR shall be responsible for transportation expenses.

7. CONTRACTOR shall provide training computers for all attendees. Computers shall be ready for live training sessions.

8. Instructor(s) shall give the trainees the opportunity to practice on simulated and actual (installed) systems.

D. The training session shall have an itemized agenda covering all aspects of the training to be covered in the sessions. CONTRACTOR shall obtain agendas approval from OWNER and Commissioning Agent.

1.06 SYSTEM REQUIREMENTS

A. The lighting controls shall be a centralized system furnished with digital room controllers, capable of working as a network system that communicates via common data line (s).

B. The system shall be furnished with transformers, control electronics, hardware, resident software and complete programming, occupancy sensors, constant light controllers, exterior light sensors, photocells, digital and analog switches, dimmer switches, conduit and wiring for a complete and functional installation.

1. Software shall be resident within the lighting control system.

2. System shall provide local access to programming functions at the master Lighting Control Panel (LCP) and remote access to programming functions via computers or other intelligent communication devices running an industry standard internet browser.

3. System software shall provide real time status of all components and ancillary devices.

4. For on-site access, the lighting control system shall have a built-in touchscreen allowing authorized access to localized control and programming

C. Areas controlled by a motion sensor; such as rooms with one luminaire and emergency fixtures designed to operate 24 hours a day, seven days a week shall be programmed accordingly.

D. The system shall have a server built into the master LCP. The server shall effectively work/operate through HTML pages from any authorized workstation.

1. WEB front end shall be accessible over an OWNER provided Ethernet 10/100 Mpbs to the local area network.

2. Protocol shall be TCP/IP and allow either http (hypertext transfer protocol) or https (hypertext transfer protocol secured) connections.

E. Desktop computers are not part of this section and will be provided by others. Non-networked, non-digital, non-server capable systems are not acceptable.

F. Lighting control system shall be able to be monitored and take commands from a remote Personal Computer (PC); should the remote PC go off-line system programming uploaded to the lighting control system shall continue to operate as intended. Systems requiring an on-line PC or server for normal operation are not acceptable

G. Devices shall be factory pre-addressed but be able to be field addressable also. Systems requiring field addressing only are not acceptable.

H. Programs, schedules, time of day, etcetera, shall be held in non-volatile memory at power failure. At restoration of power, lighting control system shall implement programs required by current time and date.

I. System shall be capable of flashing lighting OFF/ON for any relay or lighting zone prior to the lights beings turned OFF. The warning interval time between the flash and the final lights off signal shall be definable for each zone. Occupant shall be able to override any scheduled OFF sweep using local lighting zone override switches within the zone or occupied space. Occupant override time shall be pre-programmed not to exceed two hours, or current California Title 24 requirements.

J. The system shall be capable of implementing ON, OFF, Raise (dimming), and Lower (dimming), and preset commands, group or zone by means of devices connected to programmable inputs in the lighting control system.

K. Programming and scheduling shall be done at the master LCP and/or remotely via the Internet. Remote connections shall function in real time control and real time feedback.

L. System may consist of centralized relay panels, room controllers, digital switches, analog switches, photocells, motion sensors, lumen control devices, dimmer switches, and various digital interfaces. All system components, including remote and centralized room controllers, digital switches, etc. shall operate and be integrated as a network.

1. Remote Room Controllers (RRC) shall control lighting fixtures in that area or space.

2. The RRC shall provide power to ancillary and control devices, such as occupancy sensors, and take input from controlling devices, such as daylight and occupancy/vacancy sensors.

3. RRC’s shall be capable of taking inputs from OWNER specification line voltage type switches.

M. RRC, switches, photocells and occupancy sensors, and ancillary devices and components shall be integrated per lighting control manufacturer’s instructions.

N. Location of devices and relay panels or relay controllers installed above ceilings shall be identified with a printed label attached to ceiling elements. Locate label directly below equipment location.

1.07 LIGHTING CONTROL OVERVIEW-BY AREA CONTROLLED

A. Rooms:

1. The rooms shall be controlled by a combination of vacancy sensors, daylight controllers and dimmers switches.

a. The vacancy sensor is to automatically switch lights OFF when the room is not occupied for 15 minutes.

b. Daylight controls shall automatically adjust light intensity according to the natural light level in the room to maintain a uniform level of lighting in the range of 30-50 foot-candles.

c. The daylight sensors shall be enabled and disabled by the vacancy sensors to ensure daylight-controlled lights never automatically turn ON when room is unoccupied. The lighting control system shall allow an authorized person to disable the daylight sensors and dimming controls.

d. Wall switches, and dimmers are to manually switch lights ON and OFF. Switches shall comply with the operational requirements of the current T24, and include location of device, accessibility and override capability.

e. Quiet time switch is to temporarily bypass the occupancy sensors for a pre-programmed period of one hour, or as indicated on drawings.

B. Corridors and Open Areas:

1. Corridors and other common areas are to be controlled by a combination of programmable low voltage keyed switches and time schedules supplied by the networked lighting control system.

a. Low voltage keyed switches are operable 24 hours a day and are to manually switch lights ON and OFF.

b. The central timer is to automatically sweep lights OFF after hours and provide scheduling capability where and when occupancy sensors are not used.

c. Interior corridors require occupancy sensors.

C. Custodial, Unsupervised and Equipment Rooms:

1. Provide occupancy sensors with automatic on-off capability in addition to manual switches, and programming features indicated on plans. These sensors shall turn off the lights in the room via 15 minutes pre-set programmable interval after the room has been vacated.

D. Exterior Security Lights:

1. Program exterior wall packs and security lights to be controlled via exterior light sensors, and time switches as indicated on drawings.

    a. Program lights to ON state when natural lighting is below 5 foot-candles

    b. Program lights to OFF when natural light level is greater than 5 foot-candles.

E. Exterior, Non-Security Lights:

1. Exterior non-security lighting in parking lots, corridors and pathways, and decorative lights shall be controlled via exterior light sensor working in conjunction with programmable controlled time schedules via the lighting control system.

    a. Program lights to ON state when natural lighting is below 5 foot-candles, and when scheduled time is set to ON.

    b. Program lights to OFF state when natural light level is greater than 5 foot-candles, and when scheduled time is set to OFF.

F. Restrooms:

1. Student Restroom Lighting and Exhaust Fans (Fans interlocked with lights):

    a. Restroom lights shall be controlled from the lighting control panel via assigned relays.

    b. Provide by-pass lock type, vandal resistance key operated switch adjacent to the door, and ceiling mounted occupancy sensors for on/off controls.

    c. The sensor shall turn off the lights via a programmable pre-set 15 minutes interval, after the room has been vacated.

2. Staff Restrooms Lights and Exhaust Fans (Fans interlocked with lights):

    a. Restrooms lights and fan shall be controlled from the lighting control panel via assigned relays.

    b. Provide ceiling mounted occupancy sensors, and by-pass toggle switches for system override adjacent to the door.

    c. The sensor shall turn off the lights via a programmable pre-set 15 minutes interval, after the room has been vacated.

G. Emergency Lighting:

1. Provide emergency lighting controls circuitry to achieve override or bypass of manually operated switches, lighting control systems, dimmers and occupancy sensors during power failures.

2. Each area of luminaries or groups of luminaries shall be equipped with and be controlled by a UL924 listed emergency lighting control unit to allow the detection of localized power failures.

PART 2 - PRODUCTS

2.01. CENTRAL LIGHTING CONTROL PANELS

A. Central Lighting Control Panels (CLCP) shall be located in electrical closets.

B. Panels shall be surface or flush mounted type as indicated on Drawings, with a hinged door assembly. Doors shall be furnished with flush type locks, spring latching, Corbin locks for metal doors, keyed to Corbin No. 60 keys. Panels shall include the following components or features:

1. Shall be preprogrammed and preassembled with control equipment and relays as indicated on the lighting plans.

2. Shall be equipped with suitable dividers separating Class 1 and Class 2 compartments, 120V and 277V compartments as well as “normal and emergency” compartments.

3. Lighting control relays as indicated on Drawings. Provide 10 percent spare relays for centralized relay panels up to the maximum capacity of panel.

4. Shall be equipped with a neatly typewritten schedule with number and name of rooms or areas served by the relay circuits. Room numbers and names used shall be determined at the Project site and may not be those indicated on Drawings. Schedule shall indicate panel designation and voltage and shall be mounted in a frame under transparent plastic 1/32-inch-thick on inside of panel cabinet.

5. Each panel shall be rated for 120 or 277 VAC.

6. Shall be preassembled, preprogrammed and include relays capable of switching 20 amps lighting loads for 120 or 277 VAC.

7. Central lighting control panels, remote lighting control panels, relays, low voltage switches, interior light sensors, exterior light sensors, and associated control electronics shall be furnished by Lighting Control and Design (LC & D), Douglas Lighting Controls, or equal.

8. Approved products: Douglas Dialog Series, LC & D #GR-2400 series, or equal.

2.02. REMOTE ROOM CONTROLLERS

A. Remote Room Controllers (RRC) shall be mounted in the ceiling space as indicated on plans.

1. Each RRC shall be connected to the network lighting control system using manufacturer’s recommended wiring method and configuration.

2. Provide a printed label “RLCP” to the T-bar grid below the RRC”.

3. Approved products: LC&D GR-2404 Series or Douglas WRC-4244.

B. Each RRC shall contain the following hardware features:

1. Digital dataline switch inputs.

2. 12 VDC and 24 VDC inputs for occupancy sensors requiring DC voltage for analog occupancy sensors, or Digital dataline type inputs for occupancy and light sensors.

C. Switches shall be capable of switching individual relays, local groups of relays within the panel or global groups of relays system wide. Each switch shall be configured to be ON, OFF, RAISE, LOWER, or Toggle.

D. The RRC shall digital dataline occupancy sensors. The sensors shall be configured for OFF only or ON/OFF switching scenarios.

E. Photo sensor shall be linked with occupancy sensing so that when light levels are high enough, the occupancy/vacancy sensor will not switch the photo-controlled relays ON.

2.03 RELAYS

A. Relays shall be warranted for a minimum of three-years.

B. Relays shall be individually added or replaced. Lighting control systems incapable of replacing individual relays are not acceptable.

C. Each lighting control relay shall be capable of controlling LED sources.

D. Approved Products:

1. Single Pole: Douglas WR-6161, LC&D SL-277-NC, or equal.

2. Double Pole: Douglas WR-6172, LC&D SL-480-NC, or equal.

2.04 LOW VOLTAGE SWITCHES

A. Low voltage switches shall be wired in compliance with manufactures requirements. Digital switches shall be part of the lighting control system network.

1. Provide stainless steel switch plates, unless noted otherwise in construction documents.

2. Approved Products: LC&D Chelsea series, Douglas WSW-3500 series, or OWNER approved equal.

B. Physical removal of any single switch shall have no effect on the communication between relay panels in the rest of the lighting control network. Lighting control systems requiring the continuous connection of all low voltage switches are not acceptable.

C. Keyed switches shall be digital.

1. Approved products: Douglas WSK-35XX Series, LC&D KS Series, or equal.

2. Provide stainless steel switch plates, unless noted otherwise in construction documents.

D. High abuse areas (common areas, gymnasiums, etcetera) shall be controlled using a vandal resistant, touch sensitive high abuse switch and available with up to three buttons in a single gang. Multi gang versions shall also be available.

1. Touch pads shall be stainless steel and capable of handling both high abuse and power wash cleaning crews' activities.

2. Switches shall be digital or analog as indicted on plans.

3. High abuse switch touch buttons shall control a single relay or group(s) of relays of the lighting control system.

4. Touch buttons shall be controllable via programmed commands to enable or disable, ON, OFF, Toggle or Maintain operation functions. Programming shall be done locally or remotely.

5. Touch pad(s) shall be identified as to function by an engraved label.

E. Switches must be capable of handling electrostatic discharges of at least 30,000 volts (1cm spark) without any interruption or failure in operation.

2.05 INTERIOR DAYLIGHT SENSORS

A. Interior daylight sensors shall cause light fixtures to brighten or dim to maintain pre-determined and uniform light levels.

B. The sensors shall permit any relay to switch at a unique light level and shall attempt to maintain a constant light level by switching individual relays ON or OFF as the ambient light level changes.

C. Controllers offering single set point controls are not acceptable.

D. Each interior daylight sensor shall continuously monitor the true light label and shall broadcast this level to lighting control network. Controllers requiring readings at the sensor head itself are not acceptable.

E. Each interior daylight sensor shall be fully adjustable via the lighting control software. Controllers requiring adjustments at the sensor head are not acceptable.

F. Provide daylight sensors in all rooms with windows, skylights, or daylight filtration. Refer to lighting plans to determine which switch legs are controlled by the daylight controller.

G. Approved Products: LC&D iPC Series, Douglas WPS-3711, Douglas WPP-INT, or equal.

2.06 EXTERIOR LIGHT SENSORS

A. One exterior light sensor shall permit different relays to switch at different light levels. Sensors offering less than 14 remotely settable trip points are not acceptable.

B. Exterior light sensor shall continuously monitor light levels and shall broadcast this level over the lighting control network. Exterior light sensor shall be fully adjustable via the networked lighting control system.

C. Sensors and controllers requiring adjustments at the sensor head are not acceptable.

D. Sensors shall be UL or NRTL listed for exterior application.

E. Approved products: Douglas WPS-3741B, LC&D PCO, or equal.

2.07 DIMMING CONTROLLER

A. Remote relay panels shall be capable of outputting 0V – 10V dimming signal for each relay provided in the remote room controller. LED Dimming drivers shall be controlled by industry standard 0V-10V control input.

B. LED Drivers using proprietary control protocols shall not be acceptable.

C. To maximize daylight harvesting and minimize disruption to occupants, each dimming output shall provide adjustment for baseline, start point, mid point, end point, trim fade up rate, fade down rate, time delay and enable/disable masking.

D. Photocells settings must be remotely accessible.

E. Systems that provide ON, OFF with Time Delay only and systems that do not provide remote accessibility are not acceptable.

F. Mount photocells in locations indicated on plans and according to manufacturer's recommendations for daylight system type, open or closed loop. Trip points shall be able to be programmed and altered remotely via programming functions at the master Lighting Control Panel (LCP) and remote access to programming functions via computers or other intelligent communication devices.

G. Photocells requiring manual trip point adjustment, or systems that provide local adjustment only are not acceptable.

H. Photocells used for interior lighting control shall have multiple settings such as start-point, mid-point, off-point, fade-up rate, fade-down etc.

I. Approved Products: Douglas WPS-3711, Douglas WPP-INT, LC&D iPC series, or equal.

2.08 OCCUPANCY SENSORS

A. Occupancy Sensors:

1. Ceiling-Mounted Dual Technology Sensors:

a. Sensors shall be dual technology infrared-ultrasonic capable of detecting presence in floor area to be controlled, by detecting Doppler shifts in transmitted ultrasound and infrared technology.

1. ADI-Voice technology may be used in addition to the required infrared-ultrasonic features.

b. Detection shall be maintained when a person moves only within a maximum distance of 12 inches, in either a horizontal or vertical manner, at approximate

speed of 12 inches per second. Lights shall not go off when a person is reading or writing while seated at a desk.

c. Each sensor shall be furnished with a convenient shunt provision, which will enable a person to by-pass sensor in event of failure.

d. Sensitivity shall not change more than ten percent in temperature range of 0 degrees F. to 120 degrees F., and in humidity range of ten percent to 80 percent. Sensitivity adjustment shall be provided for each technology.

e. Time delay range shall be adjustable from 15 seconds to 15 minutes.

f. Sensors power supply shall be provided by power pack, consisting of a transformer and contact closure relay in one package. Power output of transformer shall be capable of operating a minimum of two sensors.

g. Approved products: Watt Stopper No. DT-200, similar as manufactured by Leviton, Sensor Switch, Unenco, or equal.

B. Dual Technology Passive Infrared Wall Switch Sensors with Daylight Controls:

a. Sensors shall be capable of detecting presence in floor area to be controlled, by detecting changes in infrared-ultrasonic energy. Small movements shall be detected such as when a person is writing while seated at a desk.

b. Passive infrared sensor shall utilize a dual-element sensor and a multi-element fresnel lens.

c. Sensor shall be furnished with a daylight filter which ensures that sensor is insensitive to short-wavelength infrared waves, such as those emitted by the sun.

d. Sensors shall be furnished with convenient bypass provisions, which enable lighting to be turned on in case of failure.

e. Time delay range shall be adjustable from 15 seconds to 15 minutes.

f. Sensitivity adjustment shall range from 0 (off) to ten (maximum).

g. Adjustments and mounting hardware shall be concealed under a removable cover to prevent tampering with adjustments and hardware.

h. Each sensor shall cover up to 800 square feet, with a field-of-view of 180 degrees.

i. Sensor shall be a completely self-contained control system.

j. Power shall be provided via an internal transformer.

k. Switching mechanism shall be a latching dry contact relay.

l. Sensor shall be capable of switching from 30 to 1000 Watts, LED, incandescent or fluorescent light sources.

m. Sensor shall be furnished with a daylight feature, adjustable from ten to 400 foot-candles, that maintains lighting off when a desired foot-candle level is present.

n. Sensors shall be dual voltage, 120 volt and 277 Volt.

o. Approved products: Watt Stopper No. WI 200, I 300, similar as manufactured by Leviton Sensor Switch, Unenco, or equal.

2.09 UNIT INVERTERS

A. Unit Inverters shall be rapid start type consisting of emergency power packs designed to be installed in channels of new lighting fixtures.

C. Power pack construction shall be of durable polycarbonate housing.

D. Units shall be furnished with test switches and pilot lights.

E. Units shall automatically power designated lamp(s) for 90 minutes of emergency service upon failure of utility power.

F. Upon return of utility power, battery shall automatically recharge.

G. Batteries shall be field-replaceable, sealed, rechargeable, spill-proof, maintenance-free nickel cadmium.

H. High efficiency inverter/charger design shall include low-voltage disconnect to prevent deep discharge of battery and dual voltage designed for connection to either 120 or 277 volts. Chargers shall recharge fully discharged batteries to provide 90 minutes operation within 24 hours. Power pack shall not operate if shut off manually.

I. An unconditional five-year warranty is required.

J. Approved products: Dual-Lite UFO-5 Series, Bodine, Iota I series, Beghelli Luce, or equal.

2.10 INTERFACE TO BUILDING MANAGEMENT SYSTEM

A. When interface to the Building Management System is required, The lighting control system shall provide a BACnet/IP interface module that communicates with the BMS via a BACnet/IP network. (a collection of one or more IP sub networks (IP domains) that are assigned a single BACnet network number). Verify if interface to BMS is required.

B. BACnet/IP interface module shall provide the capability for the BMS to:

1. Communicate directly with each relay in the lighting control system network and each group used within the lighting control system.

2. Monitor the status and status changes of each relay and each group.

C. Install wiring and confirm operation of the lighting control BACnet/IP interface module per the lighting control manufacturer’s instructions. Installing, wiring, and interfacing of BMS components to the lighting control system.

PART 3 – EXECUTION

3.01 GENERAL

A. Lighting control system shall not be used for ay other purpose other than its intended use and application.

B. Provide required interconnections with other systems such as emergency power sources, fire alarm systems, and building management system as required or indicated on drawings.

C. Installation shall meet or exceed standard practice of workmanship and quality.

D. Drawings are diagrammatic in nature and indicate work to be provided, but do not provide means and methods, bends, transitions, or special fittings required to clear beams, girders or other work already in place. Investigate conditions where conduits are to be installed and furnished and install required fittings.

3.02 INSTALLATION AND SET-UP

A. Verify that conduit for line voltage wires enters panel in line voltage areas and conduit for low-voltage control wires enters panel on low-voltage areas. Refer to manufacturer's drawings for location of line and low-voltage areas.

B. Provide for digital type switches and make all connections according to lighting control manufactures requirements.

C. Central Lighting Control Panels and Remote Room Controllers shall be connected via a data line (Douglas uses a non-polarized two No. 18 and LC&D uses Cat5 four twisted pair cable, with RJ45 end connectors). Connect entire lighting control system per manufacturer’s requirements. Do not exceed manufacturer’s total data line length requirement.

D. Panels shall be located so that they are readily accessible and not exposed to physical damage.

E. Panel locations shall be furnished with enough working space around panels to comply with the California Electrical Code.

F. Panels shall be securely fastened to the mounting surface by at least four points.

G. Unused openings in the cabinet shall be effectively closed.

H. Cabinets shall be grounded in accordance with Article 250 of the California Electrical Code, and manufacturer’s recommendations.

I. Lugs shall be suitable and listed for installation with the conductor being connected.

J. Conductor lengths shall be maintained to a minimum within the wiring gutter space. Conductors shall be long enough to reach the terminal location in a manner that avoids strain on the connecting lugs.

K. Maintain the required bending radius of conductors inside cabinets.

L. Clean cabinets of foreign material such as cement, plaster and paint.

M. Distribute and arrange conductors neatly in the wiring gutters.

N. Follow the manufacturer's torque values to tighten lugs.

O. Before energizing the panelboard, the following steps shall be taken:

1. Retighten connections to the manufacturer's torque specifications. Verify that required connections have been furnished.

2. Remove shipping blocks from component devices and the panel interior.

3. Remove debris from panelboard interior.

P. Follow manufacturers' instructions for installation.

3.03 OPERATING/SERVICE MANUALS

A. Service and Operation Manuals:

1. Submit operation and service manuals. Complete manuals shall be bound in flexible binders and data shall be typewritten or drafted.

2. Record drawings: Provide (3) printed and one electronic copy on flush media of as built documents in latest version of ACAD of the entire system; including, floor plans with equipment, and devices layouts and wiring, interconnections with other systems, conduit and cable runs, programmed configurations, sequence of operations, system labeling codes, system passwords, and other pertinent information.

3. Manuals shall include instructions necessary for proper operation and servicing of system and shall include complete wiring circuit diagrams of system, wiring destination schedules for circuits and replacement part numbers. Manuals shall include as-built cable Project site plot plans and floor plans indicating cables, both underground and in each building with conduit, and as-built coding used on cables. Programming forms of systems shall be submitted with complete information.

3.04 PROTECTION

A. Protect all work, equipment and components of the lighting control system until Substantial Completion.

3.05 TESTING

A. Set-up, commissioning and testing of the lighting control system, and OWNER instruction shall include:

1. Confirmation of system programming.

2. Confirmation of operation of individual relays, switches, occupancy sensors and daylight sensors.

3. Operation of system's features under normal and emergency operations.

4. Before energizing check and demonstrate in the presence of the Project Inspector that cables and wire connections are free from short circuits, ground faults, and that there is continuity, and necessary insulation.

5. Confirm system operations and functionality.

6. Check system interface response to other systems such as fire alarm and emergency power system conditions.

3.06 SPARE PARTS

A. Provide a minimum of five percent spare parts of each type of relay, sensors, switches, and peripheral devices.

3.07 CLEANUP

A. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

END OF SECTION

SECTION 26 12 00 - MEDIUM-VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Single and three phase individually mounted transformers and the transformer component of unit substation equipment operating at a voltage greater than 600 volts, for power and lighting applications. and medium-voltage transformers.

B. Related Requirements:

1. Division 01 - General Requirements.
2. Section 26 05 00: Common Work Results for Electrical.
3. Section 26 05 13: Basic Electrical Materials and Methods.
4. Section 26 05 26: Grounding and Bonding.
5. Section 26 05 33: Raceways, Boxes, Fittings, and Supports.
6. Section 26 05 16: Medium Voltage Cables, Splices and Terminations.
7. Section 26 13 16: Medium-Voltage Metal-Enclosed Load Interrupter.

C. Codes and Applicable Standards: Transformers shall comply with all applicable IEEE, ANSI, and NEMA Standards for medium voltage Dry-Type Transformers including those with solid cast and/or resin-encapsulated windings.

1. Department of Energy Policy Act of 2005 - Public Law 109-58.
2. California Energy Commission Appliance Efficiency Regulations.
3. California Building Code.
4. ANSI/NFPA70, National Electrical Code, as adopted by the State of California.
5. IEEE C57.12.01, General Requirements for Dry-Type Distribution and Power Transformers Including Those with Solid Cast and Resin-Encapsulated Windings
6. ANSI C57.12.51, Requirements for Ventilated Dry-Type Power Transformers, 501 KVA and Larger, Three-Phase with High-Voltage 601 to 34 500 Volts, Low Voltage 208Y/120 to 4160 Volts
7. ANSI C57.12.55, Dry-Type Transformers in Unit Installations, Including Unit Substations - Conformance Standard
8. ANSI/IEEE C57.98, Impulse Tests, Guide for Transformer (Appendix to ANSI/IEEE C57.12.90)
9. IEEE C57.12.91, Test Code for Dry-Type Distribution and Power Transformers

10. IEEE C57.94, Recommended Practice for Installation, Application, Operation and Maintenance of Dry-Type General Purpose Distribution and Power Transformers

11. IEEE C57.96, Guide for Loading Dry-Type Distribution and Power Transformers

12. NEMA ST 20, Dry Type Transformers for General Applications

13. OSHA 29 CFR 1910.145 Specification for Accident Prevention Signs and Tags

D. ACRONYMS

ANSI	American National Standards Institute
OAR	Owner Authorized Representative
CEC	California Electrical Code
EOR	Engineer of Record
IBC	International Building Code
IEEE	Institute of Electrical and Electronics Engineers
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association

1.02 SUBMITTALS

A. Provide in accordance with Division 01.

B. Shop Drawings: Include make, catalog number, dimensions, weight, KVA rating, percent impedance, finish, type, insulation class, design temperature and taps provided. Include regulation at 80 percent and 100 percent of full load, no-load loss, full-load loss, percent efficiency, percent impedance, noise level and continuous capacity rating. Provide point to point connection diagrams and elevation details.

C. Provide manufacturer’s data and inspection report that confirm compliance with the requirements of this section.

D. Provide a copy of the following test reports: Tests shall be performed on transformers, in accordance with IEEE C57.12.91. EOR shall review the reports for conformance with the specified criteria and applicable standards. Submit one copy for each set of shop drawings:

1. No-Load Losses.

2. Load Losses: Measurements shall be taken at multiple levels and plotted to show compliance with the specified criteria and applicable standards.

3. Turn Ratio.

4. Applied Potential (High-Pot).

5. Temperature Rise.

6. Induced Potential.

7. Sound Level.

8. Basic Impulse Insulation level (BIL).

9. Impedance.

10. Polarity and Phase Rotation.

11. Exciting Current.

12. Certified Test Report.

E. Installation Instructions: Submit manufacturer's complete package of printed installation instructions and connection diagrams.

1.03 WARRANTY

A. Transformers shall be warranted to be free from defects in materials, fabrication and execution for three years from date of substantial completion.

PART 2 - PRODUCTS

2.01 EQUIPMENT

A. Transformers manufactured by Square D, Siemens, General Electric, PowerSmiths, MGM, and Cutler Hammer or equal.

B. Transformers shall be substation type with side-wall primary and secondary terminations.

C. Transformers shall be solid-cast, dry-type construction, mounted in a ventilated enclosure. There shall be no exposed screws, bolts, or other fastening devices that are externally removable.

D. There shall be no openings through which foreign objects such as sticks, rods, wires, or the like might contact live parts. Screen ventilated spaces from rodents and foreign objects. Provide means for padlocking compartment door(s). Padlocked locations shall be equipped with Corbin CAT 60 padlocks.

E. The average temperature rise of the transformer windings shall not exceed 80 degrees C when the transformer is operated at full nameplate rating. The transformer shall be capable of carrying 100 percent of the nameplate KVA rating in a 40 degrees C maximum, 30 degrees C average ambient as defined by IEEE C57.12.01.

F. Terminations shall be side-wall mounted for close-coupling to high and low voltage switchgear sections (Primary connection points shall have NEMA standard termination lug holes).

G. The transformer shall be rated as indicated on Drawings. The transformer shall be furnished with two 2 ½ percent full capacity above normal and two 2 ½ percent full capability below normal primary taps. Sound level shall not exceed the maximum specified by NEMA TR-1 for the applicable KVA size of the transformer.

H. Primary and secondary windings shall be constructed of copper conductors. Primary and secondary phase windings for each phase shall each be separately cast as one rigid tubular coil, and arranged coaxially. Each cast coil shall be fully reinforced with glass cloth, and cast under vacuum to provide complete, void-free resin impregnation throughout the entire insulation system.

I. The transformer core shall be constructed of high grade, grain-oriented silicone steel laminations, with high magnetic permeability. Magnetic flux density is to be kept well below the saturation point. The core shall be cruciform in shape, with mitered joints to keep core losses, excitation current and noise level at a minimum. The outside surfaces of the core shall be protected against corrosion by painting with a suitable coating after assembly. Core dipping is not permitted.

J. The enclosure shall be constructed of heavy-gage sheet steel, minimum 12-gage. Ventilating openings shall be in accordance with NEMA and CEC standards for ventilated enclosures. The cabinet shall be furnished with a minimum of four hinged doors. The cabinet shall be furnished with door sills for easy panel installation.

   a. Outdoor units shall be furnished with a NEMA 3R enclosure.

K. The base shall be constructed to permit rolling or skidding in any direction, and shall be furnished with jacking pads designed to be flush with the transformer enclosure.

L. Transformers shall be free of partial discharge up to at least 1.2 times the rated line to ground voltage. High voltage coils shall be subjected to a partial discharge test to verify its partial discharge.

M. Each transformer to be installed under this section shall be sound tested at the factory. Contractor shall provide two copies of transformers tests reports for EOR review.

   a. Transformers up to 35 KVA shall be less than 40 decibels. Transformers 36 KVA or more shall be a minimum of five decibels below NEMA standards per unit.

N. Transformers shall be provided with vibration dampers consisting of Korfund, Mason, or Caldynamics rubber pad and Elastorib sheeting. Size and number of shock mounts shall be in accordance with manufacturer's recommendations.

O. Transformers shall be UL listed.

P. Verify all points of connection with the manufacturer’s requirements, instructions, or recommendations prior to installation. Actual dimensions, weights, clearances and installation requirements shall be verified and coordinated prior to commencement of work.

Q. Provide and install OSHA/CAL OSHA mandated bilingual (English and Spanish) hazard warning signs on all accessible equipment sides containing access doors and/or panels. The signs shall be a minimum of 14 inch by 10 inch in size and be constructed on an aluminum backing. Design of signs shall be OSHA 29 CFR 1910.145 compliant with the words DANGER HIGH VOLTAGE KEEP OUT. Signs shall be attached to its intended mounting surface with a minimum if ten evenly distributed pop rivets for metal surfaces or

tamper resistant screws on metal or other surfaces provided that protruding portion of screws if any is covered to eliminate the possibility of an injury.

PART 3 - EXECUTION

3.01 DELIVERY AND STORAGE

A. Deliver, storage, protect and handle products in accordance with the manufacturer’s recommendations.

3.02 INSTALLATION

A. Transformer core frame shall be installed level on shock absorbing pads with enclosure.

B. Mounting bolts shall be extended into pads only and shall not be in direct contact with building structural members. Install transformer ventilation openings not closer than six inches from any wall surface. Installation shall comply with CBC seismic design requirements.

C. Flexible jumpers shall be installed for grounding continuity from enclosure to conduits or bus ducts where required.

D. Transformers installed outdoors or below grade shall be installed on concrete pads as described under Section 03 3000: Cast-In-Place Concrete and as detailed in Drawings. Anchored bolts shall be tested to withstand 100 foot-pounds torque.

E. Install according to manufacturer's installation instructions.

3.03 VOLTAGE CHECK

A. Set taps on transformers as required providing satisfactory operating voltages with present loads energized, including new loads and any existing loads.

B. Provide instruments and accessories required to perform testing.

C. Follow manufacturer's instructions for checking output voltage and voltage tap changing.

3.04 PROTECTION

A. Protect the Work of this section until Substantial Completion.

3.05 CLEANUP

A. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

B. Repair scratched or marred surfaces affected during the execution of this work. Repaired surfaces shall match original finish.

C. Manufacturer to provide touch-up paint with delivery.

END OF SECTION

SECTION 26 13 16 - MEDIUM-VOLTAGE METAL-ENCLOSED LOAD INTERRUPTER

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

Medium voltage load interrupter metal enclosed switchgear, single or multiple section line-ups.

B. Related Requirements:

1. Division 01 General Requirements.
2. Section 03 30 00: Cast-In-Place Concrete.
3. Section 26 05 00: Common Work Results for Electrical.
4. Section 26 05 13: Basic Electrical Materials and Methods.
5. Section 26 05 16: Medium-Voltage Cables, Splices and Terminations.
6. Section 26 05 26: Grounding and Bonding.
7. Section 26 05 19: Low-Voltage Wires (600 Volt AC).
8. Section 26 10 00: Service Entrance.
9. Section 26 11 00 Load Center Unit Substations.
10. Section 26 12 00: Medium-Voltage Transformers.
11. Section 26 13 16: Medium-Voltage Metal-Enclosed Load Interrupter.
12. Section 26 24 13: Switchboards.
13. Section 31 23 13 Excavation, and Fill.

C. Related Standards:

1. ANSI C37.57 – Metal-Enclosed Interrupter Switchgear Assemblies - Conformance Testing.
2. ANSI C37.58 – Indoor AC Medium-Voltage Switches for Use in Metal-Enclosed Switchgear - Conformance Test Procedures.
3. ANSI C37.20.3 – Standard for Metal-Enclosed Interrupter Switchgear (1 kV–38 kV).
4. IEEE-ANSI C37.22 – Preferred Ratings and Related Required Capabilities for Indoor AC Medium-Voltage Switches Used in Metal-Enclosed Switchgear.

5. IEEE 551 – Recommended Practice for Calculating AC Short-Circuit Currents in Industrial and Commercial Power Systems.

6. IEEE 1584 – Performing Arc-Flash Hazard Calculations.

7. IEEE 3002 – Recommended Practice for Conducting Short-Circuit Studies and Analysis of Industrial and Commercial Power Systems

8. NEMA SG5 – Power Switchgear Assemblies

9. NEMA SG6 – Power Switching Equipment.

1.02 SUBMITTALS

A. Provide in accordance with Division 01.

B. List of Materials: Submit a complete list of proposed materials.

C. Shop Drawings: Provide detailed and dimensioned Shop Drawings indicating kind, weight and thickness of materials, method of fitting and fastening parts together, location and number of ancillary components fitting suspension and fastening section(s) in place. Provide wiring diagrams for power distribution and connections.

1. Include a front elevation indicating dimensions and locations of equipment, make, kind and size or capacity of equipment and bussing, barriers, nameplate inscriptions, finish, total weight and size, and locations and sizes of anchor bolts.

D. Prior to start of construction; provide copies of required test reports, proof of UL listing and compliance with IEEE and ANSI applicable industry standards.

E. Installation Instructions: Submit manufacturer's written installation instructions including recommendations for handling, protection, and storage of equipment.

F. Submit Fault Current, Coordination, and Arc-Flash reports based on installed conditions and equipment.

1.03 SUBSTITUTIONS

A. Material and products substations that deviate from these requirements shall not be accepted without written approval from OWNER’S Design Standards Section and Maintenance and Operations Technical Unit. When deviating or substituting equipment, the CONTRACTOR shall submit a substitution request form that states reasons for the request and benefits to OWNER; as well as compliance with all applicable codes and industry standards.

1.04 QUALITY ASSURANCE

A. Equipment shall be tested and approved in accordance with applicable industry standards including those listed under article 1.02.

B. Provide copies of equipment tests for metal-enclosed interrupter switchgear (ANSI), and NEMA SG6 power switching equipment.

C. Equipment shall comply with California Electrical Code.

D. CONTRACTOR shall submit proof that personnel working in the installation are properly trained and certified for working/ installing medium voltage power distribution equipment.

E. Two weeks prior to final inspection, submit the following:

1. Certification by the manufacturer that installed equipment conforms to the requirements of the drawings and specifications.

2. Certification by the CONTRACTOR that equipment has been properly installed, adjusted, and tested.

1.05 WARRANTY

A. Provide the following warranties:

1. Manufacturer shall provide five-years material warranty.

2. CONTRACTOR shall provide two-years installation warranty.

PART 2 - PRODUCTS

2.01 LOAD INTERRUPTER SWITCHGEAR

A. Switches shall be quick-make, quick-break, three-pole, two-position with a stored energy spring mechanism to provide quick switch operation independent of the handle speed. A viewing window shall be installed in switch enclosure and located to enable visible inspection of switch poles from outside enclosure.

B. Complete metal enclosed switchgear shall be rated as indicated on Drawings with fault close; momentary ratings capable of withstanding short-circuit stresses.

C. High-voltage fuses and non-disconnecting fuse mountings shall be accessible only through a separate door mechanically interlocked with load break switch, to insure the switch is in open position when fuses are accessible. A key interlocking system shall also be provided to prevent fuse access door from being opened unless switch is open, and to prevent switch from being closed unless fuse access door is closed. Switch designs with full height fuse access doors shall have a solid barrier covering area of main cross bus and/or line side of switch. Metal screen barriers are not permitted. Energized parts shall not be within normal reach of opened doorway. Four single full-length inter-phase barriers shall isolate three phases of the switch from each other and from enclosures. Fuses shall be current limiting type of self-contained design to limit available fault current stresses on system. Fuses shall be affixed in position with provisions for removal and replacement from front of gear without use of special tools. Provisions for padlocking in open and closed position shall be provided.

D. Utility company metering section shall be furnished with mounting and wiring instrument transformers and meters, as required by the serving utility company.

E. Enclosure frame and internal barriers shall be fabricated of code gage and finished with two coats of medium gray, ANSI No. 451, paint applied over a rust-inhibiting phosphate primer.

F. Power Distribution System Reports: The required reports shall be performed using an industry standards software such as SKM System Analysis Inc., ETAP Powering Success, EasyPower, or District approved equal. The following information must be submitted:

1. CONTRACTOR shall provide a complete selective coordination report of the installed power distribution system breakers and disconnects in compliance with applicable codes and IEEE standard.

2. CONTRACTOR shall provide an Arc-Flash study report in accordance to code and applicable IEEE standards. The report shall indicate trip times for protective device(s) settings, arcing fault current values, and incident energy and flash boundaries. Report shall indicate clothing requirements for each piece of equipment.

3. CONTRACTOR shall provide a Short Circuit Report of the installed power distribution system in compliance with codes and applicable IEEE Standards.

2.02 SWITCHGEAR CONSTRUCTION

A. Switch bays shall be separately constructed cubicles assembled to form rigid freestanding units. Adjacent bays shall be securely bolted together to form an integrated rigid structure. Top and rear covers shall be removable. Individual units shall be braced to prevent distortion. Installation shall adhere to seismic requirements of CBC.

B. Provisions shall be furnished to allow for convenient extension of both main bus and ground bus to adjacent bays, which may be added in future. Main crossover bus is to be furnished and supported from top of enclosure on NEMA glass insulators. Ground bus shall run continuously through entire line-up and shall be securely fastened to the steel frame of each bay.

C. Metal enclosed gear shall be fully assembled and tested at factory prior to shipment. Large line-ups shall be split to permit normal shipping and handling as well as for ease of installation at the Project site.

D. Outdoor units shall be furnished in NEMA 3R enclosures designed with sloped drip-proof roofs. Cubicles shall be provided with door-in-door construction. Outer doors shall open to normal switch doors and operating handles. Switch-operating handles shall not be exposed to weather and will be operable regardless of weather conditions. Provide the front with a bulkhead type door along with three-point latch and vault type handle with provisions for padlocking. Cubicles are to be designed to allow front and rear access and do not require routing of line side or load side connections in front of switch/fuse compartment. Padlocks shall be provided for doors and keyed to Corbin No. 60 keys.

PART 3 EXECUTION

3.01 INSTALLATION

A. Cable terminations shall be as indicated in Section 26 05 16 - Medium-Voltage Cables, Splices, and Terminations.

B. Furnish Spare Fuses: One spare fuse shall be furnished for each fusible switch installed. Spare fuse shall be of type and rating as those installed.

C. Where free-standing equipment is installed at exterior locations or in locations below grade, concrete pads shall be provided as described under Section 03 3000: Cast-In-Place Concrete. Anchor bolts for freestanding equipment shall be designed to meet code seismic requirements. Equipment shall be anchored to new slabs with four ½ inch by 3 ½-inch expansion bolts per section; ½ inch anchored bolts shall be tested to withstand 100 foot-pounds of torque (Switchgear must be installed “Level” to ensure all doors open and close without being forced).

D. Follow manufacturer's instructions for receiving, handling, storage and installation of switchgears.

E. Provide two sets of manufacture’s recommended service and maintenance documents.

3.02 PROTECTION

A. Protect the Work of this section until Substantial Completion.

3.03 CLEANUP

A. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

END OF SECTION

SECTION 26 22 00 - LOW-VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: This specification covers single-phase and three-phase general purpose individually mounted dry-type transformers, 600 V maximum, for power and lighting applications. It includes transformers as specified and as indicated on Drawings.

B. Work, material or equipment shall comply with the codes, ordinances and regulations of the local government having jurisdiction, including the regulations of serving utilities and any participating government agencies having jurisdiction.

C. Related Requirements:

1. Division 01 - General Requirements.
2. Section 26 05 00: Common Work Results for Electrical.
3. Section 26 05 13: Basic Electrical Materials and Methods.
4. Section 26 05 26: Grounding and Bonding.
5. Section 26 05 19: Low-Voltage Wires (600 Volts AC)
6. Section 26 05 33: Raceways and Boxes, Fittings and Supports.
7. Section 26 08 00: Electrical Systems Commissioning.
8. Section 26 26 00: Power Distribution Units.
9. Division 27: Communications.

D. Codes and Applicable standards: Products and installation shall meet or exceed the latest edition of the following standards.

1. ANSI/IEEE C57.96, Distribution and Power Transformers, Guide for Loading Dry-Type Transformers; Appendix to ANSI C57.12 Standards.
2. Department of Energy, Energy Act of 2005.
3. International Electrical Code adopted by the State of California.
4. ANSI/NEMA 250 Enclosure for Electrical Equipment (1000 Volts Maximum).
5. IEEE C57.12.91, Test Code for Dry-Type Distribution and Power Transformers.

6. IEEE C57.110 – IEEE Recommended Practice for establishing liquid-filled and dry-type power and distribution transformer capability when supplying nonsinusoidal load currents.

7. 1100-IEEE Recommended Practice for Powering and Grounding Sensitive Electronic Equipment.

8. NEMA standard 20, Dry-Type Transformers for General applications.

9. UL 506, Specialty Transformers.

10. UL 1561, Dry-Type General Purpose and Power Transformers.

11. NEMA TP-1, Guide for Determining Energy Efficiency for Distribution Transformers.

12. NEMA TP-2, Standard Test Method for Measuring the Energy Consumption of Distribution Transformers.

13. NEMA TP-3, Standard for the Labeling of Distribution Transformer Efficiency.

14. CSA 802.2-00 Minimum Efficiency Values for Dry Type Transformers

15. California Building Code (CBC)

16. Tri-axial shake test results conducted in accordance with AC156 test protocol.

17. California Electric Code

E. No requirement of these drawings and specifications shall be construed to void any of the provisions of the above standards. Any conflicts or changes required to the contract documents in order to obtain compliance with applicable codes shall be brought to the immediate attention of the Owner Authorized Representative by the CONTRACTOR.

F. ACRONYMS

ANSI	American National Standards Institute
AOR	Architect of Record
CEC	California Electrical Code
EOR	Engineer of Record
IBC	International Building Code
IEEE	Institute of Electrical and Electronics Engineers
NEC	National Electrical Code
NEMA	National Electrical manufacturers Association

1.02 DESIGN REQUIREMENTS

A. Premium Efficiency transformers with internal losses at 35 percent loading reduced by 30 percent when using temperature and material correction factor to 75 degrees C per NEMA Standard TP1

B. Load Mix: Transformer shall be UL 1561 listed to feed a mix of equipment load profiles such as computer without detracting or significant degradation of efficiency.

C. The transformer shall be labeled with a K-13 Rating in accordance with UL 1561 35.21 and 34.2.

D. Transformer shall be certified as required by the California Energy Commission, Title 20 – Appliance Efficiency Regulations, unless otherwise EXEMPT under 110.10(a).

E. Construction: Windings shall be continuous wound copper with brazed or welded terminations.

1. Insulation and Varnish Systems: Epoxy Polyester impregnation

2. Terminals, including those for changing taps must be readily accessible by removing a front cover plate.

F. Performance of transformers shall meet or exceed the requirements of applicable codes and standards, the DOE Energy Policy Act of 2005 - Public Law 109-58 and the latest requirements of the California Energy Commission Appliance Efficiency Regulations. In addition; transformers shall be designed to an efficiency standard higher than the lowest legal standard for the purpose of contributing to LEED Energy and Atmosphere (Optimized Energy Performance) and Utility Rebates.

G. Transformers shall be self-cooled type with 220 degrees C. insulation and a maximum temperature rise of 130 degrees C. under continuous full load conditions with an ambient of 40 degrees C.

H. Transformers shall be furnished with four 2.50 percent (two above and two below normal voltage) taps. Windings shall be of fire-resistant type, designed for natural convection cooling through normal air circulation.

I. Core mounting frames and enclosures shall be of welded and bolted construction with sufficient mechanical strength and rigidity to withstand shipping, installation, and short circuit stresses.

J. Enclosure cover plates shall be sheet steel, captive bolted to enclosure framework. Enclosure shall provide suitable ventilating openings with rodent-proof screens, NEMA 1 enclosure. Enclosure shall be provided with lifting lugs and jacking plates as required. Transformers installed outdoors shall be provided with weatherproof NEMA 3R enclosure and weatherproof kit.

1. Submit rodent-proof screen sample for OWNER’s approval.

K. Transformers shall be furnished complete with mounting channels and mounting bolts. Metal parts, excepting cores and core mounting frames shall be furnished clean, rust-proofed, and provided with a coat of an inert primer.

L. Transformers up to 35 KVA shall not exceed 40 decibels. Transformers 36 KVA or more shall be a minimum of 5 decibels below NEMA standards per unit. Transformers shall be provided with vibration dampers consisting of California Dynamic, Mason Industries, Korfund or equal neoprene mounting pad and Elastorib sheeting. Size and number of shock mounts shall be in accordance with manufacturer's recommendations.

M. Transformers shall be UL listed.

N. Each transformer to be installed under this section shall be sound tested at the factory. CONTRACTOR shall provide two copies of transformers tests reports for EOR's review.

O. Equipment shown on drawings to scale is approximate only and based upon a general class of equipment specified. The CONTRACTOR shall verify dimensions and clearances prior to commencement of work.

P. Verify points of connection with the manufacturer's requirements, instructions, or recommendations prior to installation. Actual dimensions, weights, clearances and installation requirements shall be verified and coordinated by the CONTRACTOR.

Q. K-rated transformers shall be type NL-UL.

1. Electrostatic shield.

2. NLP series shall have a maximum sound level of 3 dB below NEMA standards.

3. Double-size neutral terminal.

4. Additional coil capacity to compensate for higher non-linear load loss.

5. Heavy gage ventilated indoor enclosures (provide weather shields where installed indoors).

6. K-rated transformers shall meet other requirements of this section.

R. NLP-UL for projects where the non-linear loads as indicated on drawings and be equipped with the following features:

1. Electrostatic shield.

2. NLP series shall have a maximum sound level of 3 dB below NEMA standards.

3. Double-size neutral terminal.

4. Additional coil capacity to compensate for higher non-linear load loss.

5. Heavy gage ventilated indoor enclosures (provide weather shields where installed indoors).

6. K-rated transformers shall meet other requirements of this section.

1.03 SUBMITTALS

A. Provide submittals in accordance with Division 01.

B. Shop Drawings: Include make, catalog number, dimensions, weight, KVA Rating, Percent Impedance, finish, type, insulation class, design temperature, sound levels, efficiency and taps provided. Include regulation at 80 percent and 100 percent of full load, no-load loss, full-load loss, percent efficiency, percent impedance, noise level and continuous capacity rating.

C. Provide manufacturers data and inspection report that confirms transformers compliance with UL 1561, DOE, and NL-UL or NLP-UL (Refer to 1.02.Q).

D. Provide a connection schematic diagram.

E. Provide the following tests reports: Project Inspector will review the reports for conformance with specified criteria, and compliance with the applicable standards. Submit one copy for each set of shop drawings being submitted.

1. Load Losses: Measurements shall be taken at multiple load levels and plotted to show compliance with specifications and correlated to efficiency curve for the transformer size and type.

2. Provide No-Load and Total Losses report.

3. Applied Voltage.

4. Temperature Rise.

5. Induced Voltage.

6. Sound Level.

7. Impulse Test.

8. Manufacturer’s nonlinear load test representing real world load mix. Transformers not meeting this requirement shall not be installed.

F. Submit harmonics test plan as follows:

1. NEMA ST-20.

a. Open Circuit Test (no load losses):

1) Use for both Linear and non-Linear.

2) Measure Power.

b. Short Circuit Test (load losses):

1) Short Primary Winding: Linear Test complete with linear profile through secondary winding.

c. Non-Linear Test.

1) Complete with non-linear profile through secondary windings.

2) Measure Power.

d. Provide data and graph efficiency:

1) Graph-1 – Linear Loads 0 to 100 Percent Loads.

2) Graph 2 – Non-Linear Profile K-13 0 to 100 Percent loads.

2. Test Plans measuring Power In and Power Out will not be accepted since procedures are not covered by any standard.

1.04 SUBSTITUTIONS

A. Transformers that deviate from these requirements shall not be accepted without written approval from OWNER'S Design Standards and Maintenance and Operations Technical Units. When deviating or proposing substitutions the following information shall be submitted:

1. Substitution request form substantiating reasons for the deviation and benefits to the OWNER.

2. Proposed substitutions requests shall provide proof of compliance with transformers characteristics indicated in this specifications section.

B. Submittals must comply with contract general provisions.

1.05 QUALITY ASSURANCE

A. Installation shall be performed by State approved/ certified electricians.

B. Transformers shall be listed and approved for the intended application by Underwriter's Laboratories (UL), or other Nationally Recognized Testing Laboratory (NRTL), and in compliance with applicable industry standards and codes, including those mentioned under REFERENCES.

C. Provide labor, engineering, design, testing, supervision, material and equipment required.

D. Equipment shall be new and high quality. Manufacturer shall have been continuously manufacturing distribution transformers for at least 10 years.

1.06 COMMISSIONING

A. A Commissioning Services Provider (CxSP) retained by the OWNER will lead and provide Commissioning (Cx) of power distribution systems and assemblies, including

submittal review, installation, testing, documentation, and training as indicated in section 26 08 00 – Electrical Systems Commissioning.

B. CONTRACTOR shall follow the commissioning responsibilities stated in Section 01 91 13, General Commissioning Requirements.

C. CONTRACTOR shall provide all tools and personnel, and perform start-up, prefunctional and functional performance testing in the presence of the OWNER's Commissioning Services Provider.

1.07 WARRANTY

A. Provide a one-year labor warranty.

B. Transformers shall be warranted to be free from defects in materials and fabrication for a period of three years from the date of substantial completion.

C. Warranty period begins at project acceptance for beneficial occupancy.

D. Warranty exclusions for third party components is not acceptable.

PART 2 - PRODUCTS

2.01 EQUIPMENT

A. Transformers manufactures Siemens, Square D, General Electric, PowerSmiths, MGM, Cutler Hammer, or equal approved by OWNER.

B. There shall be no openings through which foreign objects such as sticks, rods, wires, or the like might enter and contact live parts. Provide means for padlocking compartment doors.

1. Connection terminal points shall be bottom fed and located as far as possible below vent openings, or below top connections.

2. Terminals shall be protected from external/foreign objects contact.

PART 3 - EXECUTION

3.01 DELIVERY AND STORAGE

A. Deliver, storage, protect and handle products in accordance with the manufacturer's recommendations.

3.02 INSTALLATION

A. Transformer core frame shall be installed level on shock absorbing pads within enclosure. Comply with seismic requirements of CBC.

B. Mounting bolts on floor mounted transformers shall be extended into pads only and shall not be in direct contact with building structural members.

C. Flexible jumpers shall be installed for grounding continuity from enclosure to conduits or bus ducts where required.

D. Transformers installed outdoors or below grade shall be mounted on concrete pads as specified in Section 03 30 00: Cast-In-Place Concrete.

E. Install transformer ventilation openings not closer than 6 inches from wall surfaces.

F. Do not install transformers in corrosive environments such as swimming pool pump and boiler rooms, or similar areas.

3.03 VOLTAGE CHECK

A. Set taps on transformers to provide satisfactory operating voltages with present loads energized, including new loads and existing loads. A check shall be performed in the presence of the Project Inspector at a panel fed from each transformer, which is farthest from transformer. Voltages at transformers ranging from 118 to 122 volts inclusive, for 120-volt systems and proportionately equivalent for higher voltage systems are permitted.

B. Provide instruments and accessories required to perform checks. Voltmeters shall be accurate within .075 percent or one percent and shall have scales permitting voltage readings to be performed on upper half of scale. Calibration of the meters shall be observed by the Project Inspector.

C. Adjust transformer taps under full load operating conditions, to provide normal operating voltages at the loads.

3.04 PROTECTION

A. Protect the Work of this section until Substantial Completion.

3.05 CLEANUP

A. Remove rubbish, debris and waste materials and legally dispose of off Project site.

B. Repair scratched or marred surfaces affected during the execution of work. Repair surfaces shall match original finish.

END OF SECTION

SECTION 26 24 13 - SWITCHBOARDS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Main switchboard, including metering facilities required by the utility company.

B. Related Requirements:

1. Division 01 - General Requirements.
2. Section 03 30 00: Cast-In-Place Concrete.
3. Section 26 05 00: Common Work Results for Electrical.
4. Section 26 05 13: Basic Electrical Materials and Methods.
5. Section 26 05 26: Grounding and Bonding.
6. Section 26 05 19: Low-Voltage Wires (600 Volt AC).
7. Division 27: Communications.
8. Division 28: Electronic Safety and Security.

C. Related Industry Standards: The most current version of the following industry standards.

1. ANSI/NEMA 250 – Enclosures for Electrical Equipment (1000 Volts Maximum).
2. California Electrical Code (CEC).
3. IEEE C57.12.28 – Standard for Pad-Mounted equipment Enclosure Integrity.
4. IEEE 551 - Recommended Practice for Calculating AC Short-Circuit Currents in Industrial and Commercial Power Systems.
5. IEEE 1584 – Performing Arc-Flash Hazard Calculations.
6. UL/ANSI 891 – Standard for Safety Switchboards.

1.02 SUBMITTALS

A. Provide in accordance with Division 01.

B. Shop Drawings:

1. Include a front elevation indicating dimensions and locations of equipment on switchboard, make, kind and size or capacity of equipment and bussing, location of each service conduit entering switchboard, barriers, nameplate inscriptions, finish, total weight and size of switchboard and locations and sizes of anchor bolts.

C. Fault Current, Coordination and Arc-Flash Reports: the following reports shall be prepared using SKM Systems Analysis, ETAP Powering Success, EasyPower, or equal.

1. Provide a short-circuit and coordination report signed and stamp by a registered electrical engineer. Studies shall be in accordance with applicable IEEE guidelines. Submit two copies of each study for review prior to ordering and installing equipment.

2. Provide a system coordination report for main and branch circuit protective devices including transformers secondary protective devices. Study shall be recorded on log paper. The circuit protective devices shall be set based on the coordination study. A final written record of protective device settings shall be submitted.

3. Provide a complete arch-flash report based on installed equipment, and feeders' sizes and lengths. Prepare the report in accordance with code requirements and IEEE 1584 standard. The report shall indicate trip times for protective device(s) settings, arcing fault current values, and incident energy and flash boundaries. The arc-flash report shall indicate clothing requirements for each piece of equipment.

4. Provide installation detail and seismic anchorage notes for switchboards.

PART 2 - PRODUCTS

2.01 SWITCHBOARDS

A. General Description: Switchboards shall be product of W.A. Benjamin Electric, Cuttler Hammer, General Electric, Siemens, or equal, and shall conform to the following requirements:

1. Complete assembly, including steel framing and covers, bus system, and breaker mounting, shall satisfy applicable provisions of UL 891 and NEMA PB-2 and the California Electrical Code for low-voltage distribution switchboards. Switchboards shall be furnished with UL labels.

2. Switchboards shall be floor standing, dead front, dead rear, line bussed, front operated and connected, circuit-breaker type, unless otherwise indicated and shall contain equipment indicated and specified. Switchboard shall be complete with pull, service, and distribution sections as required.

3. Required equipment shall be enclosed in fully interchangeable die formed steel sectional cabinets with top and bottom plates and required braces and gussets so that cabinets will be absolutely rigid, plumb and uniform in size. Each cabinet shall be a separate and independent unit with assembly holes die-stamped or jig drilled; openings for interconnections shall be so placed that cabinet can be located in any

position in assembly without drilling or cutting holes on job. Deliver switchboard to Project site in completely assembled sections and provide required assembly bolts and blanking plates. Front plates and doors shall be of not less than 12 gage furniture steel, completely removable, secured to cabinet with machine screws, with cup washers uniformly and symmetrically spaced. Provide hinged wire gutter covers for distribution sections. Equipment shall meet NEMA and UL standards.

4. Main circuit breaker or main fusible switch shall be as follows:

   a. Main circuit breakers shall be automatic, one-piece molded-case, trip-free, common trip, quick-make, quick-break, thermal-magnetic with solid state trips, bolted to bus with frame size and trip ratings as indicated on drawings. Voltage, amperage ratings and number of poles shall be as indicated on breakers. Main breaker shall provide a minimum short-circuit interrupting capacity as determined by utility company. Provide shunt-trip and integral ground fault devices, as indicated on drawings. Breakers shall be furnished with lockout provisions.

   b. Main fusible switch 800 amps or larger ampacity shall be high pressure contact, stored energy, quick-make/quick-break operation, with current limiting fuses, as indicated on Drawings. Provide shunt-trip, and integral ground fault devices, as indicated on Drawings. Were required, switches shall be motor operated and be furnished with an electrical trip mechanism piloted by output of ground fault sensing circuitry. Switch shall be furnished with lockout provisions.

5. Feeder circuit breakers shall be automatic, one-piece molded-case, trip-free, common trip, quick-make, quick-break, thermal-magnetic or solid-state type bolted to bus, with handles clearly indicating tripped position. Breakers shall be furnished with a single handle with no tie-bar. Voltage, amperage, and number of poles shall be as indicated on Drawings. Breaker ratings shall be on handle or label. Breakers shall be furnished with lockout provisions approved by the State of California for padlocking and shall provide a minimum symmetrical short-circuit interrupting rating, as indicated on Drawings. Series rated circuit breaker combinations are not acceptable.

6. Fusible feeder switches shall be quick-make, quick-break, voltage rating and number of poles as indicated on Drawings, with visible blades and dual horsepower ratings. Switch handles shall physically indicate on and off positions. Switches shall be lockable only in off position and accept three industrial type heavy-duty padlocks. Switch covers and handles shall be interlocked to prevent opening in on position. Provide means to permit authorized personnel to release interlock for inspection purposes. Switches shall be equipped with Class R current limiting fuses or dual element fuse of size and capacity indicated on Drawings.

7. Utility metering provisions shall meet requirements of serving utility and shall be furnished with necessary fittings.

8. Provide switchboard silver-plated copper bus bars of same capacity as main breaker, or as indicated on Drawings, between current transformer and main section and distribution sections; also, full height of breaker space in distribution

portions. Copper bus shall have current density of 1000A per square inch of cross section. Bus structure shall be free-fitted and shall have sufficient strength to withstand short-circuit as indicated on drawings. Connections shall be securely bolted together with corrosion-resistant plated carbon steel, minimum grade five machine screws secured with constant pressure-type locking devices. Bus bar bracing shall be designed to withstand maximum available short-circuit current. Connections for cables to circuit breakers, switches and motor control devices shall be heavy-duty mechanical pressure type terminal lugs. Provide service cable lugs as required by utility company. Cables and internal wiring shall be supported with suitable cleats.

9. Switchboard distribution sections shall be furnished with full height bussing. Unused spaces shall be provided with blank covers. Switchboards, as complete units, shall be given single short-circuit current ratings by manufacturer. Such ratings shall be established by actual tests by manufacturer, in accordance with UL specifications, on equipment constructed similarly to the furnished switchboard.

10. Provide a large nameplate identifying switchboard, indicating service voltage, originating power source, function and current rating. Nameplate shall be furnished with 3/16-inch engraved black letters on white background. Name plate shall be mechanically fastened to switchboard.

11. Provide labels for circuit breakers, disconnect switches, and or other disconnecting means in switchboards. Labels shall be a P-Touch type or equal, with a minimum width of 3/8 inch with black letters on white background. Label shall indicate name of load served, name or room number and if in different building, name of building. If equipment is installed in same room as source, label should indicate source name and “in this room”.

12. Paint cabinets, framework and plates inside and out with one coat of rust-resistant metal primer and one coat of gray enamel, baked on, or lacquer sprayed on.

13. Manufacture boards according to reviewed Shop Drawings. Switchboard shall meet requirements of legally constituted authorities having jurisdiction, and respective serving utility.

14. Switchboards installed outdoors shall be weatherproof NEMA Type 3R enclosure. Enclosure construction shall be formed of code gage galvanized steel with ANSI No. 61 gray enamel finish. Heavy-duty, three-point latching, vault type door handles with padlocking provisions shall be furnished on doors. Padlocks shall be furnished keyed to Corbin No. 60 keys. Switchboards installed outdoors shall be specifically required to maintain service during extreme outdoor ambient temperatures of a minimum of 150 degrees Fahrenheit in NEMA Type 3R enclosures.

15. For grounded wye electrical service switchboards rated more than 150 volts, to ground and 1,000 amperes or more, provide ground fault protection for main protective device. Ground fault protection shall be UL listed, with ground sensor encircling phase conductors and neutral conductors integral with the main protective device. Provide testing of ground fault protection system by an

independent recognized testing laboratory. Testing lab shall provide necessary testing equipment at the Project site and perform a certified test on ground protection system in presence of the Project Inspector. The ground fault setting shall be selected to coordinate with downstream circuit protective devices. Verify that the system neutral is grounded at the service entrance switchboard only, except neutrals of step-down distribution transformers. For branch circuit protective devices, rated 800 amps or more, provide ground fault protection where shown on the drawings, or as described above, for main protective device. Coordinate settings with main protective device ground fault protection.

16. In main and distribution switchboards provide a multifunctional digital meter with true RMS measured Amperes (each phase and neutral) Volts (line-to-line and line-to-neutral), Power Factor, Frequency, VA, VAR, Watts, KWH, KVARH, KVAH, voltage/current unbalance, and demand metering: W, VAR, Amperes, VA. Meter to have a front mounted RS232 port to allow programming and meter values via laptop computer and supplied software. The meter shall be GE Multiline PQM with BACnet translator capabilities; equal or better meters will be acceptable with District's approval only. Contractor shall supply the metering software and electronic key to owner.

17. Connections to bussing shall be securely bolted together with corrosion-resistant plated carbon steel, minimum grade five machine screws secured with constant pressure-type locking devices.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Switchboards shall be located so that they are readily accessible and not exposed to physical damage.

D. Switchboard locations shall provide sufficient working space around the switchboard to comply with the California Electrical Code.

E. Switchboards shall be securely fastened to the mounting surface.

F. Switchboard cabinets shall be grounded as specified in Article 250 of the California Electrical Code.

G. Conduits shall be installed so as to prevent moisture or water from entering and accumulating within the enclosure.

H. Lugs shall be suitable and as required for installation with the conductor being connected.

I. Conductor lengths shall be maintained to a minimum within the wiring gutter space. Conductors shall be long enough to reach the terminal location in a manner that avoids strain on the connecting lugs.

J. Maintain the required bending radius of conductors inside the cabinet.

K. Distribute and arrange conductors neatly in the wiring gutters.

L. Tightening the wire lugs or conductor connections shall be performed in the presence of the Project Inspector. Torque values shall be those recommended by manufacturer.

M. Remove shipping blocks from component devices.

N. Manually exercise circuit breakers to verify they operate freely.

O. Remove debris from switchboard interior.

P. Follow manufacturer's instructions for installation.

Q. Furnish one spare fuse for each fusible switch installed. Spare fuses shall be of the same type and rated as those installed.

R. Do not install in highly corrosive environments such as pool equipment, boiler, chemical and corrosive materials storage rooms, and similar areas. When equipment is installed in such areas, it shall be labeled and listed for the application.

S. Switchboard equipment and system components shall be free from short circuits and grounds, other than required grounds. The contractor shall be responsible for the testing of bolted electrical connections, and perform insulation resistance tests on each bus section, phase-to-phase and phase-to-ground for one minute in accordance with requirements stated in NETA-ATS 2007 table 100.1. Test shall be performed in the following manner:

1. Utilize the services of an approved independent testing laboratory to perform megger time-resistance insulation testing of bussing, circuit breakers and/or fused switches. The fused switches shall be equipped with fuses or temporary jumpers in place of fuses. Breaker and fused switches shall be tested in the closed position. No wiring shall be connected to the line or load side of the switchgear during testing.

    a. Provide calibration program records to assure the testing instruments to be within rated accuracy. The test equipment accuracy shall be in accord with the requirements stated by the National Institute of Standards and Technology (NIST).

    b. Test equipment shall be provided with a label stating the date of last calibration. As a minimum the equipment shall have been calibrated within the past 12 months.

    c. Test reports shall include the following:

        1) Identification of the testing organization.

        2) Equipment identification.

        3) Ambient conditions.

        4) Identification of the testing technician.

5) Summary of project.

6) Description of equipment being tested.

7) Description of tests.

8) Test results.

9) Analysis, interpretation and recommendations.

1. Perform tests in the presence of the Project Inspector.

2. During testing, provisions shall be made to prevent damage to solid state components, or electronic equipment such as TVSS equipment that may be tied onto switchboard bussing.

3. Test results shall meet manufacturer's recommendations or NETA ATS- 2007 recommendations, whichever is more stringent.

3.02 PADS AND ANCHORING

A. Where free-standing equipment is installed at exterior locations or in locations below grade, concrete pads shall be provided as specified in Section 03 3000: Cast-In-Place Concrete.

B. Where a utility meter is installed in a switchboard, concrete pad shall extend three feet from face of switchboard door or board, whichever is greater. Concrete pad installation shall comply with electric utility company requirements.

C. Anchor bolts for freestanding equipment shall meet CBC Seismic design requirements, and manufacturer's installation recommendations. The more stringent requirements will be enforced.

D. Project Record Documents: Provide project record drawings of switchboards as installed, indicating main and branch circuit ratings, circuit numbers and part numbers.

E. For ground fault relays and sensors, the following information shall be provided:

1. Certified Calibration and Acceptance Test.

2. Installation Instructions.

3. Operating Instructions.

4. Maintenance Instructions.

5. Replacement Parts List.

6. Final Test Report.

F. Test information shall be submitted to the Architect. Nameplates may be fabricated of engraved laminated plastic or etched metal and shall be permanently attached with escutcheon pins or screws.

3.03 PROTECTION

A. Protect the Work of this section until Substantial Completion.

3.04 CLEANUP

A. Remove rubbish, debris, and waste materials and legally dispose of off Project site.

END OF SECTION

SECTION 26 24 16 - PANELBOARDS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Lighting and power distribution facilities, including panelboards.

B. Related Requirements:

1. Division 01 - General Requirements.

2. Section 26 05 00: Common Work Results for Electrical.

3. Section 26 05 13: Basic Electrical Materials and Methods.

4. Section 26 26 00: Power Distribution Units.

5. Section 26 50 00: Lighting.

6. Division 27: Communications.

7. Division 28: Electronic Safety and Security.

1.02 SUBMITTALS

A. Provide in accordance with Division 01.

B. Shop Drawings: Include a front elevation indicating cabinet dimensions, make, location and capacity of equipment, size of gutters, type of mounting, finish, and catalog number of locks. General layout of internal devices, wiring drawings with wire numbers and device connections, vendor cut sheets of devices in enclosure and bill of materials listing description, manufacturer, part number, and quantity of items shall be included.

C. Installation Instructions: Submit manufacturer's written installation instructions.

1.03 DESIGN REQUIREMENTS

A. Panelboards:

1. Panelboards shall be wall-mounted, enclosed safety type with 120/240 volt, three-wire solid neutral 277/480 volt, four-wire or 120/208 volt, four-wire solid neutral mains as indicated on Drawings or specified. First panelboard of each building shall be provided with main or sub-feeder circuit breakers where so indicated.

2. Single pole branches shall be molded case, thermal magnetic circuit breakers with inverse time delay, trip free, quick-make, quick-break mechanism and silver alloy contacts. Circuit breakers shall be fully rated, with ampere rating marked on handle and shall indicate on/off and tripped positions. Ground fault interrupters shall be incorporated into circuit breakers where indicated. They shall be listed by UL, or other NRTL as

ground fault devices. Provide appropriate lug kit of sufficient size to accommodate the feeders.

3. Two- and three-pole branches shall be enclosed and shall be thermal magnetic circuit breakers with inverse time delay, tamper-proof, ambient compensated, single handle, internal common trip, and quick-make, quick-break mechanism with silver alloy contacts. Circuit breakers shall be fully rated or as otherwise indicated on the Drawings.

4. Main and subfeeder circuit breakers shall be enclosed, thermal magnetic type with inverse time delay, single handle common trip, quick-make, quick-break mechanism, corrosion-resistant bearings and silver alloy contacts. Ampere frame size and trip rating shall be as indicated on Drawings. Breakers over 225 amperes shall be furnished with interchangeable trip units. Handles of main and subfeeder circuit breakers shall be provided cabinet door. Voltage rating shall be as indicated on Drawings.

5. Circuit breakers shall be fully rated and of one-piece, bolt-on type and shall meet short-circuit interrupting capacity requirements indicated on Drawings. Series rated circuit breaker combinations are not acceptable.

6. Internal connections shall be fabricated with plated copper bus bars and the busses shall extend for full length of space available for branch circuit breakers. Feeder cable connectors shall be installed at point of feeder entrance. Terminals shall be furnished with copper conductors. Panelboards fed by conductors having over-current protection greater than 200 amperes shall be protected on supply side by over-current devices having a rating not greater than that of panelboards. Copper bussing shall be fully rated. Heat rated bussing is not acceptable.

7. Except where otherwise indicated, circuit breakers shall be in two vertical rows connected to bus bars in a distributed phase arrangement. Two-pole branches shall be balanced on busses. Single pole branches shall be numbered adjacent to its circuit breaker, with odd numbers on left and even numbers on right.

8. Specified circuit breaker spaces shall be furnished with hardware required for future installation of circuit breakers.

9. Provide locking devices for individual circuit breakers. Padlocking devices shall be secured to circuit breakers and by panel dead front plates.

B. Surge Suppressors: Where indicated on Drawings, provide transient voltage surge suppressors as an integral part of panelboards. Panelboards shall be complete with 200 percent rated copper neutral bus, ground bus and isolated ground bus in addition to requirements of this section. Surge suppressors shall be as follows:

1. Surge Capacity:

   a. Line-to-neutral for wye systems: 80 KA.

   b. Line-to-ground: 80 KA.

   c. Neutral-to-ground: 80 KA, three-phase wye.

   d. Line-to-neutral plus line-to-ground: 160 KA.

2. UL 1449 2nd Edition Suppressed Voltage Rating for 208/120 Wye System:

   a. Line-to-neutral: 400 volts.

   b. Line-to-ground: 400 volts.

   c. Neutral-to-ground: 400 volts.

   d. Maximum continuous over-voltage: 150 volts.

3. EMI/RFI High-Frequency Noise Power Filter (Characteristics):

   a. 100 KHz at 444 dB.

   b. 100 MHz at 44 dB.

   c. 10 MHz at 44 dB.

   d. 100 MHz at 444 dB.

4. Metal Oxide Varistor (MOV) shall be thermally protected for low current faults and shall be fused with surge-rated fuses. The surge-rated surge current passes and clears the circuit safely if the surge capacity is exceeded. Enhanced diagnostics shall continuously monitor the unit's status and shall include LEDs to signal a reduction in surge capacity or the loss of a suppression circuit. An audible alarm, with test and silence features, shall be furnished in diagnostic package.

5. Each phase or the entire unit shall be replaceable and have bolted-on, tin-plated copper connections. Unit to have UL witnessed fault current rating of 65,000 symmetrical amperes.

6. Surge suppression units shall comply with the following:

   a. UL certified.

   b. UL 1283.

   c. UL 1449.

   d. IEEE C 62.45.

   e. IEEE C 62.41.

   f. Nationally Recognized Testing Laboratory (NRTL) or equal.

C. Panelboard Cabinets:

1. Panelboard cabinets shall be code gage galvanized steel or blue steel; fronts, doors, and trims shall be code gage furniture steel. Cabinets shall be furnished with at least six-inch high gutters at top and bottom where feeder cable size exceeds four gage or where feeder cable passes through cabinet vertically. Cabinets shall be furnished with top and bottom gutters sized as required by inspection department having jurisdiction,

but never less than six inches where more than one feeder enters top or bottom of cabinets. Side gutters shall not be less than four inches wide. Width of cabinets shall be 20 inches, unless otherwise indicated on Drawings.

2. Doors shall be cut true, shall accurately fit opening and finish smooth across joints. Rabbets shall be inside. Hinges shall be entirely concealed except for barrels and pins. Hinge flanges shall be welded to door and trim. Doors shall be equipped with flush type, spring-latching, Corbin locks for metal doors, keyed to Corbin No. 60 keys.

3. Where contactors, time switches, and control devices are specified or indicated to be installed within panelboard cabinets, a separate compartment and door shall be provided at top of cabinet for such devices. Door shall be sized as required to permit removal of contactor and other devices intact. Gutters shall be provided at sides and top of compartment. Doors shall be equipped with flush type, spring-latching, Corbin locks for metal doors keyed to Corbin No. 60 keys.

4. Provide and install panelboard manufacturer's permanent circuit number kit option.

5. Panelboards with control devices in compartment shall arrive at the Project site completely assembled with control devices installed and wired.

6. Outdoor cabinets shall be NEMA Type 3R. Construction shall be formed from code gage galvanized steel with ANSI No. 61 gray enamel finish. Provide heavy-duty, three point latching, vault type door handles with padlocking provisions. Provide stainless steel or galvanized butt hinges on doors. Padlocks shall be furnished, keyed to Corbin No. 60 keys.

7. Self-tapping screws and bolts not permitted.

D. Panelboard Schedule: Provide a neatly typewritten schedule with number or name of room or area, or load served by each panelboard circuit. Room numbers or names shall be determined at the Project site and shall not necessarily be those indicated on the Drawings. Schedule shall also indicate panel designation, voltage and phase, building and distribution panel or switchboard from which it is fed. Schedule shall be installed in a frame under transparent plastic 1/32 inch thick on inside of each panelboard cabinet door.

E. Panelboard nameplate: Provide a nameplate identifying panelboard. Plates shall be black and white plastic nameplate stock, with character cut through black exposing white and shall bare designation of service. Name plate shall be mechanically fastened to switchboard.

F. Provide additional labeling on dead-front of panelboard. Label shall be a P-Touch or equal with a minimum width of 3/8 inch with black letters on white background. Label shall re-identify panelboard and also identify name and location of power source feeding this panel. Location information shall include building name if located in different building and name or room location. If power source is installed in same room, label should indicate source name and "In this Room"

G. Panelboard Standards: Panelboards shall be UL, or other NRTL listed and labeled. Panelboards shall meet latest revisions of following standards:

1. California Electric Code, Article 384.

2. UL 67, Panelboards.

3. UL 50, Cabinets and Boxes.

4. UL 943, GFCI.

5. UL 489, Molded Case Circuit Breakers.

6. NEMA PB1.

7. Federal Specifications W-P- 115C and WC-375B.

H. Signal Terminal Cabinets:

1. Signal terminal cabinets shall conform to the Specifications for panelboard cabinets, except as modified herein.

2. Terminal cabinets shall be flush type, with two-inch trim or surface mounted type, as indicated on Drawings. Terminal cabinets shall be furnished with sections and barriers to separate each system. Sections over 24 inches in width shall be provided with double doors and locks. Terminal cabinets, or sections of terminals housing separate systems, shall measure 12 inches long by 18 inches high by 5 ¾-inch deep, unless otherwise indicated on Drawings. Trims for sectional cabinets shall be of one-piece construction.

3. Terminal cabinets shall be furnished with ¾ inch thick plywood. Plywood shall be fastened in place with machine screws or factory installed mounting screws.

4. Flush-mounted terminal cabinets shall be finished as specified for flush-mounted panelboard cabinets. Surface and semi-flush mounted terminal cabinets shall be finished as specified for surface-mounted panelboard cabinets.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Panelboards shall be manufactured by Siemens, W.A. Benjamin, General Electric, Cutler Hammer, Square D or equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Panelboards shall be located so they are readily accessible and not exposed to physical damage.

B. Panelboards installed outdoors shall be specifically listed for wet locations and shall be weatherproof in NEMA Type 3R cabinets.

C. Panelboard locations shall provide sufficient working space around panels to comply with the California Electrical Code.

D. Panelboards shall be securely fastened to structure and mounted on surface by at least four points.

E. Unused openings in cabinets shall be effectively closed as required by the manufacturer.

F. Cabinets shall be grounded as specified in Article 250 of the California Electrical Code.

G. Conduits shall be installed so as to prevent moisture or water from entering and accumulating within the enclosure.

H. Lugs shall be suitable and listed for installation with the conductor being connected.

I. Conductor lengths shall be maintained to a minimum within the wiring gutter space. Conductors shall be long enough to reach the terminal location in a manner that avoids strain on the connecting lugs.

J. Maintain the required bending radius of conductors inside the cabinet.

K. Clean the cabinet of foreign material such as cement, plaster, and paint.

L. Distribute and arrange conductors neatly in the wiring gutters.

M. Use the manufacturer's torque values to tighten lugs.

N. Before energizing panelboards, the following steps shall be taken:

1. Retighten connections to the manufacturer's torque specifications. Verify that required connections have been provided.

2. Remove shipping blocks from component devices and panelboard interiors.

3. Manually exercise circuit breakers to verify they operate freely.

4. Remove debris from panelboard interior.

O. Follow manufacturer's instructions for installation.

P. Do not install in highly corrosive environments, unless rated for the application.

3.02 PROTECTION

A. Protect the Work of this section until Substantial Completion.

3.03 CLEANUP

A. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

END OF SECTION

SECTION 26 24 19 - MOTOR CONTROL CENTER AND MOTOR CONTROL DEVICES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Disconnect switches and motor starters for motors or equipment and connections to the motors.

B. Related Requirements:

1. Division 01 - General Requirements.

2. Division 23: Heating, Ventilating, and Air Conditioning “HVAC”.

3. Section 26 05 00: Common Work Results for Electrical.

4. Section 26 05 13: Basic Electric Materials and Methods.

5. Section 26 05 26: Grounding and Bonding.

6. Section 26 24 13: Switchboards.

1.02 SUBMITTALS

A. Shop Drawings: Include a front elevation, indicating dimensions, make, location and capacity of equipment, type of wiring, size of gutters, type of mounting, size of anchoring bolts and finish. Installation shall be in compliance with CBC seismic design requirements.

B. Product Data: Submit catalogs indicating make, ratings, dimensions, and catalog number for disconnect switches, motor starters, and control devices.

1.03 DESIGN REQUIREMENTS

A. Motor overload protection of manual reset type, as part of a motor starter and set at not to exceed 125 percent of motor full load current rating, shall be provided for each motor exceeding 1/8 horsepower in size except where indicated otherwise and except for following: Motors of sufficient impedance to prevent overheating on failure to start (such as clock motors), and motors provided with an approved built-in manual reset type device, responsive to motor current and set at not to exceed 125 percent of the motor full load current rating, which will interrupt current to motor.

B. Switchboard components shall be provided with nameplates. Plates shall be black and white plastic stock, with characters cut thorough black exposing white, and shall bear designation of service, feeders controlled, and fuse sizes.

PART 2 - PRODUCTS

2.01 EQUIPMENT

A. Motor Control Centers:

1. Motor control centers shall be of metal-clad, free floor-standing dead-front type, totally enclosed with one or more vertical sections. Arrangement and construction shall be as indicated on Drawings and as specified. Design, construction, and testing shall comply with requirements of latest CEC, UL publication UL-845, NEMA publication ICS 2.3 and applicable standards of ASA, AIEE, and NEMA. Equipment shall be completely fabricated, wired and tested at factory, and shall be shipped in sections ready for installation, complete with required assembly bolts and mounting channels. General construction shall consist of modular vertical sectioned cubicles, approximately 90 inches high and 20 inches wide. Sectional cubicles shall be bolted together to form required arrangement having the appearance of a single assembly. Cubicle sections shall be fabricated from a minimum of 12 gage P & O Mill prime sheet steel, shaped, reinforced, and welded to form a rigid structure. Sections shall contain required number of modular spaces for various starter units. Wiring gutters shall extend through cubicles with front accessible bolted filler plate covers. Connections shall be securely bolted together with corrosion-resistant plated carbon steel, of minimum grade five machine screws, secured with constant pressure type locking devices. Self-tapping screws will not be permitted.

2. Bus bars and connections shall be copper. Vertical buses shall be rated at not less than 300 amperes and shall be placed to allow starter units to be connected by pushing into place. Bus connections shall be free fitting and bolted, with silver plated connecting areas rated at 200 amperes per square inch. Bus work bracing and support shall withstand the short circuit stresses indicated on Drawings without damage to buses or structure. Connections shall be secured bolted together with corrosion-resistant plated carbon steel, of minimum grade five machine screws, secured with constant pressure type locking devices. Self-tapping screws will not be permitted

3. Main horizontal and vertical buses shall be made of copper and entire length shall be electrolytically silver-plated. Copper ground lugs shall be provided in incoming line vertical sections. Horizontal tin-plated copper ground buses shall be provided in each section of the motor control center. Horizontal ground bus shall run continuously throughout control center, drilled and tapped every ten inches for ¼ - 20 machine screws. RMS amperes symmetrical bus bracing shall be as indicated on Drawings. Vertical sections shall support horizontal and vertical buses, combination started units, covers and doors. Vertical sections shall be furnished with structural supporting members formed of a minimum of 13 gage hot-rolled steel. Reinforcement for structural parts shall be of ten gage steel to provide a strong, rigid assembly. Vertical sections shall be designed to accommodate bolts on units 20 inches wide and 20 inches deep, and shall be provided with 12 inches high horizontal wireway located at bottom of sections and a six-inch horizontal wireway at top of sections in addition to the vertical wireways for each section. Busing components shall be secured bolted together with corrosion-resistant plated carbon steel, of minimum grade five machine screws, secured with constant pressure type locking devices. Self-tapping screws will not be permitted

4. Separate control cell compartments of sizes indicated on Drawings shall be provided for future interlocking relays and transducers.

5. Starters shall be of the bolt-on combination magnetic type, as indicated on Drawings, each with a separate hinged door. Starters shall be provided with separate overloads in each phase.

a. Combination magnetic starters shall be circuit breaker magnetic across-the-line type, or as indicated on Drawings, and shall be furnished with suitable thermal overload elements for controlled motor. Breaker shall be bussed with copper bus bars. Covers shall be mechanically interlocked with circuit breakers to prevent opening when energized. Circuit breaker handles shall be capable of being padlocked in the off position with one to three padlocks.

b. Each motor starter shall be furnished with a red pilot light, HOA selector switch or pushbutton station, and a control circuit transformer, unless otherwise indicated on Drawings. Control circuit transformer shall be fused.

6. Units shall be provided with unit doors, unit support pans, unit saddles, and unit disconnect operators. Units shall be designed and constructed so that faults will be localized within compartment.

7. Control devices and wiring of motor control centers shall be in accordance with functional wiring diagrams indicated on Drawings and requirements of controlled equipment.

8. Motor control center wiring shall be NEMA Class 1, Type B.

9. Motor control center shall be as manufactured by Cutler Hammer, W.A. Benjamin Electric, Square D, General Electric, or equal.

B. Disconnect Switches:

1. Heavy duty type switches shall be 240 volt or 480 volt as required, totally enclosed, externally operated, with quick-make, quick-break operating mechanism, interlock cover, and provisions for locking cover in closed position and locking switch in on and off positions. Switches shall be single-throw, unless otherwise indicated or specified. Switches controlling direct current loads shall be DC rated.

2. Switches shall be furnished with switch blades, which are fully visible in off position when switch door is open. Current carrying parts shall be plated to resist corrosion and promote cool operation. Switches shall be furnished with removable arch suppressors where necessary to permit easy access to line side lugs. Lugs shall be front removable and UL, or other Nationally Recognized Testing Lab listed for 75 degrees C. copper wires.

3. Switch enclosure shall be NEMA Type 1 for indoor locations and rain-tight, NEMA Type 3R, rainproof for outdoor locations. NEMA Type 3R enclosures shall be manufactured from galvanized steel with gray baked enamel and shall be furnished complete with rainproof bolt on hubs. Covers shall be attached with pin type hinges. Removable closing cap types are not permitted. In kitchen area, provide disconnect switchers in a NEMA type 4 stainless steel enclosure. Quick release latches shall be permitted only when furnished tamper-resistant to prevent breakage due to vandalism, and furnished with Corbin 66 locks keyed to Corbin 60 key. Switches shall be fusible or non-fusible as indicated on Drawings. Fusible switches shall accept cartridge fuses. Current rating of switches, number of poles, solid neutral facilities, and current rating of fuses shall be as indicated on Drawings. Switches shall have proper horsepower rating equal to or greater than horsepower of motor controlled. Only lower horsepower rating of dual rated switches will be permitted as a switch rating. Switches shall accept Class H, Class J and Class R fuses.

4. Padlocking device shall lock operating handle and cover with one padlock regardless of on or off position. Switches shall be heavy duty type, as manufactured by Square D, General Electric, Cutler Hammer or equal. Furnish a minimum of two padlocks and two keys with each switch. Padlocks shall be Corbin No. 66 keyed to Corbin No. 60 keys.

5. Switches shall be UL listed and shall comply with NEMA Standard KS-1.

6. Furnish one spare fuse for each fusible disconnect switch installed. Spare fuses shall be same type and rating as those installed.

C. Motor Starters:

1. Motor starters shall be AC magnetic across-line starters unless otherwise indicated on Drawings.

2. AC magnetic across-the-line starters shall be furnished with manual reset thermal overload protective devices including heating elements. Starters shall be furnished in a NEMA Type 1, NEMA Type 3R or other type of enclosure as indicated on Drawings. Starters shall be furnished with HOA selector switches or push-buttons, as indicated on Drawings. NEMA size, voltage rating, number of poles, and special features shall be as indicated on Drawings. Horsepower rating of each starter shall be equal to or greater than motor horsepower. Starters for motor circuits rated at 208 volts and above shall be provided with a control circuit transformer, having a 120 volt secondary. Combination magnetic starters are permitted. Three-phase starters shall be furnished with three-element protection.

3. Manual across-line starters shall be furnished with manual reset thermal overload protective devices, including heating elements, start-stop-reset device or H.O.A. switch as indicated on Drawings, operable from front. Enclosure shall be NEMA Type 1 for indoor installation and NEMA Type 3R for outdoor installation or as indicated on the Drawings. NEMA size, voltage rating and number of poles shall be determined by motor horsepower, voltage and phase indicated on Drawings. Horsepower rating of each starter shall be equal to or greater than motor horsepower. Combination manual starters are permitted.

4. Thermal switch starters shall be tumbler type with plaster ears, binding screws for wiring, standard size composition cups which fully enclose mechanism, and shall be designed to fit standard outlet boxes. Thermal switches shall be fractional horsepower motor starters with thermal overload protective devices including heating elements and with handle providing on-off-reset control. Horsepower rating, voltage rating, and number of poles shall be determined from motor horsepower and voltage indicated on Drawings. Switches shall be key operated where so indicated on Drawings. Furnish one key with each key type switch. Horsepower rating of each switch shall be equal to or greater than motor horsepower.

5. Relays furnished for directly controlling motors shall be installed in NEMA Type 1 enclosure for indoor installations and NEMA Type 3R for outdoor installations, unless otherwise indicated or specified and shall be horsepower rated. Relay size, voltage rating and number of poles shall be determined from motor horsepower and voltage indicated on Drawings.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Motor control centers installed outdoors, or below grade, shall be installed on a concrete pad as specified in Section 03 3000: Cast-In-Place Concrete, and as indicated on Drawings.

B. Anchor bolts for freestanding equipment shall be designed to meet CBC seismic requirements. Equipment shall be anchored to concrete slab with anchor bolts. Provide structural drawings for Architect review prior to start of construction.

C. Equipment shall be located so that it is readily accessible and not exposed to physical damage.

D. Equipment locations shall provide sufficient working space around the equipment to comply with the California Electrical Code.

E. Equipment installed outdoors shall be specifically approved for wet locations and shall be installed in a weatherproof NEMA Type 3R enclosure.

F. Equipment shall be securely fastened to the mounting surface.

G. Equipment enclosure shall be grounded to comply with Article 250 of the California Electrical Code.

H. Conduits shall be installed so as to prevent moisture or water from entering and accumulating within the equipment enclosure.

I. Lugs shall be suitable and permitted for installation with the conductor being connected.

J. Conductor lengths shall be maintained to a minimum within the wiring space. Conductors shall be long enough to reach the terminal location in a manner that avoids strain on the connecting lugs.

K. Maintain the required bending radius of conductors inside the cabinet.

L. Distribute and arrange conductors neatly within the equipment space.

M. Tightening of wire lugs or any conductor connections shall be performed in the presence of the Project Inspector. Torque values shall be those recommended by manufacturer.

N. Remove shipment blocks from component devices.

O. Manually exercise switches and circuit breakers to verify they operate freely.

P. Remove debris from equipment interior.

Q. Follow manufacturer’s instructions for installation.

R. Furnish one spare fuse for each fusible switch installed. Spare fuses shall be of the same type and rating as those installed.

S. Record Drawings: Submit project record drawings indicating the motor control center exactly as it was installed, including wiring diagrams of components.

T. Installation Instructions: Submit manufacturer's written installation instructions, including recommendations for handling, protection and storage.

U. Installation in corrosive environments such as boiler rooms, pool equipment, and other similar spaces is not allowed.

V. Motor Control Center equipment and system components shall be free from short circuits and grounds, other than required grounds. The contractor shall be responsible for the testing of bolted electrical connections, perform insulation resistance tests on each bus section, phase-to-phase and phase-to-ground for one minute in accordance with requirements stated in NETA-ATS 2007 table 100.1. Test shall be performed in the following manner:

1. Utilize the services of an approved independent testing laboratory to perform megger time-resistance insulation testing of bussing, circuit breakers and/or fused switches. The fused switches shall be equipped with fuses or temporary jumpers in place of fuses. Breaker and fused switches shall be tested in the closed position. No wiring shall be connected to the line or load side of the motor control center during testing.

   a. Provide calibration program records to assure the testing instruments to be within rated accuracy. The test equipment accuracy shall be in accord with the requirements stated by the National Institute of Standards and Technology (NIST).

   b. Test equipment shall be provided with a label stating the date of last calibration. As a minimum the equipment shall have been calibrated within the past 12 months.

   c. Test reports shall include the following:

      1) Identification of the testing organization.

      2) Equipment identification.

      3) Ambient conditions.

      4) Identification of the testing technician.

      5) Summary of project.

      6) Description of equipment being tested.

      7) Description of tests.

      8) Test results.

      9) Analysis, interpretation and recommendations.

2. Perform test in the presence of the Project Inspector.

3. During testing, provisions shall be made to prevent damage to any solid state components, or electronic equipment such as TVSS equipment that may be tied onto panel bussing.

4. Test results shall meet manufacturer's recommendations or NETA ATS- 2007 recommendations, whichever is more stringent.

3.02 PROTECTION

A. Protect the Work of this section until Substantial Completion.

3.03 CLEANUP

A. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

END OF SECTION

SECTION 26 29 13 - VARIABLE FREQUENCY DRIVES

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes: Variable Frequency motor Drive (VFD) consisting of a pulse width modulated (PWM) inverter.

B. Related Requirements:

1. Division 01: General Requirements.

2. Section 23 50 00: Mechanical Central Heating Equipment.

3. Section 23 70 00: Mechanical Air Handling Units.

4. Section 23 80 00: Mechanical Equipment.

1.02 REFERENCES

A. Institute of Electrical and Electronics Engineers (IEEE): Standard 519, IEEE Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems.

B. Underwriters Laboratories: UL 508 and UL 508C.

C. National Electrical Manufacturers Association (NEMA): ICS 7, Variable Speed Drives.

D. International Electrotechnical Commission (IEC): 61800 Parts 1 and 2.

1.03 SUBMITTALS

A. Provide in accordance with Division 01.

B. Product Data: Manufacturer’s technical data on features, performance, electrical ratings, finishes and list of options provided.

C. Shop Drawings: Submit dimensioned plans and details and wiring diagrams.

D. Compliance to IEEE 519: Provide harmonic analysis for particular jobsite including total harmonic voltage distortion and total harmonic current distortion (TDD).

1. Manufacturer shall provide calculations, specific to this installation, showing total harmonic voltage distortion is less than five percent. Input line filters shall be sized and provided as required by the manufacturer to ensure compliance with IEEE standard 519. Variable Frequency Drives (VFD) shall include a minimum of five percent impedance reactors.

1.04 QUALITY ASSURANCE

A. Manufacturer’s Qualifications: Minimum of five years experience in design and manufacture of Variable Frequency Drives.

1.05 WARRANTY

A. Variable Frequency Drives shall be provided with manufacturer's two year unconditional warranty, (replacement only).

B. Manufacturer shall warrant parts, labor, travel time and expenses.

C. Manufacturer shall provide a 365 day and 24 hour a day support available via toll free phone number.

PART 2 – PRODUCTS

2.01 EQUIPMENT

A. The VFD package shall be enclosed in a UL Listed NEMA Type 12 enclosure for indoor applications, for outdoor applications a NEMA type 12 VFD shall be install inside a NEMA 3R enclosure completely assembled and tested by the manufacturer in an ISO9001 facility. The VFD tolerated voltage window shall allow the VFD to operate from a line of +30 percent nominal and -35 percent nominal voltage, as a minimum.

1. Environmental operating conditions: 0 to 40 degrees C continuous. VFDs that can operate at 40 degrees C intermittently (during a 24 hour period) are not acceptable and must be oversized. Altitude 0 to 3,300 feet above sea level, less than 95 percent humidity, non-condensing.

2. Indoor application, enclosure shall be rated UL NEMA type 12 and shall be UL listed as a plenum rated VFD.

3. Outdoor application, enclosure shall be rated UL NEMA type 3R with a NEMA type 12 VFD installed inside. Provide mechanical cooling if needed for operation in high temperature location.

B. VFDs shall have the following standard features:

1. VFDs shall have the same customer interface, including digital display, and keypad, regardless of horsepower rating. The keypad shall be removable, capable of remote mounting, and allow for uploading and downloading of parameter settings as an aid for start-up of multiple VFDs.

2. The keypad shall include Hand-Off-Auto selections and manual speed control. The drive shall incorporate “bumpless transfer” of speed reference when switching between “Hand” and “Auto” modes. There shall be fault reset and “Help” buttons on the keypad. The Help button shall include “on-line” assistance for programming and troubleshooting.

3. The VFD keypad shall be provided with a built-in time clock. The clock shall have a battery back-up with ten years minimum life span. The clock shall be used to date and time stamp faults and record operating parameters at the time of fault. If the battery fails, the VFD shall automatically revert to hours of operation since initial power up. The clock shall also be programmable to control start/stop functions, constant speeds, PID parameter sets and output relays. The VFD shall have a digital input that allows an override to the time clock (when in the off mode) for a programmable time frame. There shall be four (4) separate, independent timer functions that have both weekday and weekend settings.

4. The VFDs shall utilize pre-programmed application macros specifically designed to facilitate start-up. The Application Macros shall provide one command to reprogram parameters and customer interfaces for a particular application to reduce programming time. The VFD shall have two user macros to allow the end-user to create and save custom settings.

5. The VFD shall have cooling fans that are designed for easy replacement. The fans shall be designed for replacement without requiring removing the VFD from the wall or removal of circuit boards. The VFD cooling fans shall operate only when required. To extend the fan and bearing operating life, operating temperature will be monitored and used to cycle the fans on and off as required.

6. The VFD shall be capable of starting into a coasting load (forward or reverse) up to full speed and accelerate or decelerate to setpoint without safety tripping or component damage (flying start).

7. The VFD shall have the ability to automatically restart after an over-current, over-voltage, under-voltage, or loss of input signal protective trip. The number of restart attempts, trial time, and time between attempts shall be programmable.

8. The overload rating of the drive shall be 110 percent of its normal duty current rating for 1 minute every 10 minutes, 130 percent overload for 2 seconds. The minimum FLA rating shall meet or exceed the values in the NEC Table 430-150 for 4-pole motors.

9. The VFD shall have integral 5 percent impedance line reactors to reduce the harmonics to the power line and to add protection from AC line transients. The 5 percent impedance may be from dual (positive and negative DC bus) reactors, or 5 percent AC line reactors. VFDs with only one DC reactor shall add AC line reactors.

10. The input current rating of the VFD shall be no more than 3 percent greater than the output current rating. VFDs with higher input current ratings require the upstream wiring, protection devices and source transformers to be oversized per NEC, Section 430-2.

11. The VFD shall include a coordinated AC transient protection system consisting of 4-120 joule rated MOVs (phase to phase and phase to ground), a capacitor clamp, and 5 percent impedance reactors.

12. The VFD shall be capable of sensing a loss of load (broken belt / broken coupling) and signal the loss of load condition. The drive shall be programmable to signal this condition via a keypad warning, relay output and over the serial communications bus. Relay outputs shall include programmable time delays that will allow for drive acceleration from zero speed without signaling a false underload condition.

13. If the input reference (4-20mA or 2-10V) is lost, the VFD shall give the user the option of either stopping and displaying a fault, running at a programmable preset speed, hold the VFD speed based on the last good reference received, or cause a warning to be issued, as selected by the user. The drive shall be programmable to signal this condition via a keypad warning, relay output and over the serial communication bus.

14. The VFD shall have programmable “Sleep” and “Wake up” functions to allow the drive to be started and stopped from the level of a process feedback signal.

C. VFDs shall have the following adjustments:

1. Three programmable critical frequency lockout ranges to prevent the VFD from operating the load continuously at an unstable speed.

2. Two PID setpoint controllers shall be standard in the drive, allowing pressure or flow signals to be connected to the VFD, using the microprocessor in the VFD for the closed loop control. The VFD shall have 250 mA of 24 VDC auxiliary power and be capable of loop powering a transmitter supplied by others. The PID setpoint shall be Variable from the VFD keypad, analog inputs, or over the communications bus. There shall be two parameter sets for the first PID that allow the sets to be switched via a digital input, serial communications or from the keypad for night setback, summer/winter setpoints, etcetera. There shall be an independent, second PID loop that can utilize the second analog input and modulate one of the analog outputs to maintain setpoint of an independent process (i.e. valves, dampers, etc.). Setpoints, process variables, etcetera to be accessible from the serial communication network. The setpoints shall be set in Engineering units and not require a percentage of the transducer input.

3. Two programmable analog inputs shall accept current or voltage signals.

4. Two programmable analog outputs (0-20 mA or 4-20 mA). The outputs may be programmed to output proportional to Frequency, Motor Speed, Output Voltage, Output Current, Motor Torque, Motor Power (kW), DC Bus voltage, Active Reference, and other data.

5. Six programmable digital inputs for maximum flexibility in interfacing with external devices, typically programmed as follows:

    a. There shall be a run permissive circuit for damper or valve control. Regardless of the source of a run command (keypad, input contact closure, time-clock control, or serial communications), the VFD shall provide a dry contact closure that will signal the damper to open (VFD motor does not operate). When the damper is fully open, a normally open dry contact (end-switch) shall close. The closed end-switch is wired to an VFD digital input and allows VFD motor operation. Two separate safety interlock inputs shall be provided. When either safety is opened, the motor shall be commanded to coast to stop, and the damper shall be commanded to close. The keypad shall display “start enable 1 (or 2) missing.” The safety status shall also be transmitted over the serial communications bus. Digital inputs shall be programmable to initiate upon an application or removal of 24VDC.

6. Three programmable digital Form-C relay outputs. The relays shall include programmable on and off delay times and Variable hysteresis. Default settings shall be for run, not faulted (fail safe), and run permissive. The relays shall be rated for maximum switching current 8 A at 24 VDC and 0.4 A at 250 VAC; maximum voltage 300 VDC and 250 VAC; continuous current rating 2 amps RMS. Outputs shall be true form C type contacts; open collector outputs are not acceptable.

7. Seven programmable preset speeds.

8. Two independently Variable accel and decel ramps with 1 to 1800 seconds Variable time ramps.

9. The VFD shall include a motor flux optimization circuit that will automatically reduce applied motor voltage to the motor to optimize energy consumption and audible motor noise.

10. The VFD shall include a carrier frequency control circuit that reduces the carrier frequency based on actual VFD temperature that allows the highest carrier frequency without derating the VFD or operating at high carrier frequency only at low speeds.

11. The VFD shall include password protection against parameter changes.

D. The keypad shall include a backlit LCD display. The display shall be in complete English words for programming and fault diagnostics (alpha-numeric codes are not acceptable). The keypad shall utilize the following assistants:

1. Start-up assistants.

2. Parameter assistants.

3. Maintenance assistant.

4. Troubleshooting assistant.

E. Applicable operating values shall be capable of being displayed in engineering (user) units. A minimum of three operating values from the list below shall be capable of being displayed at all times. The display shall be in complete English words (alpha-numeric codes are not acceptable):

1. Output Frequency.

2. Motor Speed (RPM, percent, or Engineering units).

3. Motor Current.

4. Calculated Motor Torque.

5. Calculated Motor Power (kW).

6. DC Bus Voltage.

7. Output Voltage.

F. The VFD shall include a fireman's override input. Upon receipt of a contact closure from the fireman's control station, the VFD shall operate at an Variable preset speed. The mode shall override other inputs (analog/digital, serial communication, and keypad commands) and force the motor to run at the Variable, preset speed. "Override Mode" shall be displayed on the keypad. Upon removal of the override signal, the VFD shall resume normal operation.

G. Serial Communications:

1. The standard VFD protocol shall be BACnet, or have a BACnet translator. Each individual drive shall have the protocol in the base VFD. The use of third party gateways and multiplexers is not acceptable.

2. The BACnet connection shall be an RS485, MSTP interface operating at 9.6, 19.2, 38.4, or 76.8 Kbps. The connection shall be tested by the BACnet Testing Labs (BTL) and be BTL Listed. The BACnet interface shall conform to the BACnet standard device type of an Applications Specific Controller (B-ASC). The interface shall support BIBBs defined by the BACnet standard profile for a B-ASC including, but not limited to:

a. Data Sharing – Read Property – B.

b. Data Sharing – Write Property – B.

c. Device Management – Dynamic Device Binding (Who-Is; I-AM).

d. Device Management – Dynamic Object Binding (Who-Has; I-Have).

e. Device Management – Communication Control – B.

f. If additional hardware is required to obtain the BACnet interface, the VFD manufacturer shall supply one BACnet gateway per drive. Multiple VFDs sharing one gateway shall not be acceptable.

3. Serial communication capabilities shall include, but not be limited to; run-stop control, speed set adjustment, proportional/integral/derivative PID control adjustments, current limit, accel/decel time adjustments, and lock and unlock the keypad. The drive shall have the capability of allowing the DDC to monitor feedback such as process variable feedback, output speed / frequency, current (in amps), percent torque, power (kW), kilowatt hours (resettable), operating hours (resettable), and drive temperature. The DDC shall also be capable of monitoring the VFD relay output status, digital input status, and analog input and analog output values. Diagnostic warning and fault information shall be transmitted over the serial communications bus. Remote VFD fault reset shall be possible. The following additional status indications and settings shall be transmitted over the serial communications bus – keypad “Hand” or “Auto” selected, bypass selected, the ability to change the PID setpoint, and the ability to force the unit to bypass (if bypass is specified). The DDC system shall also be able to monitor if the motor is running in the VFD mode or bypass mode (if bypass is specified) over serial communications. A minimum of 15 field parameters shall be capable of being monitored.

4. The VFD shall allow the DDC to control the drive’s digital and analog outputs via the serial interface. This control shall be independent of any VFD function. For example, the analog outputs may be used for modulating chilled water valves or cooling tower bypass valves. The drive’s digital (relay) outputs may be used to actuate a damper, open a valve or control any other device that requires a maintained contact for operation. In addition, the drive’s digital and analog inputs shall be capable of being monitored by the DDC system.

5. The VFD shall include an independent PID loop for customer use. The independent PID loop may be used for cooling tower bypass value control, chilled water value control, etcetera. Both the VFD control PID loop and the independent PID loop shall continue functioning even if the serial communications connection is lost. The VFD shall keep the last good set-point command and last good DO and AO commands in memory in the event the serial communications connection is lost.

H. EMI / RFI filters: VFDs shall include EMI/RFI filters. The onboard filters shall allow the VFD assembly to be CE Marked and the VFD shall meet product standard IEC 61800-3 for the First Environment restricted level.

I. VFDs up to 50HP shall be protected from input and output power miss-wiring. The VFD shall sense this condition and display an alarm on the keypad.

J. OPTIONAL FEATURES: Optional features to be furnished and mounted by the drive manufacturer. Optional features shall be UL Listed by the drive manufacturer as a complete assembly and carry a UL 508 and UL 508C label.

1. A complete factory wired and tested bypass system consisting of an output contactor and bypass contactor. Overload protection and shall be provided in both drive and bypass modes.

2. Door interlocked, padlockable circuit breaker that will disconnect input power from the drive and internally mounted options.

3. Fused VFD only disconnect (service switch). Fast acting fuses exclusive to the VFD – fast acting fuses allow the VFD to disconnect from the line prior to clearing upstream branch circuit protection, maintaining bypass capability. Bypass designs, which have no such fuses, or that incorporate fuses common to both the VFD and the bypass will not be accepted. Three contactor bypass schemes are not acceptable.

4. The drive / bypass shall provide single-phase motor protection in both the VFD and bypass modes.

5. The following operators shall be provided:

   a. Bypass Hand-Off-Auto.

   b. Drive mode selector.

   c. Bypass mode selector.

   d. Bypass fault reset.

6. The following indicating lights (LED type) shall be provided. A test mode or push to test feature shall be provided.

   a. Power-on (Ready).

   b. Run enable (safeties) open.

   c. Drive mode select damper opening.

   d. Bypass mode selected.

   e. Drive running.

   f. Bypass running.

   g. Drive fault.

   h. Bypass fault.

   i. Bypass H-O-A mode.

   j. Automatic transfer to bypass selected.

   k. Safety open.

l. Damper opening.

m. Damper end-switch made.

7. The following relay (form C) outputs from the bypass shall be provided:

a. System started.

b. System running.

c. Bypass override enabled.

d. Drive fault.

e. Bypass fault (motor overload or underload (broken belt)).

f. Bypass H-O-A position.

8. The digital inputs for the system shall accept 24V or 115VAC (selectable). The bypass shall incorporate internally sourced power supply and not require an external control power source.

9. Customer Interlock Terminal Strip: provide a separate terminal strip for connection of freeze, fire, smoke contacts, and external start command. External safety interlocks shall remain fully functional whether the system is in Hand, Auto, or Bypass modes (not functional in Fireman's Override 2). The remote start/stop contact shall operate in VFD and bypass modes.

10. Dedicated digital input that will transfer motor from VFD mode to bypass mode upon dry contact closure for fireman's override. Two modes of operation are required.

a. One mode forces the motor to bypass operation and overrides both the VFD and bypass H-O-A switches and forces the motor to operate across the line (test mode). The system will only respond to the digital inputs and motor protections.

11. The VFD shall include a "run permissive circuit" that will provide a normally open contact whenever a run command is provided (local or remote start command in VFD or bypass mode). The VFD system (VFD or bypass) shall not operate the motor until it receives a dry contact closure from a damper or valve end-switch. When the VFD system safety interlock (fire detector, freezestat, high static pressure switch, etc) opens, the motor shall coast to a stop and the run permissive contact shall open, closing the damper or valve.

12. Class 20 or 30 (selectable) electronic motor overload protection shall be included.

13. There shall be an internal switch to select manual or automatic bypass.

14. There shall be an Variable current sensing circuit for the bypass to provide loss of load indication (broken belt) when in the bypass mode.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions under which VFD are to be installed for compliance with requirements, installation tolerances, and other conditions affecting performance.

B. Proceed with installation only after unsatisfactorily conditions have been corrected.

3.02 INSTALLATION

A. Anchor each VFD arranged and sized according to manufacturer’s written instructions.

3.03 TRAINING

A. Before Substantial Completion, provide the services of a manufacturer's representative on the Project site to instruct persons designated by the Owner in the operation and maintenance of the Variable Frequency Drives. Instruction time shall not be less than eight hours.

END OF SECTION

SECTION 26 50 00 - LIGHTING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Lighting fixtures, including lamps, wiring, and lighting controls.

B. Light fixtures model numbers were determined at the time this specification was written; model numbers may need to be modified, or may require the addition or deletion of options to fully meet specification requirements.

C. Related Requirements:

1. Division 01 - General Requirements.

2. Section 26 05 00: Common Work Results for Electrical.

3. Section 26 05 13: Basic Electrical Materials and Methods.

4. Section 26 05 26: Grounding and Bonding.

5. Section 26 05 19: Low-Voltage Wires (600 Volt AC or less).

6. Section 26 09 23: Lighting Controls Systems.

7. Section 32 1313 - Site Concrete Work.

1.02 SUBMITTALS

A. List of Materials: Submit a complete list of materials proposed for this section.

B. Shop Drawings: Provide detailed and dimensioned Shop Drawings indicating kind, weight and thickness of materials, method of fitting and fastening parts together, location and number of sockets, size of lamps, and complete details of method of fitting suspension and fastening fixtures in place. Provide wiring diagrams for lighting control equipment. Drawings shall contain sufficient information to assemble and install equipment at the Project site without further instructions.

C. Prior to start of construction; provide photometric calculations with graphic of luminance levels of work plane, ceiling and walls of each rooms. Calculations shall comply with IESNA recommendations.

D. Installation Instructions: Submit manufacturer's written installation instructions for fixtures and accessories.

E. Light fixtures shall be Underwriters Laboratory (UL) or Nationally Recognized Testing Laboratory (NRTL) listed, and in compliance with applicable industry standards and codes.

F. Submittals must comply with contract general provisions.

1.03 MOUNTING REQUIREMENTS

A. Design of lighting fixtures, accessories, supports, and method of fixture installation shall comply with requirements for earthquake-resistant construction of the State of California.

B. Provide suspension points at no more than two feet from fixture ends. Spacing between supports shall not exceed eight feet.

1.04 QUALITY ASSURANCE

A. Components and fixtures shall be listed and approved for the intended application by Underwriter's Laboratories (UL), or other Nationally Recognized Testing Laboratory (NRTL).

B. OWNER’s written approval shall be obtained for any equipment or materials substitutions prior to their use.

1.05 GUARANTEE

A. Provide a two year labor warranty.

B. Provide material warranty as specified:

1. Lamps: two years.

2. Standards: one year.

3. Controls: three years.

C. Warranty period begins at substantial completion or project acceptance for beneficial occupancy.

PART 2 - PRODUCTS

2.01 MATERIAL AND FABRICATION

A. Lighting fixtures shall be the type indicated on Drawings and as specified. Fixtures of same type shall be of one manufacturer.

B. Fixtures shall be of the types and manufacturers described in the LIGHTING FIXTURE SCHEDULE provided in the Electrical drawings, with lamps, wattage and voltage as indicated. Specific manufacturer and model number references are indicated as a standard of performance and quality; other manufacturers’ models may be supplied provided the product meets or exceeds the specifications. The alternate fixtures shall achieve the same photometric levels and uniformity ratios.

C. Fixtures shall be baked-on enamel or powder-coated, unless otherwise specified in subsections below.

2.02 SWIMMING POOL LIGHTS

A. Fixtures shall be wet-niched type and shall comply with requirements by California Electrical Code Section 680-20 for underwater lighting fixtures.

B. Fixtures shall be furnished with solid-state sensors, which automatically cut off units when water is not present in niche area, to prevent overheating.

C. Provision for ¾ inch conduit entry shall be provided on forming shell of fixture.

D. Fixtures shall be factory-wired with a 12-foot long, three-conductor, No. 16 waterproof cords.

E. Stainless steel forming and light shells.

F. Clear glass lenses and gaskets.

G. Stainless steel clamping bands with screws and nuts for watertight seal.

H. Polished stainless steel face rings.

I. Manufacturers: Refer to the Lighting Fixture Schedule.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install a lighting fixture for each lighting outlet indicated and mark with day of installation.

B. Fixture voltage shall be as indicated on Drawings.

C. Install recessed and surface-mounted fixtures, with plaster frames compatible with ceiling and wall systems employed; secure fixtures mechanically to frames.

D. Align rows of suspended and surface-mounted fluorescent fixtures to form straight lines at uniform elevations.

E. Recessed fixtures shall fit snugly against ceilings to prevent light leakage.

F. Notwithstanding the following paragraphs in Part 3-Execution, fixture installations shall comply with the most current CBSC and Department of State Architect Seismic requirements.

G. Support suspended recessed fixtures in accordance with DSA IR 25-2.10. Support pendant-mounted fixtures in accordance with DSA IR 16-9. Fixture installations shall be coordinated with acoustical and gypsum ceiling installation.

H. Emergency light fixtures shall be labeled “Emergency Fixture” with one inch high letters produced with a P-touch or similar labeling system.

I. Continuous suspended fixtures:

1. Fixture suspension device shall allow vertical adjustment of fixture without the use of tools. Cable shall be minimum seven strand twisted stainless steel capable of supporting minimum four times the fixture weight. For continuous linear suspended fixtures longer than eight feet, provide not less than three suspension points.

2. Top of fixture shall be suspended as shown on the Drawings, typically 24 inches below the ceiling and a minimum of 18 inches from the ceiling.

3. Fixture shall utilize factory furnished or approved hardware and canopy for either hard or T-bar ceilings.

J. Where fixtures with emergency battery packs are installed, these fixtures shall receive constant powered circuits. When powering unit inverter power packs, use the same circuit that powers the switched ballast to power the inverter.

K. Surface mount fixtures shall be attached to structure. Toggle bolts shall NOT be used or permitted. Provide backing supported by structure where required.

L. Low level exit signs shall be installed with the bottom of the sign not less than six inches, or more than eight inches above the floor level and shall indicate the path of exit travel. For exit and exit-access doors, the sign shall be on the door or adjacent to the door with the closest edge of the sign within four inches of the door frame.

3.02 TESTING

A. Check and adjust fixtures for required illumination.

B. Test and adjust lighting control equipment for proper operation.

3.03 SPARE PARTS

Provide the following spare parts:

a. Furnish 5% spare lamps with a minimum of one spare lamp of each type.

b. Furnish 5% spare motion detectors of each type with a minimum of one spare detector of each type.

3.04 HAZARDOUS WASTE DISPOSAL

A. Hazardous waste disposals and recycling shall be handled and disposed of by an approved, licensed CONTRACTOR.

B. Store, remove, transport and dispose of hazardous materials in all accordance with state and federal regulations.

C. Provide OWNER with copy of manifest and certificate of destruction and/or recycling no later than achievement of substantial completion.

3.05 PROTECTION

A. Protect the Work of this section until Substantial Completion.

3.06 CLEANUP

A. Remove rubbish, debris, and waste materials from all areas of work each day.

B. Clean fixture surfaces of dirt, cement, plaster and debris. Furnish cleansers compatible with material surfaces being cleaned.

END OF SECTION

SECTION 26 50 00A – LIGHTING CUT SHEETS

PART 1 - GENERAL

1.1 SUMMARY

A. See following Cut Sheets

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

NOT USED

END OF SECTION

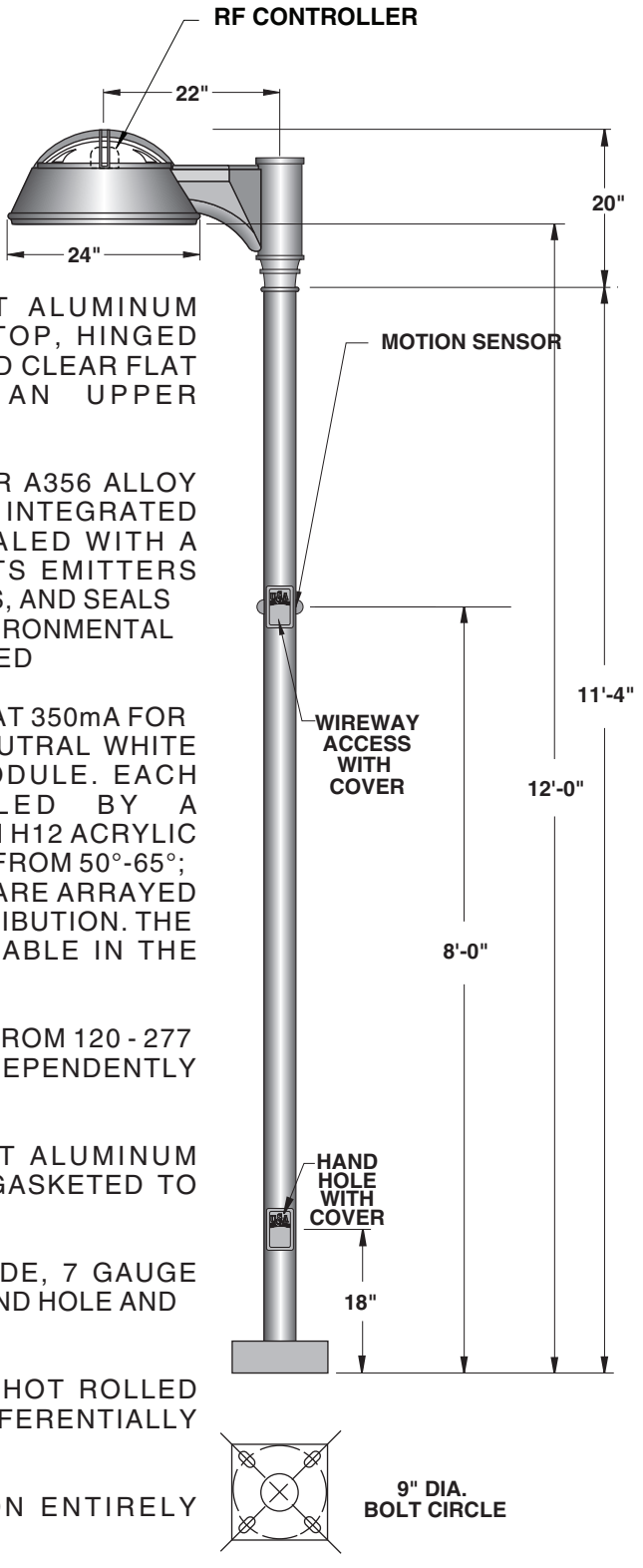
FORMULA
TECHNOLOGIES INC.

CUSTOMER APPROVAL:

X _____ DATE: _____

A signed approval will be required with the released order

PN: 2626 XXX 120 LED 208V



SPECIFICATIONS:

LUMINAIRE: DURABLE CORROSION RESISTANT CAST ALUMINUM HOUSING WITH DECORATIVE ALUMINUM TOP, HINGED ALUMINUM DOOR FRAME ENCASES TEMPERED CLEAR FLAT LENS. LUMINAIRE SUPPLIED WITH AN UPPER POLYCARBONATE LENS.

***V*LED OPTICAL MODULE:** SEALED LED OPTICAL MODULE. LOW COPPER A356 ALLOY (<.2% COPPER) CAST ALUMINUM HOUSING. INTEGRATED CLEAR TEMPERED 3/16" GLASS LENS SEALED WITH A CONTINUOUS SILICONE GASKET PROTECTS EMITTERS (LED'S) AND EMITTER REFLECTOR-PRISM OPTICS, AND SEALS THE MODULE FROM WATER INTRUSION AND ENVIRONMENTAL CONTAMINANTS. ENTIRE MODULE IS IP67 RATED

***V*LED EMITTERS AND OPTICS:** 120 LUXEON REBEL EMITTERS (LED'S) DRIVEN AT 350mA FOR 140 TOTAL INPUT WATTS. HIGH OUTPUT, NEUTRAL WHITE NOMINAL 4100K CCT FOR THE ENTIRE MODULE. EACH EMITTER IS OPTICALLY CONTROLLED BY A REFLECTOR-PRISM INJECTION MOLDED FROM H12 ACRYLIC (3 TYPES PER MODULE; ONE FROM 0°-50°; ONE FROM 50°-65°; ONE FROM 65°-70°. THE REFLECTOR-PRISMS ARE ARRAYED TO PRODUCE IES TYPE II, IV, V-SQ LIGHT DISTRIBUTION. THE ENTIRE OPTICAL MODULE IS FIELD ROTATABLE IN THE LUMINAIRE IN 90° INCREMENTS.

***V*LED DRIVER:** LED DRIVER OPERATES ON INPUT VOLTAGES FROM 120 - 277 V., 50/60Hz. FACTORY WIRED DRIVER IS INDEPENDENTLY SEALED AND UL LISTED FOR WET LOCATION.

ARM: CORROSION RESISTANT TWO PIECE CAST ALUMINUM CONSTRUCTION. REMOVABLE ARM COVER GASKETED TO PRESSURE SEAL ARM.

SHAFT: 4" DIAMETER FABRICATED FROM HIGH GRADE, 7 GAUGE STRUCTURAL STEEL, SHAFT SUPPLIED WITH HAND HOLE AND COVER.

BASE COVER: FABRICATED FROM STRUCTURAL QUALITY HOT ROLLED STEEL, BASE TELESCOPES AND IS CIRCUMFERENTIALLY WELDED TO SHAFT.

ANCHOR BASE: TWO PIECE, HEAVY WALL CONSTRUCTION ENTIRELY CONCEALS ANCHOR BASE.

ANCHORAGE: (4) 3/4"X18" FULLY GALVANIZED ANCHOR BOLTS. EACH BOLT SUPPLIED WITH TWO NUTS AND TWO WASHERS.

FINISH: POLYESTER POWDER COAT (COLOR: **SPECIFY COLOR**)

SCALE: 1/2" = 1'-0"

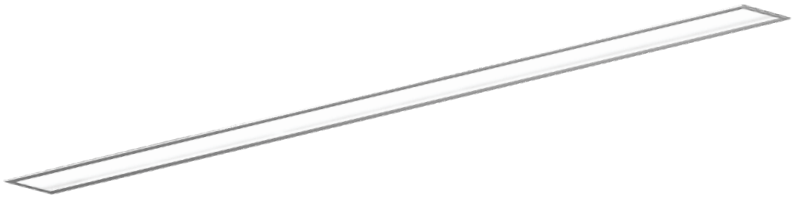
Date: _____ Customer: _____

Project: _____

Type: _____ Qty: _____

selux

M60 LED H_2O Recessed
for Wet Locations
(IP65 rated geartray and driver)



Order Code: _____ - _____ - _____ - _____ - _____ - _____ - _____ - _____ - _____ - _____ - _____ - _____ - _____ - CN22xxxx

_____	**Series**	**W60** M60 LED H_2O Multi-Mount Form for Wet Location	**W6R1** M60 LED H_2O Continuous Flange (Flanged Endcaps) for Wet Location	**W6R2** M60 LED H_2O Continuous Flange (Flangeless Endcaps) for Wet Location
_____	**Light Engine**	**1C45**[1,2] 80CRI-848lm 90CRI-712lm 11.1W per foot	**1C40**[1,2] 80CRI-794lm 90CRI-668lm 9.9W per foot	**1C35**[1] 80CRI-694lm 90CRI-584lm 8.7W per foot
		1C30[1] 80CRI-621lm 90CRI-522lm 7.3W per foot	**1C25**[1] 80CRI-495lm 90CRI-416lm 6.1W per foot	**1C20**[1] 80CRI-411lm 90CRI-346m 4.9W per foot
_____	**CCT**	**935** 3500K 90 CRI nominal	**940** 4000K 90 CRI nominal	**950** 5000K 90 CRI nominal
		955 5500K 90 CRI nominal	**835**[3]	**840**[3] **850**[3] **855**[3]
_____	**Shielding**	**LW** LED Optimized White Lens	**MI** Clear Lens with Microprism	**NB** LMO Symmetric with Satine Lens
		A2 LMO Asymmetric 20° Wall Washer with Satine Lens	**A5** LMO Asymmetric 5° Wall Grazer with Satine Lens	**BW** LMO Batwing with Satine Lens
_____	**Mounting W60** or **Mounting W6R1 or W6R2**	**SF1** Spackle Flange (½" Drywall)	**SF2** Spackle Flange (⅝" Drywall)	**SF3** Spackle Flange (After Drywall)
		SG Slot Grid (9⁄16") (Wire Suspension or ¼"-20 stud)	**DC** Decoustic Ceiling (up to 2" thick)	
		TB[4] T-Bar Length with suspension clips	**TBS**[4] T-Bar Length with 1" ¼"-20 Stud	**RC**[4] Rotating Crossbar (Ceilings ¼" to 2" thick)
		TS 1" ¼"-20 Stud		
_____	**Nominal Fixture Length**	**02**[5] 2 ft.	**03** 3 ft.	**04**[5] 4 ft.
		05[5] 5 ft.	**06**[5] 6 ft.	**07** 7 ft.
		08[5] 8 ft.	**XX** Runs (over 8') and Configurations, round up to the nearest foot and replace the "xx" with the # (i.e. 09=09' nominal)	
		Individual fixtures, Runs and Configurations are supplied in nominal lengths to ensure full, even, illumination. See pages 2 through 6 for additional details.		
_____	**Finish**	**WH** White	**BL** Semi-Matte Black	**SV** Silver
		SP Specify Premium Color		
_____	**Voltage**	**1** 120V	**2** 277V	**U** 120V through 277V 50/60hz capable
_____	**Driver**	**DIM**[6] 0-10V 1% (Linear)	**DIL**[6] eldoLED 1% ECOdrive 0-10V (Logarithmic)	**DED**[6] eldoLED 1% ECOdrive DALI-2 (Logarithmic)
		D01[6] eldoLED 0.1% SOLOdrive 0-10V (Linear)	**DL01**[6] eldoLED 0.1% SOLOdrive 0-10V (Logarithmic)	**DC2**[6,7] Lutron 1% 2-Wire
		DE1[6] Lutron 1% EcoSystem	**DC3** Lutron 1% 3-Wire (consult factory)	
_____	**Fixture Options**	**SS**[8] Separate Switching	**CCEA** CCEA approved	
_____	**Emergency Options**	**EC**[9] Emergency Circuit Wiring	**EMR** Remote Micro Inverter (consult factory)	
_____	**Configuration Options**	**L9** Lit Horizontal 90° Corner	**V9** Lit Inverted 90° Corner	**T9** Lit "T" section
		X9 Lit "X" section		
CN22xxxx		**CN22xxxx:** M60 LED with IP65 rated LED engine and IP rated driver		

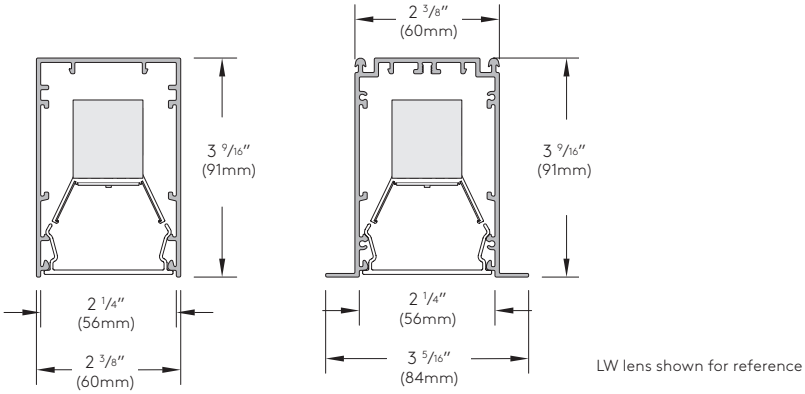
[1] Values calculated from a 4' fixture at 3500K, 90+ CRI using LW shielding and DIM driver. For additional information please see page 2.
[2] Not available with Lutron
[3] Consult factory
[4] L6R1 only
[5] Length intended to fit centered between the grid for SG, TB, TBS mountings
[6] See page 7 for full details
[7] 120V only
[8] See page 10 for details
[9] See page 10 for full details and restrictions

* See page 2 for details on CCT and CRI

* *Custom colors are available, please consult factory*

* 347V not available with EM integral battery option

* See pages 12 for full details and restrictions



LW lens shown for reference

Construction:

Housing - Continuous, low copper 6063-T6 extruded aluminum profile with aluminum endcaps, available as Individual fixtures (up to 8') or Runs.

Flange (W6R1 or W6R2 Series) - 9/16" (14mm) wide flange runs full lengths of both sides and is part of the main extruded body. Specify continuous flange (W6R1) or flush (W6R2) end cap. W6R2 does not work in T-Bar ceiling.

Geartray - Low copper 6063-T6 extruded aluminum profile. Geartray and connections encased in silicone for IP65 rating.

Shielding - Extruded, impact resistant acrylic snap in lens:
- LED Optimized White Lens (LW)
- Clear Lens with Microprism (MI)

"LMO" refers to the Selux proprietary LED optical system - Light modulation optics. These lenses are offered in M60 behind a Satine Lens for even illumination and comfortable lit appearance.
- "LMO" Symmetric Lens (NB)
- "LMO" Asymmetric 20° Wall Washer (A2)
- "LMO" Asymmetric 5° Wall Grazer (A5)
- "LMO" Batwing (BW)

Mounting(s) - Spackle-in (drywall), Slot grid, Decoustic, T-bar grid, Rotating Crossbar and Threaded Stud Mountings (see pages 3 through 6 for details).

Standard Luminaire lengths - All standard luminaires are supplied in nominal lengths to ensure full, even, illumination. Runs and Configurations are available in approximately 1/4" increments starting at the nominal 8' fixture length.
**Individual luminaires are not joinable in the field.

Exact length luminaires - Individual luminaires, Runs, and Configurations are available in exact lengths to meet your project needs. Please consult factory with you requirements.
**Lens luminance may soften at the very ends of the straight sections for exact length luminaires.

W60 Joiner(s) - Runs and Configurations are supplied in multiple housings that are joined together in the field using the supplied W60 Joiner System. This allows ease of installation and ensures a uniform appearance (see page 10 for detail).

Weight: 2.4 lb. per foot.

Electrical/Performance:

LED Light Engine - Brand-name mid-power LEDs create a high efficiency LED light engine able to provide a lumen maintenance of 95% at 25,000 hours and 90% at 60,000 hours at 25°C per TM-21 reports. Reported L70 greater than 60,000 hours.

Photometrics - Consult website or factory for IES Files. Independent photometric lumen measurement complies with IES LM-79-08 testing procedures. Due to the LED manufacturer's tolerances, the listed output has a ±5% tolerance. For outputs based on different optics or CCT, please see page 14 for details.

CCT - Available in four CCTs. LEDs have a color shift due to the silicone encapsulation, and the delivered nominal CCTs are listed below.

CRI - 90 CRI standard, consult factory 80 CRI.

CRI / CCT	Nominal CCT
935	3500K
940	4000K
950	5000K
955	5500K

All Drivers - High efficiency, constant current, soft start, Electronic Class 2 with a PFC>0.90. For more detailed information on the available drivers please see page 7.

Driver enclosure is IP65 rated, extruded aluminum case with silicone injection-molded plugs.

Emergency - Emergency Circuit and Remote Micro Inverter. For more details on EC, see page 10.

Thermal Performance:

Ambient Operating Temperature - Luminaires suitable for maximum ambient temperature of 35°C (95°F) for all drivers.

Luminaires are suitable for minimum ambient temperatures of -40°C (-40°F) for DIM, DIL, DED, D01, and DL01 drivers; 0°C (32°F) for DC2 and DE1 drivers.

Luminaire Finish:

Powder Coat - All Selux luminaries are finished in high quality polyester powder coating in our Tiger Drylac certified facility and are tested in accordance with test specifications for coatings from ASTM and PCI.

All products undergo a five stage intensive pretreatment process where product is thoroughly cleaned, phosphated, and sealed. Selux powder coated products provide excellent salt and humidity resistance as well as ultra violet resistance for color retention.

Standard interior colors are White (WH), Semi-Matte Black (BL), and Silver (SV). Selux premium colors (SP) are available, please specify from your Selux color selection guide.

Warranty:

5 Year Limited LED Luminaire Warranty - Selux offers a 5 Year Limited Warranty to the original purchaser that the M60 series LED luminaire shall be free from defects in material and workmanship for up to five (5) years from date of shipment. This limited warranty covers the LED driver and LED light engine when installed according to Selux instructions and operated within the Ambient Temperature. For additional details and exclusions, see "Selux Terms and Condition of Sale."

Certifications and Compliance:

NRTL - For Wet location
(I.E. cULus; cCSAus)
ARRA Compliant
RoHS Compliant
IC Rated (EM option is non-IC Rated)

HUBBELL Outdoor Lighting

DATE: LOCATION:

TYPE: PROJECT:

CATALOG #:

RATIO Wall

RWL1/RWL2 LED WALLPACK

FEATURES

- Low profile LED wall luminaire with a variety of IES distributions for lighting applications such as retail, commercial and industrial building mount
- Featuring Micro Strike Optics which maximizes target zone illumination with minimal losses at the house-side, reducing light trespass issues
- Visual comfort standard
- Control options including photo control, occupancy sensing, NX Distributed Intelligence™, Wiscape and 7-Pin with networked controls
- Battery Backup options available for emergency code compliance
- Quick-mount adapter allows easy installation/maintenance
- 347V and 480V versions for industrial applications and Canada
- Stock versions available in 3500lm and 5500lm configurations at 4000K

C US

BUY AMERICAN SOLUTIONS
See Certification Specifications

DLC QPL LISTED

DLC QPL LISTED PREMIUM

RELATED PRODUCTS

Ratio Family | Ratio Area | Ratio Flood

CONTROL TECHNOLOGY

SiteSync LIGHTING CONTROL | NX DISTRIBUTED™ INTELLIGENCE | wiSCAPE™

SPECIFICATIONS

CONSTRUCTION

- Die-cast housing with hidden vertical heat fins that are optimal for heat dissipation while keeping a clean smooth outer surface
- Corrosion resistant, die-cast aluminum housing with powder coat paint finish
- Powder paint finish provides durability in outdoor environments. Tested to meet 1000 hour salt spray rating.

OPTICS

- Entire optical aperture illuminates to create a larger luminous surface area resulting in a low glare appearance without sacrificing optical performance
- 48 or 160 midpower LEDs
- 3000K, 4000K or 5000K (70 CRI/80 CRI) CCT
- Zero uplight distributions
- LED optics provide IES type II, III and IV distributions. Type II only available in RWL2 configurations.

INSTALLATION

- Quick-mount adapter provides easy installation to wall or to recessed junction boxes (4" square junction box)
- Designed for direct j-box mount.
- Integral back box contains 1/2" conduit hubs
- Integral back box standard with Dual Driver, Dual Power Feed, NX, Wiscape and battery versions (battery versions for RWL1 only)

ELECTRICAL

- 120V-277V universal voltage 50/60Hz 0-10V dimming drivers
- 347V and 480V dimmable driver option for all wattages above 35W.

ELECTRICAL (CONTINUED)

- Ambient operating temperature -40˚C to 40˚C
- Drivers have greater than .90 power factor and less than 20% Total Harmonic Distortion
- Driver RoHS and IP66
- Field replaceable surge protection device provides 20kA protection meeting ANSI/IEEE C62.41.2 Category C High and Surge Location Category C3; Automatically takes fixture off-line for protection when device is compromised
- Dimming drivers are standard and dimming leads are extended out of the luminaire unless control options require connection to the dimming leads. Must specify if wiring leads are to be greater than 6" standard.

CONTROLS

- Photo control, occupancy sensor and wireless available for complete on/off and dimming control
- Button photocontrol is suitable for 120-277V operation
- 7-pin ANSI C136.41-2013 photocontrol receptacle option available for twist lock photocontrols or wireless control modules (control accessories sold separately)
- NX Distributed Intelligence™ available with in fixture wireless control module, features dimming and occupancy sensor wiSCAPE® available with in fixture wireless control module, features dimming and occupancy sensor
- Integral Battery Backup provides emergency lighting for the required 90 minute path of egress
- Battery Backup suitable for operating temperatures -25˚C to 40˚C

CONTROLS (CONTINUED)

- Dual Driver and Dual Power Feed options creates product configuration with 2 internal drivers for code compliance
- Please consult brand or sales representative when combining control and electrical options as some combinations may not operate as anticipated depending on your application.

CERTIFICATIONS

- Listed to UL1598 and CSAC22.2#250.0-24 for wet locations
- IP65 rated housing
- This product qualifies as a "designated country construction material" per FAR 52.225-11 Buy American-Construction Materials under Trade Agreements effective 04/23/2020. See Buy American Solutions
- DLC® (DesignLights Consortium Qualified), with some Premium Qualified configurations. Please refer to the DLC website for specific product qualifications at www.designlights.org

WARRANTY

- 5 year limited warranty
- See HLI Standard Warranty for additional information

KEY DATA	
Lumen Range	1,000–19,500
Wattage Range	10–155
Efficacy Range (LPW)	118–148
Fixture Projected Life (Hours)	L70>60K
Weights lbs. (kg)	6.5/16.5 (2.9/7.5)

HUBBELL Lighting

HUBBELL Outdoor Lighting

DATE: LOCATION:

TYPE: PROJECT:

CATALOG #:

RATIO WALL

RWL1/RWL2 LED WALLPACK

ORDERING GUIDE

Example: RWL1–48L-10–3K7–2–UNV–BLS–E

CATALOG #

ORDERING INFORMATION

Series		# LEDs - Wattage		CCT/CRI		Distribution		Voltage		Color	
RWL1	Ratio Wall 1	**48L-10**	1,000 Lumens[4]	**3K7**	3000K, 70 CRI	**2**	IES TYPE II[1]	**UNV**	120-277V	**BLT**	Black Matte Textured
		48L-15	2,000 Lumens[4]	**4K7**	4000K, 70 CRI	**3**	IES TYPE III	**120**	120V	**BLS**	Black Gloss Smooth
		48L-20	2,500 Lumens[4]	**5K7**	5000K, 70 CRI	**4W**	IES TYPE IV	**208**	208V	**DBT**	Dark Bronze Matte Textured
		48L-25	3,500 Lumens[4]					**240**	240V	**DBS**	Dark Bronze Gloss Smooth
		48L-35	4,500 Lumens					**277**	277V	**GTT**	Graphite Matte Textured
		48L-45	5,500 Lumens[4]					**347**	347V	**LGS**	Light Grey Gloss Smooth
RWL2	Ratio Wall 2	**160L-45**	6,500 Lumens					**480**	480V	**LGT**	Light Grey Matte Textured
		160L-50	7,500 Lumens							**PSS**	Platinum Silver Smooth
		160L-65	9,500 Lumens							**WHT**	White Matte Textured
		160L-80	11,000 Lumens							**WHS**	White Gloss Smooth
		160L-95	13,000 Lumens							**VGT**	Verde Green Textured
		160L-115	15,000 Lumens							**Color Option**	
		160L-135	17,500 Lumens							**CC**	Custom Color
		160L-155	19,500 Lumens								

Control Options Network	
NXWE	NX Wireless Enabled (module + radio)[4,7]
NXSPW_F	NX Wireless, PIR Occ. Sensor, Daylight Harvesting[4,5,7]
NXSP_F	NX, PIR Occ. Sensor, Daylight Harvesting[4,5,7]
WIR	Wireless Controls, wiSCAPE™[2,6]
Stand Alone Sensors	
SCP-8F	Remote control programmable line voltage sensor[3,4]
SCP-20F	Remote control programmable line voltage sensor[3,4]
Control Options	
7PR_	7-Pin Receptacle[6]

Options	
F	Fusing (must specify voltage)
E	Emergency Battery Backup[7,8,9]
EH	Emergency Battery w/ Heater Option[7,8,9]
2DR	Dual Driver[4,6]
2PF	Dual Power Feed[4,6]
PC	Button Photocontrol[8]

Notes:
1. Only available with RWL2
2. wiSCAPE Gateway required for system programming
3. Specific voltage selection is required
4. Not available with 480V
5. Replace "_" with "14" for up to 14' mounting height, "40" for up to 40' mounting height
6. This item is located in the integral backbox which will be automatically added onto the fixture if chosen.
7. This item is located in the integral backbox for RWL1 configurations only.
8. Option only available at 120 or 277V
9. Only available with RWL1

STOCK ORDERING INFORMATION

Catalog Number	Lumens	Wattage	LED Count	CCT/CRI	Voltage	Distribution	Finish
RWL1-48L-25-4K-3	3500lm	25	48L	4000K/70CRI	120-277V	Type III	Dark Bronze Textured
RWL1-48L-25-4K-4W	3500lm	25	48L	4000K/70CRI	120-277V	Type IV Wide	Dark Bronze Textured
RWL1-48L-45-4K-3	5500lm	45	48L	4000K/70CRI	120-277V	Type III	Dark Bronze Textured
RWL1-48L-45-4K-4W	5500lm	45	48L	4000K/70CRI	120-277V	Type IV Wide	Dark Bronze Textured

CONTROLS

Control Options	
Standalone	
SCPREMOTE	Order at least one per project location to program and control

ACCESSORIES AND REPLACEMENT PARTS - MADE TO ORDER

	Catalog Number	Description
☐	**WP-BB-XXX**	Accessory for conduit entry[1]

Notes:
1. replace "xxx" with color option

HUBBELL Lighting

HUBBELL Outdoor Lighting

DATE: LOCATION:

TYPE: PROJECT:

CATALOG #:

RATIO WALL

RWL1/RWL2 LED WALLPACK

PERFORMANCE DATA

Description	Nominal Wattage	System Watts	Dist. Type	5K (5000K NOMINAL 70 CRI)					4K (4000K NOMINAL 70 CRI)					3K (3000K NOMINAL 70 CRI)				
				Lumens	LPW	B	U	G	Lumens	LPW	B	U	G	Lumens	LPW	B	U	G
RWL1	10	10.1	3	1362	135	0	0	1	1355	134	0	0	1	1303	129	0	0	1
			4W	1343	133	0	0	1	1336	132	0	0	1	1285	127	0	0	1
	15	14.5	3	1972	136	1	0	1	1962	135	1	0	1	1887	130	1	0	1
			4W	1945	134	0	0	1	1935	133	0	0	1	1861	128	0	0	1
	20	19.9	3	2722	137	1	0	1	2709	136	1	0	1	2605	131	1	0	1
			4W	2685	135	1	0	1	2672	134	1	0	1	2569	129	1	0	1
	25	28.0	3	3749	134	1	0	1	3732	133	1	0	1	3588	128	1	0	1
			4W	3698	132	1	0	1	3680	131	1	0	1	3538	126	1	0	1
	35	36.9	3	4751	129	1	0	2	4728	128	1	0	2	4546	123	1	0	1
			4W	4685	127	1	0	2	4663	126	1	0	2	4483	121	1	0	2
	45	46.5	3	5812	125	1	0	2	5784	124	1	0	2	5562	120	1	0	2
			4W	5731	123	1	0	2	5704	123	1	0	2	5485	118	1	0	2
RWL2	45	46.1	2	6701	145	1	0	2	6668	145	1	0	2	6412	139	1	0	2
			3	6812	148	1	0	2	6780	147	1	0	2	6519	141	1	0	2
			4W	6678	145	1	0	2	6646	144	1	0	2	6390	139	1	0	2
	50	54.0	2	7747	143	1	0	2	7710	143	1	0	2	7413	137	1	0	2
			3	7876	146	1	0	2	7838	145	1	0	2	7537	140	1	0	2
			4W	7720	143	1	0	2	7683	142	1	0	2	7388	137	1	0	2
	65	67.2	2	9539	142	1	0	2	9494	141	1	0	2	9129	136	1	0	2
			3	9699	144	2	0	2	9652	144	2	0	2	9281	138	2	0	2
			4W	9507	141	2	0	2	9461	141	2	0	2	9097	135	2	0	2
	80	80.8	2	11228	139	2	0	2	11174	138	2	0	2	10745	133	2	0	2
			3	11416	141	2	0	2	11361	141	2	0	2	10924	135	2	0	2
			4W	11190	138	2	0	2	11136	138	2	0	2	10708	133	2	0	2
	95	93.2	2	13148	141	2	0	2	13085	140	2	0	2	12582	135	2	0	2
			3	13368	143	2	0	2	13304	143	2	0	2	12792	137	2	0	2
			4W	13103	141	2	0	2	13040	140	2	0	2	12539	135	2	0	2
	115	109.8	2	15102	138	2	0	3	15030	137	2	0	3	14452	132	2	0	3
			3	15354	140	2	0	3	15281	139	2	0	3	14693	134	2	0	3
			4W	15050	137	2	0	3	14978	136	2	0	3	14402	131	2	0	3
	135	137.1	2	17533	128	2	0	3	17449	127	2	0	3	16778	122	2	0	3
			3	17826	130	2	0	3	17740	129	2	0	3	17058	124	2	0	3
			4W	17473	127	2	0	3	17389	127	2	0	3	16720	122	2	0	3
	155	156.8	2	19495	124	2	0	3	19402	124	2	0	3	18656	119	2	0	3
			3	19821	126	2	0	3	19726	126	2	0	3	18967	121	2	0	3
			4W	19542	125	2	0	3	19448	124	2	0	3	18700	119	2	0	3

HUBBELL Lighting

HUBBELL Outdoor Lighting

DATE: LOCATION:

TYPE: PROJECT:

CATALOG #:

RATIO WALL

RWL1/RWL2 LED WALLPACK

LUMINAIRE AMBIENT TEMPERATURE FACTOR (LATF)

Ambient Temperature		Lumen Multiplier
0°C	32°F	1.03
10°C	50°F	1.01
20°C	68°F	1.00
25°C	77°F	1.00
30°C	86°F	0.99
40°C	104°F	0.98
50°C	122°F	0.97

Use these factors to determine relative lumen output for average ambient temperatures from 0-40°C (32-104°F).

PROJECTED LUMEN MAINTENANCE

Ambient Temperature	OPERATING HOURS					
	0	25,000	TM-21-11 L90 36,000	50,000	100,000	L70 (Hours)
25°C / 77°F	1.00	0.97	0.96	0.95	0.91	408,000
40°C / 104°F	0.99	0.96	0.95	0.94	0.89	356,000

ELECTRICAL DATA

# OF LEDS	Nominal Wattage	Input Voltage	Oper. Current (Amps)	System Power (Watts)
RWL1	10	120	0.08	10.1
		208	0.05	
		240	0.04	
		277	0.04	
		347	0.03	
		480	0.02	
	15	120	0.12	14.5
		208	0.07	
		240	0.06	
		277	0.05	
		347	0.04	
		480	0.03	
	20	120	0.17	19.9
		208	0.10	
		240	0.08	
		277	0.07	
		347	0.06	
		480	0.04	
	25	120	0.23	28.0
		208	0.13	
		240	0.12	
		277	0.10	
		347	0.08	
		480	0.06	
	35	120	0.31	36.9
		208	0.18	
		240	0.15	
		277	0.13	
		347	0.11	
		480	0.08	
	45	120	0.39	46.5
		208	0.22	
		240	0.19	
		277	0.17	
		347	0.13	
		480	0.10	

# OF LEDS	Nominal Wattage	Input Voltage	Oper. Current (Amps)	System Power (Watts)
RWL2	45	120	0.38	46.1
		208	0.22	
		240	0.19	
		277	0.17	
		347	0.13	
		480	0.10	
	50	120	0.45	54.0
		208	0.26	
		240	0.23	
		277	0.19	
		347	0.16	
		480	0.11	
	65	120	0.56	67.2
		208	0.32	
		240	0.28	
		277	0.24	
		347	0.19	
		480	0.14	
	80	120	0.67	80.8
		208	0.39	
		240	0.34	
		277	0.29	
		347	0.23	
		480	0.17	
	95	120	0.78	93.2
		208	0.45	
		240	0.39	
		277	0.34	
		347	0.27	
		480	0.19	
	115	120	0.92	109.8
		208	0.53	
		240	0.46	
		277	0.40	
		347	0.32	
		480	0.23	
	135	120	1.14	137.1
		208	0.66	
		240	0.57	
		277	0.49	
		347	0.40	
		480	0.29	
	155	120	1.31	156.8
		208	0.75	
		240	0.65	
		277	0.57	
		347	0.45	
		480	0.33	

HUBBELL Lighting

HUBBELL Outdoor Lighting

DATE: LOCATION:

TYPE: PROJECT:

CATALOG #:

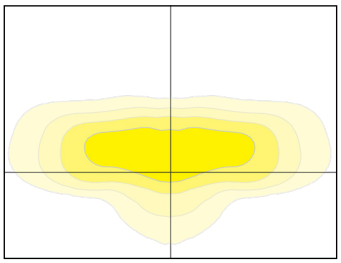
RATIO WALL

RWL1/RWL2 LED WALLPACK

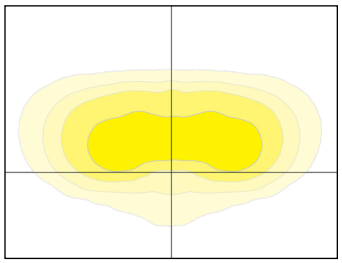
PHOTOMETRY

Mounting Height: 30ft

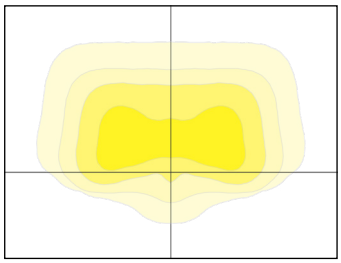
Type II



Type III

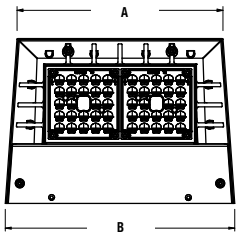


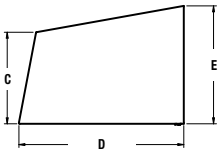
Type VI



DIMENSIONS

RWL1

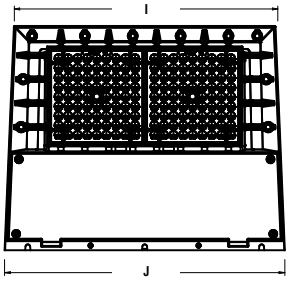


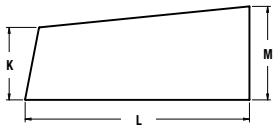


A	B	C	D	E
8.7"	9.7"	3.9"	7.0"	5.0"
221mm	246mm	99mm	178mm	127mm

Weight
6.5 lbs (2.95 kgs)

RWL2

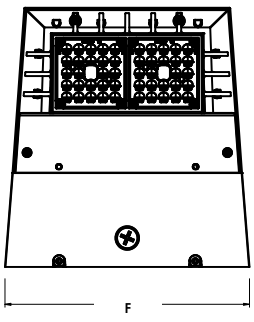


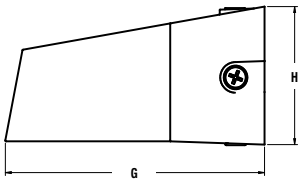


I	J	K	L	M
14.0"	15.0"	3.9"	12.0"	5.0"
356mm	381mm	99mm	305mm	127mm

Weight
16.5 lbs (7.48 kgs)

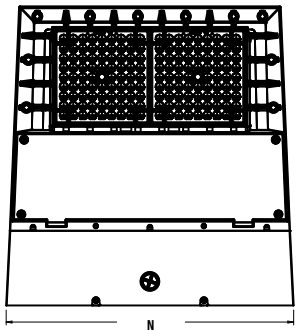
RWL1 with Integral Back Box

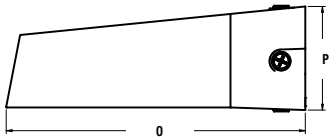




F	G	H
10.4"	11.0"	5.9"
264mm	279mm	150mm

RWL2 with Integral Back Box





N	O	P
15.4"	16.0"	5.5"
391mm	406mm	140mm

HUBBELL Lighting

DATE: LOCATION:

TYPE: PROJECT:

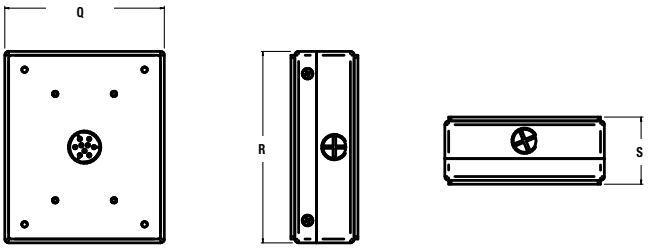
CATALOG #:

RATIO WALL

RWL1/RWL2 LED WALLPACK

DIMENSIONS (CONTINUED)

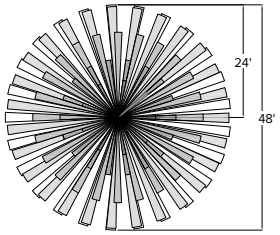
Back Box Accessory

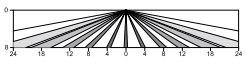


Q	R	S
4.9" 124mm	5.9" 150mm	2.1" 53mm

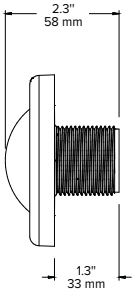
ADDITIONAL INFORMATION

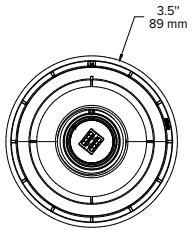
NXSP-14F



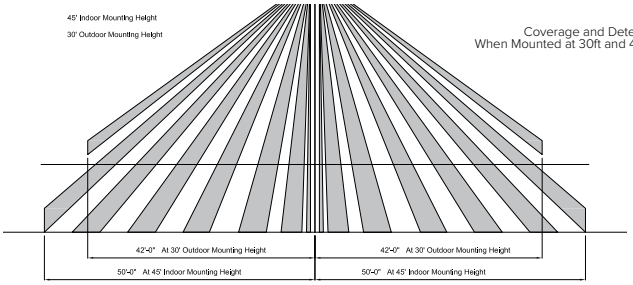


Sensor Lens Coverage and Detection Patterns
When Mounted at 8ft with Low Mount Lens

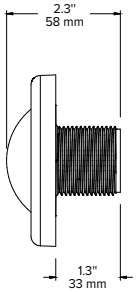


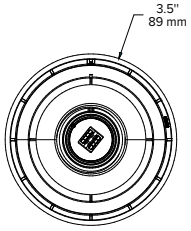


NXSP-40F

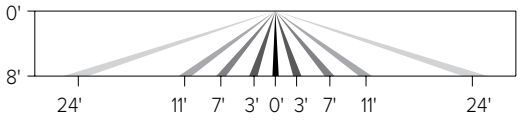


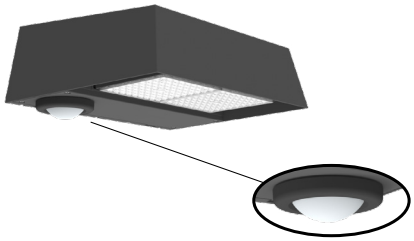
Coverage and Detection Patterns
When Mounted at 30ft and 45ft with Standard Lens

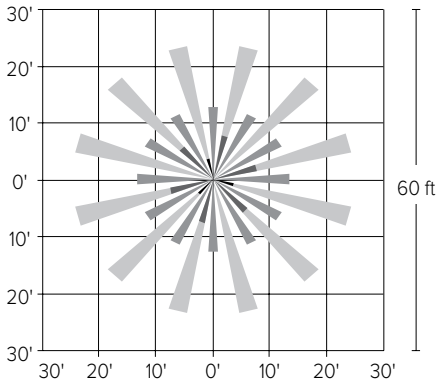


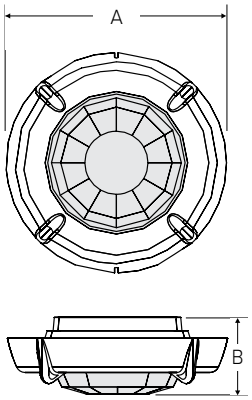


SCP-8F







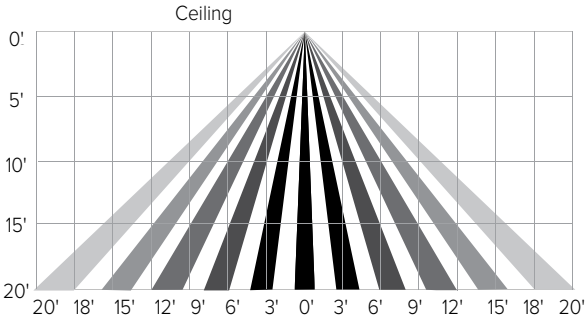


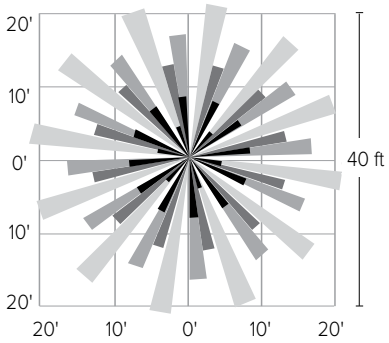
A	B
2.3" (59mm)	.8" (20mm)

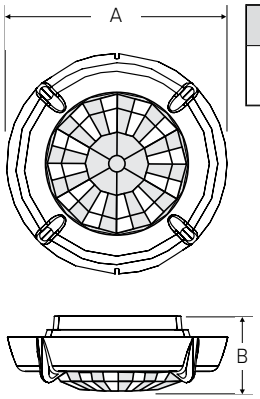
RATIO WALL

RWL1/RWL2 LED WALLPACK

SCP-20F

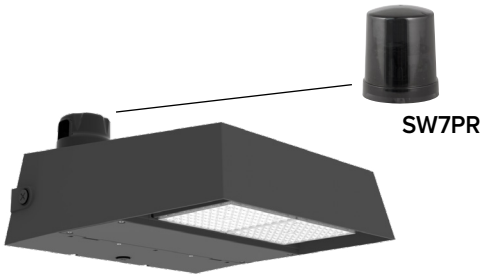






A	B
2.3" (59mm)	.8" (20mm)

SITESYNC 7-PIN MODULE



SW7PR

SiteSync™ LIGHTING CONTROL

- SiteSync features in a new form
- Available as an accessory for new construction or retrofit applications (with existing 7-Pin receptacle)

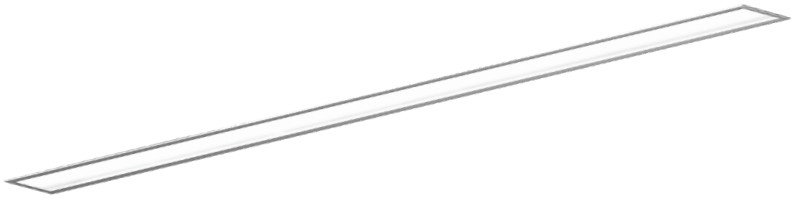
Date: _____ Customer: _____

Project: _____

Type: _____ Qty: _____

selux

M60 LED H_2O Recessed
for Wet Locations
(IP65 rated geartray and driver)



Order Code: _____ - _____ - _____ - _____ - _____ - _____ - _____ - _____ - _____ - _____ - _____ - _____ - _____ - CN22xxxx

_____	**Series**	**W60** M60 LED H_2O Multi-Mount Form for Wet Location	**W6R1** M60 LED H_2O Continuous Flange (Flanged Endcaps) for Wet Location	**W6R2** M60 LED H_2O Continuous Flange (Flangeless Endcaps) for Wet Location
_____	**Light Engine**	**1C45**[1,2] 80CRI-848lm 90CRI-712lm 11.1W per foot	**1C40**[1,2] 80CRI-794lm 90CRI-668lm 9.9W per foot	**1C35**[1] 80CRI-694lm 90CRI-584lm 8.7W per foot
		1C30[1] 80CRI-621lm 90CRI-522lm 7.3W per foot	**1C25**[1] 80CRI-495lm 90CRI-416lm 6.1W per foot	**1C20**[1] 80CRI-411lm 90CRI-346m 4.9W per foot
_____	**CCT**	**935** 3500K 90 CRI nominal	**940** 4000K 90 CRI nominal	**950** 5000K 90 CRI nominal
		955 5500K 90 CRI nominal	**835**[3]	**840**[3] **850**[3] **855**[3]
_____	**Shielding**	**LW** LED Optimized White Lens	**MI** Clear Lens with Microprism	**NB** LMO Symmetric with Satine Lens
		A2 LMO Asymmetric 20° Wall Washer with Satine Lens	**A5** LMO Asymmetric 5° Wall Grazer with Satine Lens	**BW** LMO Batwing with Satine Lens
_____	**Mounting W60** or **Mounting W6R1 or W6R2**	**SF1** Spackle Flange (½" Drywall)	**SF2** Spackle Flange (⅝" Drywall)	**SF3** Spackle Flange (After Drywall)
		SG Slot Grid (9⁄16") (Wire Suspension or ¼"-20 stud)	**DC** Decoustic Ceiling (up to 2" thick)	
		TB[4] T-Bar Length with suspension clips	**TBS**[4] T-Bar Length with 1" ¼"-20 Stud	**RC**[4] Rotating Crossbar (Ceilings ¼" to 2" thick)
		TS 1" ¼"-20 Stud		
_____	**Nominal Fixture Length**	**02**[5] 2 ft.	**03** 3 ft.	**04**[5] 4 ft.
		05[5] 5 ft.	**06**[5] 6 ft.	**07** 7 ft.
		08[5] 8 ft.	**XX** Runs (over 8') and Configurations, round up to the nearest foot and replace the "xx" with the # (i.e. 09=09' nominal)	
		Individual fixtures, Runs and Configurations are supplied in nominal lengths to ensure full, even, illumination. See pages 2 through 6 for additional details.		
_____	**Finish**	**WH** White	**BL** Semi-Matte Black	**SV** Silver
		SP Specify Premium Color		
_____	**Voltage**	**1** 120V	**2** 277V	**U** 120V through 277V 50/60hz capable
_____	**Driver**	**DIM**[6] 0-10V 1% (Linear)	**DIL**[6] eldoLED 1% ECOdrive 0-10V (Logarithmic)	**DED**[6] eldoLED 1% ECOdrive DALI-2 (Logarithmic)
		D01[6] eldoLED 0.1% SOLOdrive 0-10V (Linear)	**DL01**[6] eldoLED 0.1% SOLOdrive 0-10V (Logarithmic)	**DC2**[6,7] Lutron 1% 2-Wire
		DE1[6] Lutron 1% EcoSystem	**DC3** Lutron 1% 3-Wire (consult factory)	
_____	**Fixture Options**	**SS**[8] Separate Switching	**CCEA** CCEA approved	
_____	**Emergency Options**	**EC**[9] Emergency Circuit Wiring	**EMR** Remote Micro Inverter (consult factory)	
_____	**Configuration Options**	**L9** Lit Horizontal 90° Corner	**V9** Lit Inverted 90° Corner	**T9** Lit "T" section
		X9 Lit "X" section		
CN22xxxx		**CN22xxxx:** M60 LED with IP65 rated LED engine and IP rated driver		

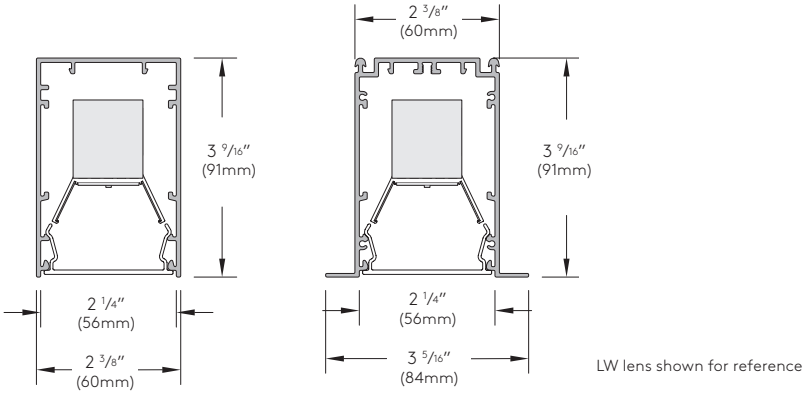
[1] Values calculated from a 4' fixture at 3500K, 90+ CRI using LW shielding and DIM driver. For additional information please see page 2.
[2] Not available with Lutron
[3] Consult factory
[4] L6R1 only
[5] Length intended to fit centered between the grid for SG, TB, TBS mountings
[6] See page 7 for full details
[7] 120V only
[8] See page 10 for details
[9] See page 10 for full details and restrictions

* See page 2 for details on CCT and CRI

* *Custom colors are available, please consult factory*

* 347V not available with EM integral battery option

* See pages 12 for full details and restrictions



LW lens shown for reference

Construction:

Housing - Continuous, low copper 6063-T6 extruded aluminum profile with aluminum endcaps, available as Individual fixtures (up to 8') or Runs.

Flange (W6R1 or W6R2 Series) - 9/16" (14mm) wide flange runs full lengths of both sides and is part of the main extruded body. Specify continuous flange (W6R1) or flush (W6R2) end cap. W6R2 does not work in T-Bar ceiling.

Geartray - Low copper 6063-T6 extruded aluminum profile. Geartray and connections encased in silicone for IP65 rating.

Shielding - Extruded, impact resistant acrylic snap in lens:
- LED Optimized White Lens (LW)
- Clear Lens with Microprism (MI)

"LMO" refers to the Selux proprietary LED optical system - Light modulation optics. These lenses are offered in M60 behind a Satine Lens for even illumination and comfortable lit appearance.
- "LMO" Symmetric Lens (NB)
- "LMO" Asymmetric 20° Wall Washer (A2)
- "LMO" Asymmetric 5° Wall Grazer (A5)
- "LMO" Batwing (BW)

Mounting(s) - Spackle-in (drywall), Slot grid, Decoustic, T-bar grid, Rotating Crossbar and Threaded Stud Mountings (see pages 3 through 6 for details).

Standard Luminaire lengths - All standard luminaires are supplied in nominal lengths to ensure full, even, illumination. Runs and Configurations are available in approximately 1/4" increments starting at the nominal 8' fixture length.
**Individual luminaires are not joinable in the field.

Exact length luminaires - Individual luminaires, Runs, and Configurations are available in exact lengths to meet your project needs. Please consult factory with you requirements.
**Lens luminance may soften at the very ends of the straight sections for exact length luminaires.

W60 Joiner(s) - Runs and Configurations are supplied in multiple housings that are joined together in the field using the supplied W60 Joiner System. This allows ease of installation and ensures a uniform appearance (see page 10 for detail).

Weight: 2.4 lb. per foot.

Electrical/Performance:

LED Light Engine - Brand-name mid-power LEDs create a high efficiency LED light engine able to provide a lumen maintenance of 95% at 25,000 hours and 90% at 60,000 hours at 25°C per TM-21 reports. Reported L70 greater than 60,000 hours.

Photometrics - Consult website or factory for IES Files. Independent photometric lumen measurement complies with IES LM-79-08 testing procedures. Due to the LED manufacturer's tolerances, the listed output has a ±5% tolerance. For outputs based on different optics or CCT, please see page 14 for details.

CCT - Available in four CCTs. LEDs have a color shift due to the silicone encapsulation, and the delivered nominal CCTs are listed below.

CRI - 90 CRI standard, consult factory 80 CRI.

CRI / CCT	Nominal CCT
935	3500K
940	4000K
950	5000K
955	5500K

All Drivers - High efficiency, constant current, soft start, Electronic Class 2 with a PFC>0.90. For more detailed information on the available drivers please see page 7.

Driver enclosure is IP65 rated, extruded aluminum case with silicone injection-molded plugs.

Emergency - Emergency Circuit and Remote Micro Inverter. For more details on EC, see page 10.

Thermal Performance:

Ambient Operating Temperature - Luminaires suitable for maximum ambient temperature of 35°C (95°F) for all drivers.

Luminaires are suitable for minimum ambient temperatures of -40°C (-40°F) for DIM, DIL, DED, D01, and DL01 drivers; 0°C (32°F) for DC2 and DE1 drivers.

Luminaire Finish:

Powder Coat - All Selux luminaries are finished in high quality polyester powder coating in our Tiger Drylac certified facility and are tested in accordance with test specifications for coatings from ASTM and PCI.

All products undergo a five stage intensive pretreatment process where product is thoroughly cleaned, phosphated, and sealed. Selux powder coated products provide excellent salt and humidity resistance as well as ultra violet resistance for color retention.

Standard interior colors are White (WH), Semi-Matte Black (BL), and Silver (SV). Selux premium colors (SP) are available, please specify from your Selux color selection guide.

Warranty:

5 Year Limited LED Luminaire Warranty - Selux offers a 5 Year Limited Warranty to the original purchaser that the M60 series LED luminaire shall be free from defects in material and workmanship for up to five (5) years from date of shipment. This limited warranty covers the LED driver and LED light engine when installed according to Selux instructions and operated within the Ambient Temperature. For additional details and exclusions, see "Selux Terms and Condition of Sale."

Certifications and Compliance:

NRTL - For Wet location
(I.E. cULus; cCSAus)
ARRA Compliant
RoHS Compliant
IC Rated (EM option is non-IC Rated)

Date: ______ Customer: ______

Project: ______

Type: ______ Qty: ______

selux

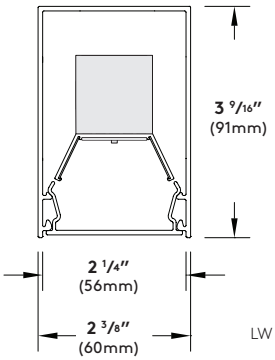
M60 LED H_2O Direct
for Wet Locations
(IP65 rated geartray and driver)

Order Code: W60 - ____ - ____ - ____ - ____ - ____ - ____ - ____ - ____ - ____ - ____ - ____ - CN22xxxx

	Category	Options	Notes
W60	Series	**W60** M60 LED H_2O	
	Light Engine	**1C45**[1,2] 80CRI-848lm, 90CRI-712lm, 11.1W per foot; **1C40**[1,2] 80CRI-794lm, 90CRI-668lm, 9.9W per foot; **1C35**[1] 80CRI-694lm, 90CRI-584lm, 8.7W per foot; **1C30**[1] 80CRI-621lm, 90CRI-522lm, 7.3W per foot; **1C25**[1] 80CRI-495lm, 90CRI-416lm, 6.1W per foot; **1C20**[1] 80CRI-411lm, 90CRI-346m, 4.9W per foot	[1] Values calculated from a 4' fixture at 3500K, 90+ CRI using LW shielding and DIM driver. For additional information please see page 2. [2] Not available with Lutron.
	CCT	**935** 3500K 90 CRI nominal; **940** 4000K 90 CRI nominal; **950** 5000K 90 CRI nominal; **955** 5500K 90 CRI nominal; **835**[3]; **840**[3]; **850**[3]; **855**[3]	* See page 2 for details on CCT and CRI. [3] Consult factory
	Shielding	**LW** LED Optimized White Lens; **MI** Clear Lens with Microprism; **NB** LMO Symmetric with Satine Lens; **A2** LMO Asymmetric 20° Wall Washer with Satine Lens; **A5** LMO Asymmetric 5° Wall Grazer with Satine Lens; **BW** LMO Batwing with Satine Lens	
	Mounting	**C** Cable; **S** Swivel Stem; **RS** Rigid Stem; **W** Wall Mount; **F**[4] Surface Mount	[4] Over 8' supplied with 2 or more housings that are joined in the field.
	Nominal Fixture Length	**02** 2 ft.; **03** 3 ft.; **04** 4 ft.; **05** 5 ft.; **06** 6 ft.; **07** 7 ft.; **08** 8 ft.; **09** 9 ft.; **10** 10 ft.; **11** 11 ft.; **12** 12 ft.; **XX** Runs (over 12') and Configurations, round up to the nearest foot and replace the "xx" with the # (i.e. 13=13' nominal). *Individual fixtures, Runs and Configurations are supplied in nominal lengths to ensure full, even, illumination. See pages 2 through 6 for additional details.*	
	Finish	**WH** White; **BL** Semi-Matte Black; **SV** Silver; **SP** Specify Premium Color	** Custom colors are available, please consult factory*
	Voltage	**1** 120V; **2** 277V; **U** 120V through 277V 50/60hz capable	
	Driver	**DIM**[5] 0-10V 1% (Linear); **DIL**[5] eldoLED 1% ECOdrive 0-10V (Logarithmic); **DED**[5] eldoLED 1% ECOdrive DALI-2 (Logarithmic); **D01**[5] eldoLED 0.1% SOLOdrive 0-10V (Linear); **DL01**[5] eldoLED 0.1% SOLOdrive 0-10V (Logarithmic); **DC2**[5,6] Lutron 1% 2-Wire; **DE1**[5] Lutron 1% EcoSystem; **DC3** Lutron 1% 3-Wire (consult factory)	[5] See page 7 for full details. [6] 120V only
	Fixture Options	**SS**[7] Separate Switching	[7] See page 10 for details
	Emergency Options	**EC**[8] Emergency Circuit Wiring; **EMR** Remote Micro Inverter (consult factory)	[8] See page 8 for full details and restrictions
	Configuration Options	**L9** Lit Horizontal 90° Corner; **V9** Lit Inverted 90° Corner; **T9** Lit "T" section; **X9** Lit "X" section	* See page 11 for full details and restrictions
CN22xxxx		**CN22xxxx:** M60 LED with IP65 rated LED engine and IP rated driver	

BUY AMERICAN · NRTL WET · 5 YEAR LED WARRANTY · ARRA Compliant · ADA Compliant · RoHS COMPLIANT · UNION MADE IBEW LOCAL 363 · LUTRON OEM ADVANTAGE

selux



LW lens shown for reference

Construction:

Housing - Continuous, low copper 6063-T6 extruded aluminum profile with aluminum endcaps, available as Individual fixtures (up to 12') or Runs.

Geartray - Low copper 6063-T6 extruded aluminum profile. Geartray and connections encased in silicone for IP65 rating.

Shielding - Extruded, impact resistant acrylic lens:
- LED Optimized White Lens (LW)
- Clear Lens with Microprism (MI)

"LMO" refers to the Selux proprietary LED optical system - Light modulation optics. These lenses are offered in M60 behind a Satine Lens for even illumination and comfortable lit appearance.
- "LMO" Symmetric Lens (NB)
- "LMO" Asymmetric 20° Wall Washer (A2)
- "LMO" Asymmetric 5° Wall Grazer (A5)
- "LMO" Batwing (BW)

Mounting(s) - 1/16" Aircraft Cable, Ø5/8" Swivel or Rigid Steel Stem, Wall Bracket, Surface mounting (see pages 3 through 6 for details).
**Cable, Stem and Wall mountings may not be symmetrical for Runs and Configurations due to the use of modular housing lengths. If symmetrical suspensions are required please consult the factory.

Standard Luminaire lengths - All standard luminaires are supplied in nominal lengths to ensure full, even, illumination. Runs and Configurations are available in approximately 1/4" increments starting at the nominal 12' fixture length.
**Individual luminaires are not joinable in the field.

Exact length luminaires - Individual luminaires, Runs, and Configurations are available in exact lengths to meet your project needs. Please consult factory with your requirements.
**Lens luminance may soften at the very ends of the straight sections for exact length luminaire.

W60 Joiner(s) - Runs and Configurations are supplied in multiple housings that are joined together in the field using the supplied W60 Joiner System. This allows ease of installation and ensures a uniform appearance (see page 9 for detail).

Weight: 2.4 lb. per foot.

Electrical/Performance:

LED Light Engine - Brand-name mid-power LEDs create a high efficiency LED light engine able to provide a lumen maintenance of 95% at 25,000 hours and 90% at 60,000 hours at 25°C per TM-21 reports. Reported L70 greater than 60,000 hours.

Photometrics - Consult website or factory for IES Files. Independent photometric lumen measurement complies with IES LM-79-08 testing procedures. Due to the LED manufacturer's tolerances, the listed output has a ±5% tolerance. For outputs based on different optics or CCT, please see page 13 for details.

CCT - Available in four CCTs. LEDs have a color shift due to the silicone encapsulation, and the delivered nominal CCTs are listed below.

CRI - 90 CRI standard, consult factory 80 CRI.

CRI / CCT	Nominal CCT
935	3500K
940	4000K
950	5000K
955	5500K

All Drivers - High efficiency, constant current, soft start, Electronic Class 2 with a PFC>0.90. For more detailed information on the available drivers please see page 7.

Driver enclosure is IP65 rated, extruded aluminum case with silicone injected-molded plugs.

Emergency - Emergency Circuit and Remote Micro Inverter. For more details on EC, see page 9.

Thermal Performance:

Ambient Operating Temperature - Luminaires suitable for maximum ambient temperature of 35°C (95°F) for all drivers.

Luminaires are suitable for minimum ambient temperatures of -40°C (-40°F) for DIM, DIL, DED, D01, and DL01 drivers; 0°C (32°F) for DC2 and DE1 drivers.

Luminaire Finish:

Powder Coat - All Selux luminaries are finished in high quality polyester powder coating in our Tiger Drylac certified facility and are tested in accordance with test specifications for coatings from ASTM and PCI.

All products undergo a five stage intensive pretreatment process where product is thoroughly cleaned, phosphated, and sealed. Selux powder coated products provide excellent salt and humidity resistance as well as ultra violet resistance for color retention.

Standard interior colors are White (WH), Semi-Matte Black (BL), and Silver (SV). Selux premium colors (SP) are available, please specify from your Selux color selection guide.

Warranty:

5 Year Limited LED Luminaire Warranty - Selux offers a 5 Year Limited Warranty to the original purchaser that the M60 series LED luminaire shall be free from defects in material and workmanship for up to five (5) years from date of shipment. This limited warranty covers the LED driver and LED light engine when installed according to Selux instructions and operated within the Ambient Temperature. For additional details and exclusions, see "Selux Terms and Condition of Sale."

Certifications and Compliance:

NRTL - For Wet location
(I.E. cULus; cCSAus)
ADA Compliant
ARRA Compliant
RoHS Compliant

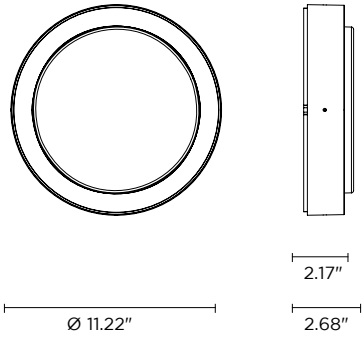
FRAME MAXI ROUND

datasheet

Frame Maxi Round is a 11.2” round, surface mounted luminaire that is suitable for outdoor installation on a façade/wall. It is available in 2 color temperatures, diffused optics and 3 standard finishes.

ADA Compliant

Fixture Dimensions:



TECHNICAL DATA

Wattage / Input	20W (700mA)
Power Supply	Remote, not included. See page 2.
Construction	Body: Extruded Copper-free Aluminum Lens: Tempered Glass Diffuser - White Painted Internally Cable Length: 0.98’ included
CCT	3000K, 4000K
BUG Rating	B1-U2-G1
Delivered Lumens	1010 lm (3000K)
Efficacy	50.5 lm/W
Optics	Diffused
Finishes	Textured Gray, Anthracite Gray, Matte Black
Fixture Dimensions	Ø11.2” x 2.68”
Fixture Weight	9.26 lbs
LED Source	48 Mid-Power SAMSUNG 2835 LED
IP Rating	IP65
IK Rating	IK09

ORDERING INFORMATION

Example: 402803P-30K-DIF-TG. Power Supplies ordered separately.

402803P	-		-	**DIF**	

Model No.	CCT	Optics	Finish
402803P	**30K** - 3000K **40K** - 4000K	**DIF** - Diffuse	**TG** - Textured Gray **AG** - Anthracite Gray **MB** - Matte Black
402803EMP	OPTIONAL VERSION WITH 3H EMERGENCY - on request		

Job Name/Date:

Fixture Type Designation:

sales@designplan.com
www.designplan.com

79 Trenton Avenue, Frenchtown NJ 08825

Published: May 25, 2022

P: 908-996-7710
F: 908-996-7042

SUGGESTED POWER SUPPLIES

700mA

Part Number	Description	Input/Output	# of Fixtures
PPLT00465-P	0-10V Dimming to 1.0%	120-277VAC to 700mA, 20W, Class 2, DAMP	1-1
PPLT00308-P	0-10V Dimming to 0.1%	120-277VAC to 700mA, 30W, Class 2, DAMP	1-1
PPLT00309-P	0-10V Dimming to 0.1%	120-277VAC to 700mA, 50W, Class 2	1-1
PPLT00538-P	0-10V Dimming to 0.1%	120-277VAC to 700mA, 100W, Class 2	1-4

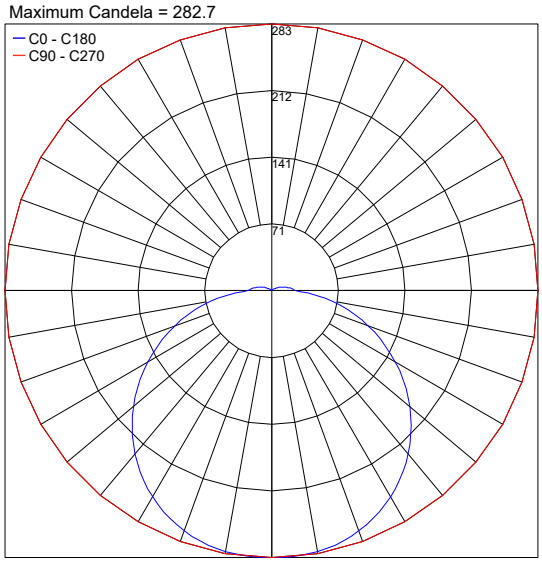
Suggested Lutron Compatible

Part Number	Option	Lutron SKU	Dim Range	Description	Input/Output	# of Fixtures
PPLT00510	LTEA2W	LTEA	100%-1%	Hi-Lume™ 1% 2-Wire LED Driver (120V forward phase only)	120VAC to 700mA, 38W, Class 2	1-1
PPLT00181	L3DAE / L3DA3W	L3DA	100%-1%	Hi-Lume™ 1% EcoSystem™ or 1% 3-Wire LED Driver	120-277VAC to 700mA, 38W, Class 2	1-1

For other power supply options consult factory.

PHOTOMETRIC DATA

Note: All photometry is 3000K



PHOTOMETRIC FILENAME : FRAME MAXI RD. 30K DIF 402803P.IES

Job Name/Date:

Fixture Type Designation:

sales@designplan.com
www.designplan.com

79 Trenton Avenue, Frenchtown NJ 08825

Published: May 25, 2022

P: 908-996-7710
F: 908-996-7042

HUBBELL Outdoor Lighting

DATE: LOCATION:

TYPE: PROJECT:

CATALOG #:

RATIO Wall

RWL1/RWL2 LED WALLPACK

FEATURES

- Low profile LED wall luminaire with a variety of IES distributions for lighting applications such as retail, commercial and industrial building mount
- Featuring Micro Strike Optics which maximizes target zone illumination with minimal losses at the house-side, reducing light trespass issues
- Visual comfort standard
- Control options including photo control, occupancy sensing, NX Distributed Intelligence™, Wiscape and 7-Pin with networked controls
- Battery Backup options available for emergency code compliance
- Quick-mount adapter allows easy installation/maintenance
- 347V and 480V versions for industrial applications and Canada
- Stock versions available in 3500lm and 5500lm configurations at 4000K

C US

BUY AMERICAN SOLUTIONS
See Certification Specifications

DLC QPL LISTED

DLC QPL LISTED PREMIUM

RELATED PRODUCTS

Ratio Family | Ratio Area | Ratio Flood

CONTROL TECHNOLOGY

SiteSync LIGHTING CONTROL | NX DISTRIBUTED™ INTELLIGENCE | wiSCAPE™

SPECIFICATIONS

CONSTRUCTION

- Die-cast housing with hidden vertical heat fins that are optimal for heat dissipation while keeping a clean smooth outer surface
- Corrosion resistant, die-cast aluminum housing with powder coat paint finish
- Powder paint finish provides durability in outdoor environments. Tested to meet 1000 hour salt spray rating.

OPTICS

- Entire optical aperture illuminates to create a larger luminous surface area resulting in a low glare appearance without sacrificing optical performance
- 48 or 160 midpower LEDs
- 3000K, 4000K or 5000K (70 CRI/80 CRI) CCT
- Zero uplight distributions
- LED optics provide IES type II, III and IV distributions. Type II only available in RWL2 configurations.

INSTALLATION

- Quick-mount adapter provides easy installation to wall or to recessed junction boxes (4" square junction box)
- Designed for direct j-box mount.
- Integral back box contains 1/2" conduit hubs
- Integral back box standard with Dual Driver, Dual Power Feed, NX, Wiscape and battery versions (battery versions for RWL1 only)

ELECTRICAL

- 120V-277V universal voltage 50/60Hz 0-10V dimming drivers
- 347V and 480V dimmable driver option for all wattages above 35W.

ELECTRICAL (CONTINUED)

- Ambient operating temperature -40˚C to 40˚C
- Drivers have greater than .90 power factor and less than 20% Total Harmonic Distortion
- Driver RoHS and IP66
- Field replaceable surge protection device provides 20kA protection meeting ANSI/IEEE C62.41.2 Category C High and Surge Location Category C3; Automatically takes fixture off-line for protection when device is compromised
- Dimming drivers are standard and dimming leads are extended out of the luminaire unless control options require connection to the dimming leads. Must specify if wiring leads are to be greater than 6" standard.

CONTROLS

- Photo control, occupancy sensor and wireless available for complete on/off and dimming control
- Button photocontrol is suitable for 120-277V operation
- 7-pin ANSI C136.41-2013 photocontrol receptacle option available for twist lock photocontrols or wireless control modules (control accessories sold separately)
- NX Distributed Intelligence™ available with in fixture wireless control module, features dimming and occupancy sensor wiSCAPE® available with in fixture wireless control module, features dimming and occupancy sensor
- Integral Battery Backup provides emergency lighting for the required 90 minute path of egress
- Battery Backup suitable for operating temperatures -25˚C to 40˚C

CONTROLS (CONTINUED)

- Dual Driver and Dual Power Feed options creates product configuration with 2 internal drivers for code compliance
- Please consult brand or sales representative when combining control and electrical options as some combinations may not operate as anticipated depending on your application.

CERTIFICATIONS

- Listed to UL1598 and CSAC22.2#250.0-24 for wet locations
- IP65 rated housing
- This product qualifies as a "designated country construction material" per FAR 52.225-11 Buy American-Construction Materials under Trade Agreements effective 04/23/2020. See Buy American Solutions
- DLC® (DesignLights Consortium Qualified), with some Premium Qualified configurations. Please refer to the DLC website for specific product qualifications at www.designlights.org

WARRANTY

- 5 year limited warranty
- See HLI Standard Warranty for additional information

KEY DATA	
Lumen Range	1,000–19,500
Wattage Range	10–155
Efficacy Range (LPW)	118–148
Fixture Projected Life (Hours)	L70>60K
Weights lbs. (kg)	6.5/16.5 (2.9/7.5)

HUBBELL Lighting

HUBBELL Outdoor Lighting

DATE: LOCATION:

TYPE: PROJECT:

CATALOG #:

RATIO WALL

RWL1/RWL2 LED WALLPACK

ORDERING GUIDE

Example: RWL1–48L-10–3K7–2–UNV–BLS–E

CATALOG #

ORDERING INFORMATION

Series		# LEDs - Wattage		CCT/CRI		Distribution		Voltage		Color	
RWL1	Ratio Wall 1	**48L-10**	1,000 Lumens[4]	**3K7**	3000K, 70 CRI	**2**	IES TYPE II[1]	**UNV**	120-277V	**BLT**	Black Matte Textured
		48L-15	2,000 Lumens[4]	**4K7**	4000K, 70 CRI	**3**	IES TYPE III	**120**	120V	**BLS**	Black Gloss Smooth
		48L-20	2,500 Lumens[4]	**5K7**	5000K, 70 CRI	**4W**	IES TYPE IV	**208**	208V	**DBT**	Dark Bronze Matte Textured
		48L-25	3,500 Lumens[4]					**240**	240V	**DBS**	Dark Bronze Gloss Smooth
		48L-35	4,500 Lumens					**277**	277V	**GTT**	Graphite Matte Textured
		48L-45	5,500 Lumens[4]					**347**	347V	**LGS**	Light Grey Gloss Smooth
RWL2	Ratio Wall 2	**160L-45**	6,500 Lumens					**480**	480V	**LGT**	Light Grey Matte Textured
		160L-50	7,500 Lumens							**PSS**	Platinum Silver Smooth
		160L-65	9,500 Lumens							**WHT**	White Matte Textured
		160L-80	11,000 Lumens							**WHS**	White Gloss Smooth
		160L-95	13,000 Lumens							**VGT**	Verde Green Textured
		160L-115	15,000 Lumens							**Color Option**	
		160L-135	17,500 Lumens							**CC**	Custom Color
		160L-155	19,500 Lumens								

Control Options Network	
NXWE	NX Wireless Enabled (module + radio)[4,7]
NXSPW_F	NX Wireless, PIR Occ. Sensor, Daylight Harvesting[4,5,7]
NXSP_F	NX, PIR Occ. Sensor, Daylight Harvesting[4,5,7]
WIR	Wireless Controls, wiSCAPE™[2,6]
Stand Alone Sensors	
SCP-8F	Remote control programmable line voltage sensor[3,4]
SCP-20F	Remote control programmable line voltage sensor[3,4]
Control Options	
7PR_	7-Pin Receptacle[6]

Options	
F	Fusing (must specify voltage)
E	Emergency Battery Backup[7,8,9]
EH	Emergency Battery w/ Heater Option[7,8,9]
2DR	Dual Driver[4,6]
2PF	Dual Power Feed[4,6]
PC	Button Photocontrol[8]

Notes:
1. Only available with RWL2
2. wiSCAPE Gateway required for system programming
3. Specific voltage selection is required
4. Not available with 480V
5. Replace "_" with "14" for up to 14' mounting height, "40" for up to 40' mounting height
6. This item is located in the integral backbox which will be automatically added onto the fixture if chosen.
7. This item is located in the integral backbox for RWL1 configurations only.
8. Option only available at 120 or 277V
9. Only available with RWL1

STOCK ORDERING INFORMATION

Catalog Number	Lumens	Wattage	LED Count	CCT/CRI	Voltage	Distribution	Finish
RWL1-48L-25-4K-3	3500lm	25	48L	4000K/70CRI	120-277V	Type III	Dark Bronze Textured
RWL1-48L-25-4K-4W	3500lm	25	48L	4000K/70CRI	120-277V	Type IV Wide	Dark Bronze Textured
RWL1-48L-45-4K-3	5500lm	45	48L	4000K/70CRI	120-277V	Type III	Dark Bronze Textured
RWL1-48L-45-4K-4W	5500lm	45	48L	4000K/70CRI	120-277V	Type IV Wide	Dark Bronze Textured

CONTROLS

Control Options	
Standalone	
SCPREMOTE	Order at least one per project location to program and control

ACCESSORIES AND REPLACEMENT PARTS - MADE TO ORDER

	Catalog Number	Description
☐	**WP-BB-XXX**	Accessory for conduit entry[1]

Notes:
1. replace "xxx" with color option

HUBBELL Lighting

HUBBELL Outdoor Lighting

DATE: LOCATION:

TYPE: PROJECT:

CATALOG #:

RATIO WALL

RWL1/RWL2 LED WALLPACK

PERFORMANCE DATA

Description	Nominal Wattage	System Watts	Dist. Type	5K (5000K NOMINAL 70 CRI)					4K (4000K NOMINAL 70 CRI)					3K (3000K NOMINAL 70 CRI)				
				Lumens	LPW	B	U	G	Lumens	LPW	B	U	G	Lumens	LPW	B	U	G
RWL1	10	10.1	3	1362	135	0	0	1	1355	134	0	0	1	1303	129	0	0	1
			4W	1343	133	0	0	1	1336	132	0	0	1	1285	127	0	0	1
	15	14.5	3	1972	136	1	0	1	1962	135	1	0	1	1887	130	1	0	1
			4W	1945	134	0	0	1	1935	133	0	0	1	1861	128	0	0	1
	20	19.9	3	2722	137	1	0	1	2709	136	1	0	1	2605	131	1	0	1
			4W	2685	135	1	0	1	2672	134	1	0	1	2569	129	1	0	1
	25	28.0	3	3749	134	1	0	1	3732	133	1	0	1	3588	128	1	0	1
			4W	3698	132	1	0	1	3680	131	1	0	1	3538	126	1	0	1
	35	36.9	3	4751	129	1	0	2	4728	128	1	0	2	4546	123	1	0	1
			4W	4685	127	1	0	2	4663	126	1	0	2	4483	121	1	0	2
	45	46.5	3	5812	125	1	0	2	5784	124	1	0	2	5562	120	1	0	2
			4W	5731	123	1	0	2	5704	123	1	0	2	5485	118	1	0	2
RWL2	45	46.1	2	6701	145	1	0	2	6668	145	1	0	2	6412	139	1	0	2
			3	6812	148	1	0	2	6780	147	1	0	2	6519	141	1	0	2
			4W	6678	145	1	0	2	6646	144	1	0	2	6390	139	1	0	2
	50	54.0	2	7747	143	1	0	2	7710	143	1	0	2	7413	137	1	0	2
			3	7876	146	1	0	2	7838	145	1	0	2	7537	140	1	0	2
			4W	7720	143	1	0	2	7683	142	1	0	2	7388	137	1	0	2
	65	67.2	2	9539	142	1	0	2	9494	141	1	0	2	9129	136	1	0	2
			3	9699	144	2	0	2	9652	144	2	0	2	9281	138	2	0	2
			4W	9507	141	2	0	2	9461	141	2	0	2	9097	135	2	0	2
	80	80.8	2	11228	139	2	0	2	11174	138	2	0	2	10745	133	2	0	2
			3	11416	141	2	0	2	11361	141	2	0	2	10924	135	2	0	2
			4W	11190	138	2	0	2	11136	138	2	0	2	10708	133	2	0	2
	95	93.2	2	13148	141	2	0	2	13085	140	2	0	2	12582	135	2	0	2
			3	13368	143	2	0	2	13304	143	2	0	2	12792	137	2	0	2
			4W	13103	141	2	0	2	13040	140	2	0	2	12539	135	2	0	2
	115	109.8	2	15102	138	2	0	3	15030	137	2	0	3	14452	132	2	0	3
			3	15354	140	2	0	3	15281	139	2	0	3	14693	134	2	0	3
			4W	15050	137	2	0	3	14978	136	2	0	3	14402	131	2	0	3
	135	137.1	2	17533	128	2	0	3	17449	127	2	0	3	16778	122	2	0	3
			3	17826	130	2	0	3	17740	129	2	0	3	17058	124	2	0	3
			4W	17473	127	2	0	3	17389	127	2	0	3	16720	122	2	0	3
	155	156.8	2	19495	124	2	0	3	19402	124	2	0	3	18656	119	2	0	3
			3	19821	126	2	0	3	19726	126	2	0	3	18967	121	2	0	3
			4W	19542	125	2	0	3	19448	124	2	0	3	18700	119	2	0	3

HUBBELL Lighting

HUBBELL Outdoor Lighting

DATE: LOCATION:

TYPE: PROJECT:

CATALOG #:

RATIO WALL

RWL1/RWL2 LED WALLPACK

LUMINAIRE AMBIENT TEMPERATURE FACTOR (LATF)

Ambient Temperature		Lumen Multiplier
0°C	32°F	1.03
10°C	50°F	1.01
20°C	68°F	1.00
25°C	77°F	1.00
30°C	86°F	0.99
40°C	104°F	0.98
50°C	122°F	0.97

Use these factors to determine relative lumen output for average ambient temperatures from 0-40°C (32-104°F).

PROJECTED LUMEN MAINTENANCE

Ambient Temperature	OPERATING HOURS					
	0	25,000	TM-21-11 L90 36,000	50,000	100,000	L70 (Hours)
25°C / 77°F	1.00	0.97	0.96	0.95	0.91	408,000
40°C / 104°F	0.99	0.96	0.95	0.94	0.89	356,000

ELECTRICAL DATA

# OF LEDS	Nominal Wattage	Input Voltage	Oper. Current (Amps)	System Power (Watts)
RWL1	10	120	0.08	10.1
		208	0.05	
		240	0.04	
		277	0.04	
		347	0.03	
		480	0.02	
	15	120	0.12	14.5
		208	0.07	
		240	0.06	
		277	0.05	
		347	0.04	
		480	0.03	
	20	120	0.17	19.9
		208	0.10	
		240	0.08	
		277	0.07	
		347	0.06	
		480	0.04	
	25	120	0.23	28.0
		208	0.13	
		240	0.12	
		277	0.10	
		347	0.08	
		480	0.06	
	35	120	0.31	36.9
		208	0.18	
		240	0.15	
		277	0.13	
		347	0.11	
		480	0.08	
	45	120	0.39	46.5
		208	0.22	
		240	0.19	
		277	0.17	
		347	0.13	
		480	0.10	

# OF LEDS	Nominal Wattage	Input Voltage	Oper. Current (Amps)	System Power (Watts)
RWL2	45	120	0.38	46.1
		208	0.22	
		240	0.19	
		277	0.17	
		347	0.13	
		480	0.10	
	50	120	0.45	54.0
		208	0.26	
		240	0.23	
		277	0.19	
		347	0.16	
		480	0.11	
	65	120	0.56	67.2
		208	0.32	
		240	0.28	
		277	0.24	
		347	0.19	
		480	0.14	
	80	120	0.67	80.8
		208	0.39	
		240	0.34	
		277	0.29	
		347	0.23	
		480	0.17	
	95	120	0.78	93.2
		208	0.45	
		240	0.39	
		277	0.34	
		347	0.27	
		480	0.19	
	115	120	0.92	109.8
		208	0.53	
		240	0.46	
		277	0.40	
		347	0.32	
		480	0.23	
	135	120	1.14	137.1
		208	0.66	
		240	0.57	
		277	0.49	
		347	0.40	
		480	0.29	
	155	120	1.31	156.8
		208	0.75	
		240	0.65	
		277	0.57	
		347	0.45	
		480	0.33	

HUBBELL Lighting

HUBBELL Outdoor Lighting

DATE: LOCATION:

TYPE: PROJECT:

CATALOG #:

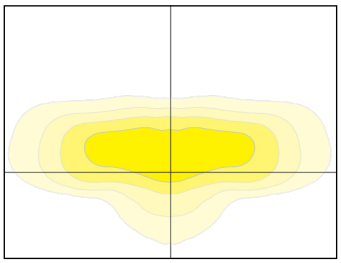
RATIO WALL

RWL1/RWL2 LED WALLPACK

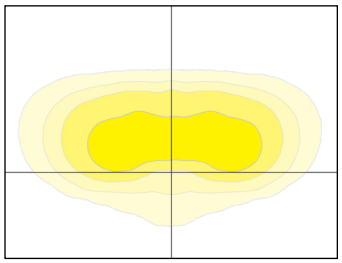
PHOTOMETRY

Mounting Height: 30ft

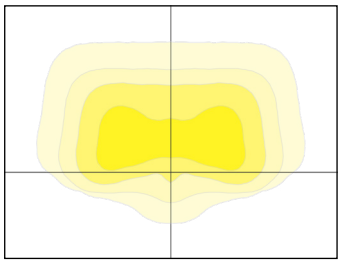
Type II



Type III

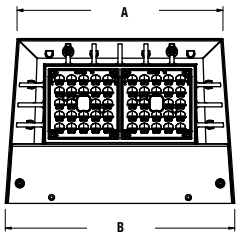


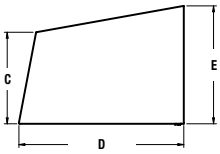
Type VI



DIMENSIONS

RWL1

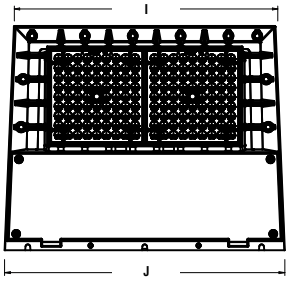


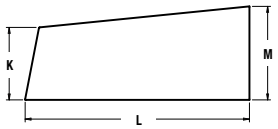


A	B	C	D	E
8.7"	9.7"	3.9"	7.0"	5.0"
221mm	246mm	99mm	178mm	127mm

Weight
6.5 lbs (2.95 kgs)

RWL2

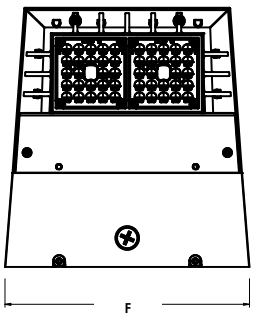


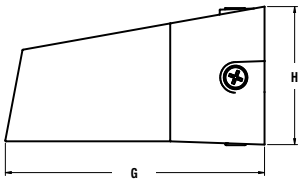


I	J	K	L	M
14.0"	15.0"	3.9"	12.0"	5.0"
356mm	381mm	99mm	305mm	127mm

Weight
16.5 lbs (7.48 kgs)

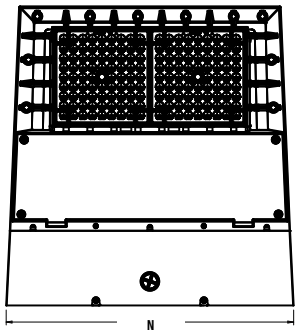
RWL1 with Integral Back Box

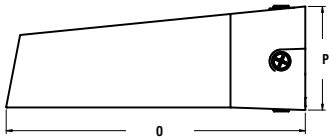




F	G	H
10.4"	11.0"	5.9"
264mm	279mm	150mm

RWL2 with Integral Back Box





N	O	P
15.4"	16.0"	5.5"
391mm	406mm	140mm

HUBBELL Lighting

DATE: LOCATION:

TYPE: PROJECT:

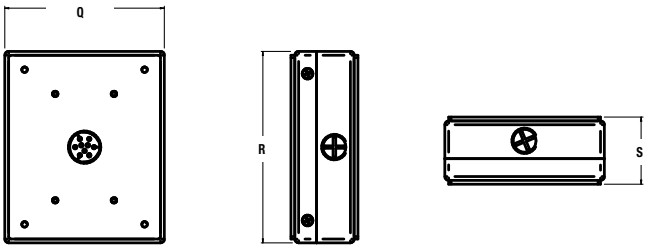
CATALOG #:

RATIO WALL

RWL1/RWL2 LED WALLPACK

DIMENSIONS (CONTINUED)

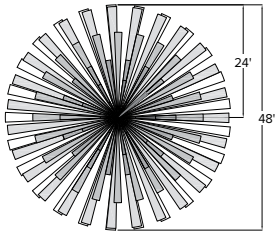
Back Box Accessory

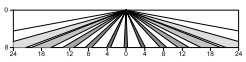


Q	R	S
4.9" 124mm	5.9" 150mm	2.1" 53mm

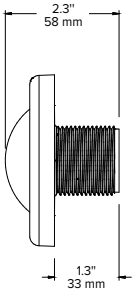
ADDITIONAL INFORMATION

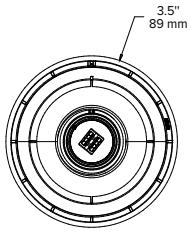
NXSP-14F



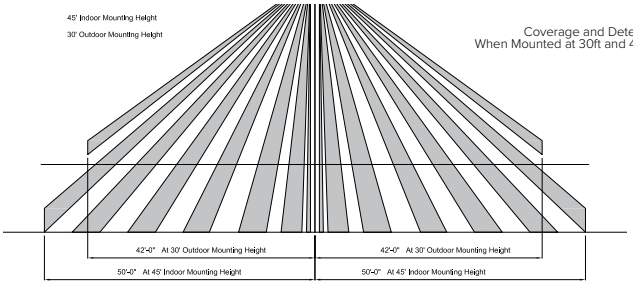


Sensor Lens Coverage and Detection Patterns
When Mounted at 8ft with Low Mount Lens

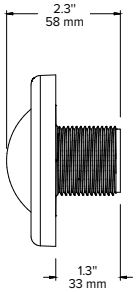


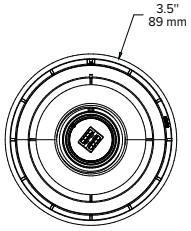


NXSP-40F

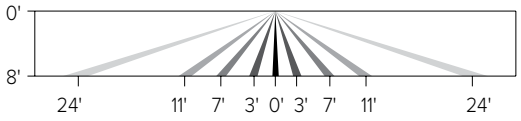


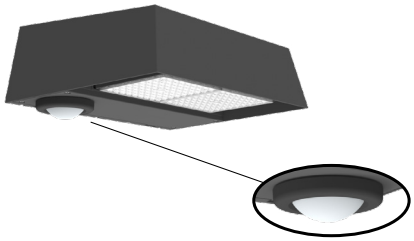
Coverage and Detection Patterns
When Mounted at 30ft and 45ft with Standard Lens

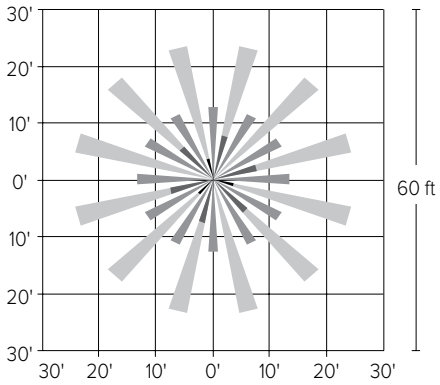


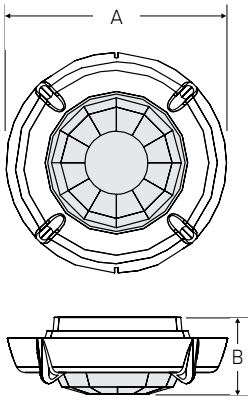


SCP-8F







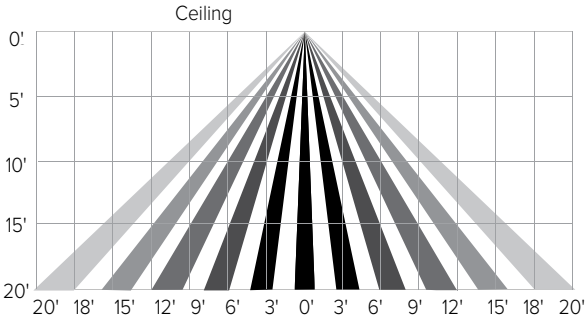


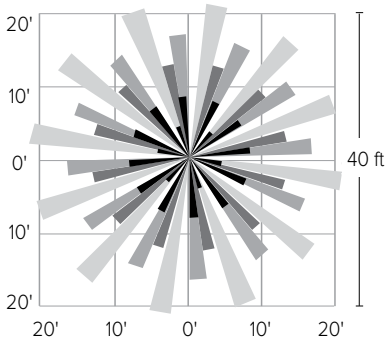
A	B
2.3" (59mm)	.8" (20mm)

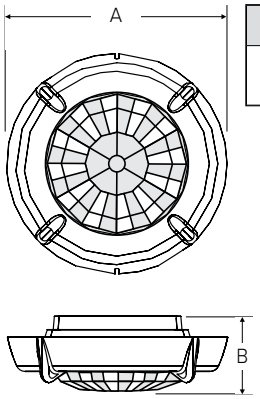
RATIO WALL

RWL1/RWL2 LED WALLPACK

SCP-20F

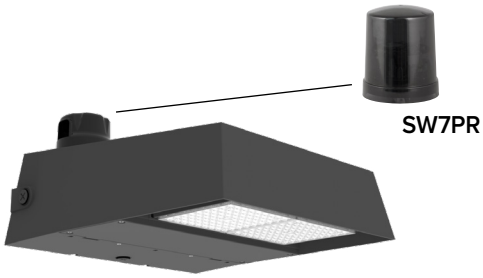






A	B
2.3" (59mm)	.8" (20mm)

SITESYNC 7-PIN MODULE



SW7PR

SiteSync™ LIGHTING CONTROL

- SiteSync features in a new form
- Available as an accessory for new construction or retrofit applications (with existing 7-Pin receptacle)

RSA-H SERIES POLES
ROUND STRAIGHT ALUMINUM

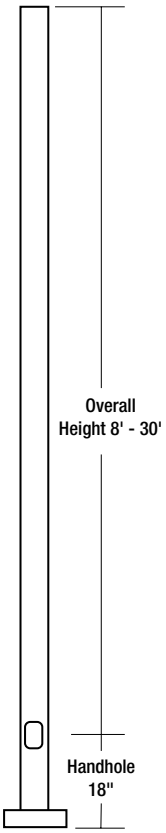
Cat.#

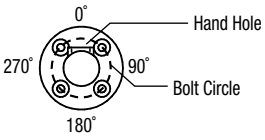
Job

Type

HUBBELL Outdoor Lighting

Approvals





APPLICATIONS

- Lighting installations for side and top mounting of luminaires with effective projected area (EPA) not exceeding maximum allowable loading of the specified pole in its installed geographic location

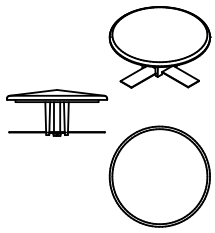
CONSTRUCTION

- SHAFT: One-piece straight aluminum with round cross section; Extruded shafts of 6061-T6 aluminum in 1/8", 3/16", or 1/4" thickness. Base plate of 356 cast aluminum.
- BOLT COVERS: Four (4) individual bolt covers provided, painted to match pole and base finish.
- BASE COVER: 2-Piece base cover supplied with 3" diameter poles
- POLE CAP: Pole shaft supplied with removable cover when applicable; Tenon and post-top configurations also available
- HAND HOLE: Rectangular 3x5 aluminum hand hole frame (2.38" x 4.38" opening); Mounting provisions for grounding lug located behind gasketed cover
- ANCHOR BOLTS: Four galvanized anchor bolts provided per pole with minimum yield of 55,000 psi (ASTM F1554). Galvanized hardware with two washers and two nuts per bolt for leveling

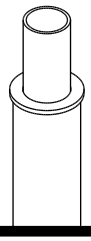
FINISH

- Durable thermoset polyester powder coat paint finish with nominal 3.0 mil thickness
- Powder paint finish coat available in multiple standard colors; Custom colors available; RAL number preferable.

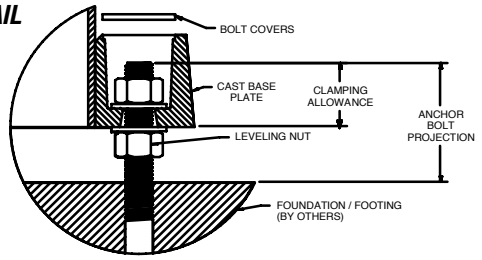
POLE CAP



TENON



BASE DETAIL



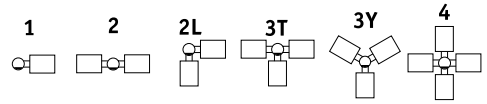
ORDERING EXAMPLE:

RSA-H - 16 - 40 - A/B/C - 2L - S2 - DBT - VM2

SERIES	HEIGHT	SHAFT	THICKNESS
RSA-H Round Straight Aluminum Pole Hubbell Outdoor	Reference page 2 Ordering matrix	Reference page 2 Ordering matrix	Reference page 2 Ordering matrix

MOUNTING ORIENTATION

Denotes handhole location



MOUNTING	
1	Single arm mount
2	Two fixtures at 180˚
2L	Two fixtures at 90˚
3T	Three fixtures at 90˚
3Y	Three at 120˚
4	Four fixtures at 90˚
TA	Tenon (2.375" OD)
TB	Tenon (2.875" OD)
OT	Open top (includes pole cap)

FINISH	
BLT	Black Matte Textured
BLS	Black Gloss Smooth
DBT	Dark Bronze Matte Textured
DBS	Dark Bronze Gloss Smooth
GTT	Graphite Matte Textured
LGS	Light Grey Gloss Smooth
PSS	Platinum Silver Smooth
WHT	White Matte Textured
WHS	White Gloss Smooth
VGT	Verde Green Textured

Color Option	
CC	Custom Color

OPTIONS	
GFI[1]	20 Amp GFCI Receptacle and Cover
EHH[1]	Extra Handhole
C05[1]	.5" Coupling
C07[1]	.75" Coupling
C20[1]	2" Coupling
VM2	2nd mode vibration damper
LAB	Less Anchor Bolts

DRILL PATTERN	
B3	2 bolt (2-½" spacing), Ratio
S2	2 bolt (3-½" spacing)

1 Specify option location using logic found on page 2 **(Option Orientation)**

ACCESSORIES- Order Separately

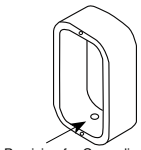
Catalog Number	Description
VM2SXX	2nd mode vibration damper

ORDERING INFORMATION Cont.

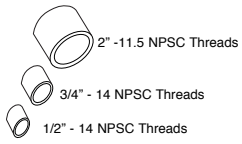
Catalog Number	Height		Nominal Shaft Dimensions	Wall Thick-ness	Bolt Circle (suggested)	Bolt Square (range)	Base Plate Diameter	Anchor bolt size	Bolt Projection	Pole weight (lbs)
	Feet	Meters								
RSA-H-08-30-A	8	2.4	3" Round	.125	6"	5.66	TRIANGULAR	5/8 x 24 x 3	2-3/4"	18
RSA-H-08-30-C	8	2.4	3" Round	.25	6"	5.66	TRIANGULAR	5/8 x 24 x 3	2-3/4"	28
RSA-H-10-40-A	10	3.0	4" Round	.125	6.75"	4.77	9.62" Dia x 1.88" Thk	3/4 x 30 x 3	2-3/4"	27
RSA-H-12-40-A	12	3.7	4" Round	.125	6.75"	4.77	9.62" Dia x 1.88" Thk	3/4 x 30 x 3	2-3/4"	31
RSA-H-14-40-A	14	4.3	4" Round	.125	6.75"	4.77	9.62" Dia x 1.88" Thk	3/4 x 30 x 3	2-3/4"	36
RSA-H-16-40-A	16	4.9	4" Round	.125	6.75"	4.77	9.62" Dia x 1.88" Thk	3/4 x 30 x 3	2-3/4"	40
RSA-H-18-40-A	18	5.5	4" Round	.125	6.75"	4.77	9.62" Dia x 1.88" Thk	3/4 x 30 x 3	2-3/4"	45
RSA-H-20-40-A	20	6.1	4" Round	.125	6.75"	4.77	9.62" Dia x 1.88" Thk	3/4 x 30 x 3	2-3/4"	50
RSA-H-10-40-B	10	3.0	4" Round	.188	6.75"	4.77	9.62" Dia x 1.88" Thk	3/4 x 30 x 3	2-3/4"	38
RSA-H-12-40-B	12	3.7	4" Round	.188	6.75"	4.77	9.62" Dia x 1.88" Thk	3/4 x 30 x 3	2-3/4"	44
RSA-H-14-40-B	14	4.3	4" Round	.188	6.75"	4.77	9.62" Dia x 1.88" Thk	3/4 x 30 x 3	2-3/4"	51
RSA-H-16-40-B	16	4.9	4" Round	.188	6.75"	4.77	9.62" Dia x 1.88" Thk	3/4 x 30 x 3	2-3/4"	58
RSA-H-18-40-B	18	5.5	4" Round	.188	6.75"	4.77	9.62" Dia x 1.88" Thk	3/4 x 30 x 3	2-3/4"	65
RSA-H-20-40-B	20	6.1	4" Round	.188	6.75"	4.77	9.62" Dia x 1.88" Thk	3/4 x 30 x 3	2-3/4"	71
RSA-H-12-40-C	12	3.7	4" Round	.25	6.75"	4.77	9.62" Dia x 1.88" Thk	3/4 x 30 x 3	2-3/4"	57
RSA-H-14-40-C	14	4.3	4" Round	.25	6.75"	4.77	9.62" Dia x 1.88" Thk	3/4 x 30 x 3	2-3/4"	66
RSA-H-16-40-C	16	4.9	4" Round	.25	6.75"	4.77	9.62" Dia x 1.88" Thk	3/4 x 30 x 3	2-3/4"	75
RSA-H-18-40-C	18	5.5	4" Round	.25	6.75"	4.77	9.62" Dia x 1.88" Thk	3/4 x 30 x 3	2-3/4"	83
RSA-H-20-40-C	20	6.1	4" Round	.25	6.75"	4.77	9.62" Dia x 1.88" Thk	3/4 x 30 x 3	2-3/4"	92
RSA-H-12-50-B	12	3.7	5" Round	.188	7.75"	5.48	10.62" Dia x 1.88" Thk	3/4 x 30 x 3	2-3/4"	56
RSA-H-14-50-B	14	4.3	5" Round	.188	7.75"	5.48	10.62" Dia x 1.88" Thk	3/4 x 30 x 3	2-3/4"	64
RSA-H-16-50-B	16	4.9	5" Round	.188	7.75"	5.48	10.62" Dia x 1.88" Thk	3/4 x 30 x 3	2-3/4"	73
RSA-H-18-50-B	18	5.5	5" Round	.188	7.75"	5.48	10.62" Dia x 1.88" Thk	3/4 x 30 x 3	2-3/4"	81
RSA-H-20-50-B	20	6.1	5" Round	.188	7.75"	5.48	10.62" Dia x 1.88" Thk	3/4 x 30 x 3	2-3/4"	90
RSA-H-25-50-B	25	7.6	5" Round	.188	7.75"	5.48	10.62" Dia x 1.88" Thk	3/4 x 30 x 3	2-3/4"	111
RSA-H-16-60-A	16	4.9	6" Round	.125	8.75"	6.19	11.62" Dia x 1.88" Thk	3/4 x 30 x 3	2-3/4"	60
RSA-H-18-60-A	18	5.5	6" Round	.125	8.75"	6.19	11.62" Dia x 1.88" Thk	3/4 x 30 x 3	2-3/4"	67
RSA-H-20-60-A	20	6.1	6" Round	.125	8.75"	6.19	11.62" Dia x 1.88" Thk	3/4 x 30 x 3	2-3/4"	74
RSA-H-25-60-A	25	7.6	6" Round	.125	8.75"	6.19	11.62" Dia x 1.88" Thk	3/4 x 30 x 3	2-3/4"	91
RSA-H-18-60-C	18	5.5	6" Round	.25	8.75"	6.19	11.62" Dia x 1.88" Thk	3/4 x 30 x 3	2-3/4"	127
RSA-H-20-60-C	20	6.1	6" Round	.25	8.75"	6.19	11.62" Dia x 1.88" Thk	3/4 x 30 x 3	2-3/4"	140
RSA-H-25-60-C	25	7.6	6" Round	.25	8.75"	6.19	11.62" Dia x 1.88" Thk	3/4 x 30 x 3	2-3/4"	174
RSA-H-30-60-C	30	9.1	6" Round	.25	8.75"	6.19	11.62" Dia x 1.88" Thk	3/4 x 30 x 3	2-3/4"	208

NOTE Factory supplied template must be used when setting anchor bolts. Hubbell Lighting will deny any claim for incorrect anchorage placement resulting from failure to use factory supplied template and anchor bolts.

EHH - EXTRA HANDHOLE



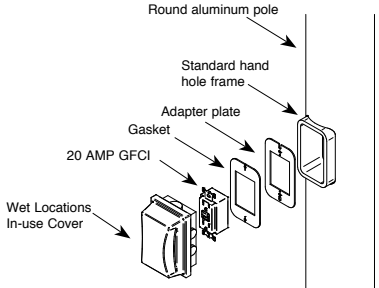
C05 - C07 - C20 - COUPLING



VM2 - VIBRATION DAMPER 2ND MODE

Factory installed, internal damper designed to alter pole resonance to reduce movement and material fatigue caused by 2nd mode vibration.

GFI – 20 AMP GFCI RECEPTACLE & COVER



OPTION ORIENTATION

Follow the logic below when ordering location specific options. For each option, include its orientation (in degrees) and its height (in feet). Example: Option C07 should be ordered as: **RSA-H-20-40-A-TA-DB-C05-0-15** (.5" coupling on the handhole/arm side of pole, 15 feet up from the pole base) 1' spacing required between option. Consult factory for other configurations.

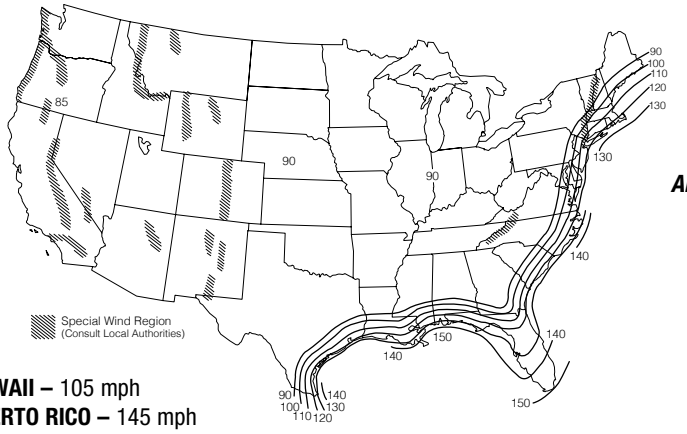
VM2SXX - VIBRATION DAMPER 2ND MODE

Field installed, internal damper designed to alter pole resonance to reduce movement and material fatigue caused by 2nd mode vibration.

VM2S08 – 8'
VM2S12 – 12'
VM2S16 – 16'
VM2S20 – 20'
VM2S24 – 24'

For more information about pole vibration and vibration dampers, please consult http://cdn.spauldinglighting.com/content/products/literature/literature_files/Pole_Wind_Induced_Flyer_HL0I0022.pdf
Due to our continued efforts to improve our products, product specifications are subject to change without notice.

ASCE7-05 WIND MAP

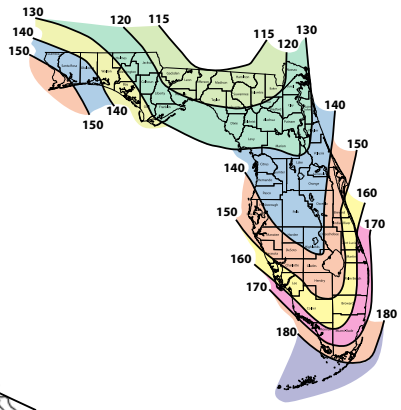


HAWAII – 105 mph
PUERTO RICO – 145 mph

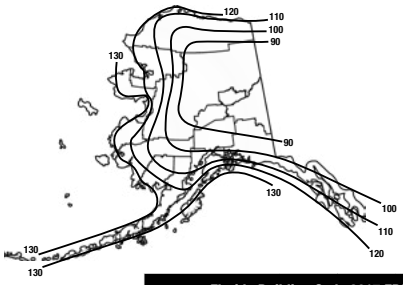
***PRINTED WITH PERMISSION FROM ASCE**

FLORIDA REGION WIND MAP

- Florida region wind map above is based upon 3-second gust winds and the 2017 Florida Building Code



ALASKA REGION WIND MAP



ASCE 7-05 wind map EPA Load Rating - 3 second gust wind speeds										
Catalog Number	**85**	**90**	**100**	**105**	**110**	**120**	**130**	**140**	**145**	**150**
RSA-H-08-30-A	6.3	5.5	4.3	3.8	3.4	2.7	2.2	1.7	1.5	1.4
RSA-H-08-30-C	11.8	10.5	8.5	7.6	6.9	5.6	4.7	3.9	3.6	3.3
RSA-H-10-40-A	9.0	7.9	6.2	5.5	4.8	3.9	3.2	2.7	2.5	2.3
RSA-H-12-40-A	6.8	5.9	4.5	3.9	3.4	2.6	2.1	1.7	1.6	1.4
RSA-H-14-40-A	5.1	4.4	3.1	2.6	2.2	1.6	1.2	0.9	0.8	0.7
RSA-H-16-40-A	3.8	3.2	2.1	1.6	1.3	0.7	0.5	NR	NR	NR
RSA-H-18-40-A	2.7	2.1	1.2	0.8	NR	NR	NR	NR	NR	NR
RSA-H-20-40-A	1.7	1.2	NR	NR	NR	NR	NR	NR	NR	NR
RSA-H-10-40-B	13.7	12.1	9.6	8.6	7.7	6.3	5.3	4.5	4.2	3.9
RSA-H-12-40-B	10.7	9.4	7.3	6.5	5.7	4.6	3.8	3.2	3.0	2.7
RSA-H-14-40-B	8.4	7.3	5.6	4.9	4.2	3.3	2.7	2.2	2.0	1.9
RSA-H-16-40-B	6.6	5.8	4.2	3.6	3.0	2.2	1.8	1.4	1.3	1.1
RSA-H-18-40-B	5.1	4.3	3.0	2.4	2.0	1.3	1.0	0.7	0.6	0.5
RSA-H-20-40-B	3.8	3.1	2.0	1.5	1.1	0.5	NR	NR	NR	NR
RSA-H-12-40-C	14.1	12.5	9.9	8.8	7.9	6.4	5.4	4.6	4.2	3.9
RSA-H-14-40-C	11.3	9.9	7.7	6.8	6.0	4.8	4.0	3.4	3.1	2.9
RSA-H-16-40-C	9.1	7.9	6.0	5.3	4.6	3.5	2.9	2.4	2.2	2.0
RSA-H-18-40-C	7.3	6.3	4.6	3.9	3.3	2.4	1.9	1.6	1.4	1.2
RSA-H-20-40-C	5.7	4.8	3.4	2.8	2.3	1.5	1.1	0.8	0.7	0.6
RSA-H-12-50-B	18.1	16.0	12.9	11.7	10.6	8.9	7.5	6.4	5.9	5.5
RSA-H-14-50-B	14.6	12.8	10.2	9.2	8.4	7.0	5.8	5.0	4.6	4.3
RSA-H-16-50-B	11.9	10.3	8.1	7.3	6.6	5.4	4.5	3.8	3.5	3.3
RSA-H-18-50-B	9.5	8.2	6.3	5.7	5.1	4.2	3.4	2.8	2.6	2.4
RSA-H-20-50-B	7.5	6.4	4.8	4.3	3.8	3.0	2.4	2.0	1.8	1.6
RSA-H-25-50-B	3.8	2.9	1.9	1.6	1.3	0.9	0.6	NR	NR	NR
RSA-H-16-60-A	11.9	10.6	8.4	7.6	6.9	5.7	4.7	4.0	3.7	3.4
RSA-H-18-60-A	9.5	8.4	6.7	6.0	5.4	4.4	3.6	3.0	2.8	2.5
RSA-H-20-60-A	7.5	6.5	5.1	4.6	4.1	3.3	2.7	2.2	2.0	1.8
RSA-H-25-60-A	3.6	3.1	2.2	1.9	1.6	1.1	0.8	0.5	NR	NR
RSA-H-18-60-C	21.4	19.1	15.5	14.0	12.0	9.9	8.3	7.0	6.5	6.0
RSA-H-20-60-C	17.9	15.9	12.8	11.6	10.5	8.1	6.8	5.7	5.2	4.8
RSA-H-25-60-C	11.4	10.1	8.0	7.2	6.5	4.8	3.9	3.2	2.9	2.6
RSA-H-30-60-C	6.9	6.0	4.6	4.1	3.6	2.4	1.8	1.4	1.2	1.1

Florida Building Code 2017 EPA Load Rating - 3 second gust wind speeds								
Catalog Number	**115**	**120**	**130**	**140**	**150**	**160**	**170**	**180**
RSA-H-08-30-A	4.5	4.1	3.3	2.7	2.2	1.8	1.5	1.2
RSA-H-08-30-C	8.8	8.1	6.8	5.7	4.9	4.1	3.5	3.0
RSA-H-10-40-A	6.4	5.8	4.7	3.8	3.1	2.5	2.4	2.3
RSA-H-12-40-A	4.6	4.1	3.2	2.4	1.8	1.7	1.6	1.5
RSA-H-14-40-A	3.2	2.8	2.0	1.4	0.9	NR	NR	NR
RSA-H-16-40-A	2.1	1.7	1.0	0.5	NR	NR	NR	NR
RSA-H-18-40-A	1.1	0.8	NR	NR	NR	NR	NR	NR
RSA-H-10-40-B	10.1	9.1	7.6	6.3	5.3	4.4	4.2	3.9
RSA-H-12-40-B	7.6	6.9	5.6	4.5	3.7	2.9	2.8	2.7
RSA-H-14-40-B	5.8	5.1	4.0	3.1	2.4	1.8	1.6	1.4
RSA-H-16-40-B	4.3	3.7	2.7	2.0	1.3	0.8	0.5	NR
RSA-H-18-40-B	3.0	2.5	1.7	1.0	NR	NR	NR	NR
RSA-H-20-40-B	1.9	1.5	0.7	NR	NR	NR	NR	NR
RSA-H-12-40-C	10.3	9.3	7.7	6.4	5.3	4.4	4.2	4.0
RSA-H-14-40-C	8.0	7.2	5.8	4.7	3.8	3.0	2.8	2.6
RSA-H-16-40-C	6.2	5.5	4.3	3.3	2.5	1.9	1.7	1.5
RSA-H-18-40-C	4.6	4.0	3.0	2.1	1.5	0.9	0.7	0.5
RSA-H-20-40-C	3.3	2.8	1.9	1.2	0.6	NR	NR	NR
RSA-H-12-50-B	13.2	12.0	9.9	9.4	8.0	6.8	5.9	5.1
RSA-H-14-50-B	10.4	9.3	7.5	7.0	6.3	5.3	4.5	3.8
RSA-H-16-50-B	8.0	7.1	5.6	5.3	4.9	4.0	3.3	2.7
RSA-H-18-50-B	6.1	5.3	3.9	3.6	3.3	3.0	2.3	1.8
RSA-H-20-50-B	4.4	3.7	2.9	2.8	2.7	2.1	1.5	1.1
RSA-H-25-50-B	1.3	0.7	1.0	0.5	NR	NR	NR	NR
RSA-H-16-60-A	9.3	8.4	6.8	5.5	4.5	3.7	2.9	2.3
RSA-H-18-60-A	7.4	6.6	5.3	4.2	3.3	2.5	1.9	1.4
RSA-H-20-60-A	5.9	5.2	4.0	3.0	2.2	1.6	1.0	0.6
RSA-H-25-60-A	3.0	2.4	1.5	0.8	0.2	NR	NR	NR
RSA-H-18-60-C	16.5	15.0	12.4	10.4	8.7	7.4	6.2	5.2
RSA-H-20-60-C	13.8	12.5	10.3	8.5	7.0	5.8	4.8	4.0
RSA-H-25-60-C	9.0	8.0	6.3	4.9	3.8	2.9	2.1	1.5
RSA-H-30-60-C	5.6	4.8	3.5	2.4	1.5	0.8	NR	NR

NOTES

Wind-speed Website disclaimer:
Hubbell Lighting has no connection to the linked website and makes no representations as to its accuracy. While the information presented on this third-party website provides a useful starting point for analyzing wind conditions, Hubbell Lighting has not verified any of the information on this third party website and assumes no responsibility or liability for its accuracy. The material presented in the windspeed website should not be used or relied upon for any specific application without competent examination and verification of its accuracy, suitability and applicability by engineers or other licensed professionals. Hubbell Lighting Inc. does not intend that the use of this information replace the sound judgment of such competent professionals, having experience and knowledge in the field of practice, nor to substitute for the standard of care required of such professionals in interpreting and applying the results of the windspeed report provided by this website. Users of the information from this third party website assume all liability arising from such use. Use of the output of these referenced websites do not imply approval by the governing building code bodies responsible for building code approval and interpretation for the building site described by latitude/longitude location in the windspeed report. http://windspeed.atcouncil.org

- Allowable EPA, to determine max pole loading weight, multiply allowable EPA by 30 lbs.
- The tables for allowable pole EPA are based on the ASCE 7-05 Wind Map or the Florida Region Wind Map for the 2010 Florida Building Code. The Wind Maps are intended only as a general guide and cannot be used in conjunction with other maps. Always consult local authorities to determine maximum wind velocities, gusting and unique wind conditions for each specific application
- Allowable pole EPA for jobsite wind conditions must be equal to or greater than the total EPA for fixtures, arms, and accessories to be assembled to the pole. Responsibility lies with the specifier for correct pole selection. Installation of poles without luminaires or attachment of any unauthorized accessories to poles is discouraged and shall void the manufacturer's warranty
- Wind speeds and listed EPAs are for ground mounted installations. Poles mounted on structures (such as bridges and buildings) must consider vibration and coefficient of height factors beyond this general guide; Consult local and federal standards
- Wind Induced Vibration brought on by steady, unidirectional winds and other unpredictable aerodynamic forces are not included in wind velocity ratings. Consult Hubbell Lighting's Pole Vibration Application Guide for environmental risk factors and design considerations. http://cdn.spauldinglighting.com/content/products/literature/literature_files/Pole_Wind_Induced_Flyer_HLOI0022.pdf
- Extreme Wind Events like, Hurricanes, Typhoons, Cyclones, or Tornadoes may expose poles to flying debris, wind shear or other detrimental effects not included in wind velocity ratings

Due to our continued efforts to improve our products, product specifications are subject to change without notice.

HUBBELL Outdoor Lighting

DATE: LOCATION:

TYPE: PROJECT:

CATALOG #:

RATIO Series

AREA/SITE LIGHTER

FEATURES

- Low profile LED area/site luminaire with a variety of IES distributions for lighting applications such as retail, commercial and campus parking lots
- Featuring Micro Strike Optics which maximizes target zone illumination with minimal losses at the house-side, reducing light trespass issues
- Visual comfort standard
- Compact and lightweight design with low EPA
- 3G rated for high vibration applications including bridges and overpasses
- Control options including photo control, occupancy sensing, NX Distributed Intelligence™ and 7-Pin with networked controls
- Best in class surge protection available

c UL us IP66 DLC LISTED DLC PREMIUM BUY AMERICAN SOLUTIONS

See Certification Specifications

RELATED PRODUCTS

Airo | Cimarron LED | Ratio Family

CONTROL TECHNOLOGY

SiteSync LIGHTING CONTROL | NX DISTRIBUTED INTELLIGENCE™ | wiSCAPE™

SPECIFICATIONS

CONSTRUCTION

- Rectilinear form mimics the traditional shoebox form factor keeping a similar but updated style and appearance, ideal for retrofit applications
- Die-cast housing with hidden vertical heat fins that are optimal for heat dissipation while keeping a clean smooth outer surface
- Corrosion resistant, die-cast aluminum housing with powder coat paint finish

OPTICS

- Entire optical aperture illuminates to create a larger luminous surface area resulting in a low glare appearance without sacrificing optical performance
- 80, 160, 320 or 480 midpower LEDs
- 3000K, 4000K or 5000K (70 CRI) CCT
- Zero uplight at 0 degrees of tilt
- Field rotatable optics

INSTALLATION

- Standard square arm mount, compatible with B3 drill pattern
- Optional universal mounting block for ease of installation during retrofit applications. Available as an option or accessory for square and round poles.
- Knuckle arm fitter option available for 2-3/8" OD tenon. Max tilt of 60 degrees with 4 degree adjustable increments. (Restrictions apply for 7-pin options)

ELECTRICAL

- Universal 120-277 VAC or 347-480 VAC input voltage, 50/60 Hz

ELECTRICAL (CONTINUED)

- Ambient operating temperature -40˚C to 40˚C
- Drivers have greater than 90% power factor and less than 20% THD
- LED drivers have output power over-voltage, over-current protection and short circuit protection with auto recovery
- Field replaceable surge protection device provides 20kA protection meeting ANSI/IEEE C62.41.2 Category C High and Surge Location Category C3; Automatically takes fixture off-line for protection when device is compromised

CONTROLS

- Photo control, occupancy sensor and wireless available for complete on/off and dimming control
- 7-pin ANSI C136.41-2013 photocontrol receptacle option available for twist lock photocontrols or wireless control modules (control accessories sold separately)
- 0-10V dimming leads available for use with control devices (provided by others, must specify lead length)
- SiteSync™ wireless control system is available via 7-pin See ordering information and details at: www.hubbelllighting.com/sitesync
- NX Distributed Intelligence™ available with in fixture wireless control module, features dimming and occupancy sensor
- wiSCAPE® available with in fixture wireless control module, features dimming and occupancy sensor via 7-pin

CERTIFICATIONS

- DLC® (DesignLights Consortium Qualified), with some Premium Qualified configurations. Please refer to the DLC website for specific product qualifications at www.designlights.org
- Listed to UL1598 and CSA C22.2#250.0-24 for wet locations and 40˚C ambient temperatures
- 3G rated for ANSI C136.31 high vibration applications
- Fixture is IP66 rated
- Meets IDA recommendations using 3K CCT configuration at 0 degrees of tilt
- This product qualifies as a "designated country construction material" per FAR 52.225-11 Buy American-Construction Materials under Trade Agreements effective 04/23/2020. See Buy American Solutions

WARRANTY

- 5 year limited warranty
- See HLI Standard Warranty for additional information

KEY DATA	
Lumen Range	3,000–48,000
Wattage Range	25–340
Efficacy Range (LPW)	118–155
Fixture Projected Life (Hours)	L70>60K
Weights lbs. (kg)	13.5–24 (6.1–10.9)

HUBBELL Lighting

HUBBELL Outdoor Lighting

DATE: LOCATION:

TYPE: PROJECT:

CATALOG #:

RATIO SERIES

AREA/SITE LIGHTER

ORDERING GUIDE

Example: RAR1-80L-25-3K7-2-UNV-ASQ-BL-NXWE-BC

CATALOG #

ORDERING INFORMATION

Series		# LEDs - Wattage		CCT/CRI		Distribution		Optics Rotation		Voltage	
RAR1	Ratio Area Size 1	**80L-25**	25W - 3,000 Lumens	**3K7**	3000K, 70 CRI	**2**	IES TYPE II	Blank for no rotation		**UNV**	Universal 120-277V
		80L-39	39W -5,200 Lumens	**4K7**	4000K, 70 CRI	**3**	IES TYPE III	**L**	Optic rotation left	**120**	120V
		80L-50	50W - 6,000 Lumens	**5K7**	5000K, 70 CRI	**4W**	IES TYPE IV	**R**	Optic rotation right	**208**	208V
		160L-70	70W - 9,000 Lumens			**5QW**	IES TYPE V			**240**	240V
		160L-100	100W - 12,000 Lumens							**277**	277V
		160L-115	115W - 15,000 Lumens							**347**	347V
		160L-135	135W - 18,000 Lumens							**480**	480V
RAR2	Ratio Area Size 2	**320L-110**	110W - 15,000 Lumens								
		320L-140	140W - 18,000 Lumens								
		320L-165	165W - 21,000 Lumens								
		480L-185	185W - 24,000 Lumens								
		480L-210	210W - 27,000 Lumens								
		480L-240	240W - 30,000 Lumens								
		480L-255	255W - 36,000 Lumens								
		480L-295	295W - 42,000 Lumens								
		480L-340	340W - 48,000 Lumens								

Mounting		Color		Control Options Network		Options	
ASQ	Arm mount for square pole/flat surface	**BLT**	Black Matte Textured	**NXWE**	NX Wireless Enabled (module + radio)	**BC**	Backlight control
ASQU	Universal arm mount for square pole/flat surface	**BLS**	Black Gloss Smooth	**NXSPW_F**	NX Wireless, PIR Occ. Sensor, Daylight Harvesting[2]	**CD**	Continuous dimming
Mounting Round Poles		**DBT**	Dark Bronze Matte Textured	**NXSP_F**	NX, PIR Occ. Sensor, Daylight Harvesting[2]	**F**	Fusing (must specify voltage)
A_	Arm mount for round pole[1]	**DBS**	Dark Brone Gloss Smooth	**Control Options Other**		**TB**	Terminal block
A_U	Universal arm mount for round pole[1]	**GTT**	Graphite Matte Textured	**SCP-40F**	Programmable occupancy sensor[4]	**2PF**	2 power feed with 2 drivers[3]
Mounting Other		**LGS**	Light Grey Gloss Smooth	**7PR**	7-Pin twist lock receptacle		
WB	Wall bracket	**PSS**	Platinum Silver Smooth	**7PR-SC**	7-Pin receptacle with shorting cap		
MAF	Mast arm fitter for 2-3/8" OD horizontal arm	**WHT**	White Matte Textured	**7PR-MD40F**	Low voltage sensor for 7PR		
K	Knuckle	**WHS**	White Gloss Smooth	**7PR-TL**	7-Pin PCR with photocontrol		
		VGT	Verde Green Textured				
		Color Option					
		CC	Custom Color				

Notes:

1 Replace "_" with "3" for 3.5"-4.13" OD pole, "4" for 4.18"-5.25" OD pole, "5" for 5.5"-6.5" OD pole

2 Replace "_" with "14" for up to 14' mounting height, "30F" for 15-30' mounting height

3 Not available with 25, 50, 255, 295 & 340W configurations

4 At least one SCPREMOTE required to program SCP motion sensor

STOCK ORDERING INFORMATION

Catalog Number	Lumens	Wattage	LED Count	CCT/CRI	Voltage	Distribution	Mounting	Finish
RAR1-100-4K-3	12,000	100W	160L	4000K/70CRI	120-277V	Type 3	Square Arm	Bronze
RAR1-100-4K-4W	12,000	100W	160L	4000K/70CRI	120-277V	Type 4W	Square Arm	Bronze
RAR1-135-4K-3	18,000	135W	160L	4000K/70CRI	120-277V	Type 3	Square Arm	Bronze
RAR1-135-4K-4W	18,000	135W	160L	4000K/70CRI	120-277V	Type 4W	Square Arm	Bronze
RAR2-165-4K-3	21,000	165W	320L	4000K/70CRI	120-277V	Type 3	Square Arm	Bronze
RAR2-165-4K-4W	21,000	165W	320L	4000K/70CRI	120-277V	Type 4W	Square Arm	Bronze

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HUBBELL Lighting

DATE: LOCATION:

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CATALOG #:

RATIO SERIES

AREA/SITE LIGHTER

OPTIONS AND ACCESSORIES - STOCK (ORDERED SEPARATELY)

	Catalog Number	Description
☐	**RARRPA3DB**	Round pole adapter 3.5" to 4.13" for ASQ arm, 3.5" to 4.13" OD pole, dark bronze finish
☐	**RARA3UDB**	Universal mount for square pole or round pole 3.5" to 4.13", dark bronze finish
☐	**RARBC80L**	Ratio blacklight control 80L
☐	**RARBC160L**	Ratio blacklight control 160L
☐	**RARBC320L**	Ratio blacklight control 320L
☐	**RARBC480L**	Ratio blacklight control 480L

ACCESSORIES AND REPLACEMENT PARTS - MADE TO ORDER

	Catalog Number	Description
☐	**RAR–ASQU–XX**	Universal arm mount for square pole/flat surface[2]
☐	**RAR–A_U-XX**	Universal arm mount for round poles[1,2]
☐	**RAR–RPA_–XX**	Round pole adapter[1, 2]
☐	**SETAVP-XX**	4" square pole top tenon adapter, 2 3/8" OD slipfitter[2]
☐	**RETAVP-XX**	4" round pole top tenon adapter; 2 3/8" OD slipfitter for max. Four fixtures (90o); order 4" round pole adapters separately[2]
☐	**BIRD–SPIKE–3**	Ratio size 1 bird deterrent/spikes
☐	**BIRD–SPIKE–4**	Ratio size 2 bird deterrent/spikes
☐	**RARWB–XX**	Wall bracket - use with Mast Arm Fitter or Knuckle[2]

1 Replace "_" with "3" for 3.5"-4.13" OD pole, "4" for 4.18"-5.25" OD pole, "5" for 5.5"-6.5" OD pole

2 Replace "XX" with desired color/paint finish

CONTROLS

Control Options	
Standalone	
SW7PR	SiteSync™ on fixture module via 7PR
SWUSB	SiteSync™ Software on USB
SWTAB	SiteSync™ Windows Tablet
SWBRG	SiteSync™ Wireless Bridge Node
SWFC	SiteSync™ Field Commission Serve
SCPREMOTE	Order at least one per project location to program and control
Networked – Wireless	
WIR-RME-L	wiSCAPE External Fixture Module[1,2]
NX Networked – Wireless	
NXOFM-1R1D-UNV	NX Wireless, Daylight Harvesting, BLE, 7 pin twisted lock

Notes:

1 Works with external networked photosensor

2 wiSCAPE Gateway required for system programming

DATE: LOCATION:

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CATALOG #:

RATIO SERIES

AREA/SITE LIGHTER

PERFORMANCE DATA

Description	Nominal Wattage	System Watts	Dist. Type	5K (5000K NOMINAL 70 CRI)					4K (4000K NOMINAL 70 CRI)					3K (3000K NOMINAL 80 CRI)				
				Lumens	LPW	B	U	G	Lumens	LPW	B	U	G	Lumens	LPW	B	U	G
RAR1	25	25.4	2	3438	135	1	0	1	3445	136	1	0	1	3240	128	1	0	1
			3	3460	136	1	0	1	3467	136	1	0	1	3260	128	1	0	1
			4W	3406	134	1	0	1	3412	134	1	0	1	3209	126	1	0	1
			5QW	3483	137	2	0	1	3490	137	2	0	1	3282	129	2	0	1
	39	39	2	5263	139	1	0	2	5273	139	1	0	2	4960	131	1	0	2
			3	5297	139	1	0	2	5308	140	1	0	2	4991	131	1	0	2
			4W	5200	137	1	0	2	5210	137	1	0	2	4900	129	1	0	2
			5QW	5333	140	3	0	1	5344	141	3	0	1	5025	132	3	0	1
	50	49.8	2	6310	127	1	0	2	6323	127	1	0	2	5946	120	1	0	2
			3	6349	128	1	0	2	6362	128	1	0	2	5983	120	1	0	2
			4W	6233	125	1	0	2	6245	126	1	0	2	5873	118	1	0	2
			5QW	6392	129	3	0	1	6405	129	3	0	1	6023	121	3	0	1
	70	68.4	2	9486	139	1	0	2	9505	139	1	0	2	8938	131	1	0	2
			3	9544	140	1	0	2	9563	140	1	0	2	8993	131	1	0	2
			4W	9395	137	1	0	2	9414	138	1	0	2	8853	129	1	0	2
			5QW	9608	140	4	0	2	9628	141	4	0	2	9054	132	4	0	2
	100	90.0	2	11976	133	2	0	2	12000	133	2	0	2	11285	125	2	0	2
			3	12050	134	2	0	2	12074	134	2	0	2	11354	126	2	0	2
			4W	11861	132	2	0	2	11885	132	2	0	2	11177	124	2	0	2
			5QW	12131	135	4	0	2	12155	135	4	0	2	11431	127	4	0	2
	115	109.7	2	15572	142	2	0	2	15494	141	2	0	2	14871	136	2	0	2
			3	15833	144	2	0	2	15754	144	2	0	2	15121	138	2	0	2
			4W	15281	139	2	0	3	15205	139	2	0	3	14623	133	2	0	3
			5QW	15732	143	4	0	2	15653	143	4	0	2	15024	137	4	0	2
	135	133.3	2	17971	135	3	0	3	17881	134	3	0	3	17163	129	3	0	3
			3	18272	137	2	0	2	18181	136	2	0	2	17450	131	2	0	2
			4W	17635	132	2	0	3	17547	132	2	0	3	16876	127	2	0	3
			5QW	18156	136	4	0	2	18065	136	4	0	2	17339	130	4	0	2

RAR2 Performance Data on next page

* Lumen values are from photometric test performed in accordance with IESNA LM-79-08. Data is considered to be representative of the configurations shown. Actual performance may differ as a result of end-user environment and application.

DATE: LOCATION:

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RATIO SERIES

AREA/SITE LIGHTER

PERFORMANCE DATA

Description	Nominal Wattage	System Watts	Dist. Type	5K (5000K NOMINAL 70 CRI)					4K (4000K NOMINAL 70 CRI)					3K (3000K NOMINAL 80 CRI)				
				Lumens	LPW	B	U	G	Lumens	LPW	B	U	G	Lumens	LPW	B	U	G
RAR2	110	100.3	2	15326	153	2	0	3	15357	153	2	0	3	14442	144	2	0	3
			3	15421	154	2	0	3	15452	154	2	0	3	14531	145	2	0	3
			4W	15180	151	2	0	2	15210	152	2	0	2	14304	143	2	0	2
			5QW	15525	155	4	0	2	15556	155	4	0	2	14629	146	4	0	2
	140	133.2	2	19395	146	2	0	3	19434	146	2	0	3	18276	137	2	0	3
			3	19515	147	2	0	3	19554	147	2	0	3	18389	138	2	0	3
			4W	19210	144	2	0	3	19248	145	2	0	3	18101	136	2	0	3
			5QW	19647	148	5	0	3	19686	148	5	0	3	18513	139	5	0	3
	165	153.6	2	21651	141	3	0	3	21695	141	3	0	3	20402	133	3	0	3
			3	21785	142	3	0	3	21828	142	3	0	3	20527	134	3	0	3
			4W	21444	140	3	0	3	21487	140	3	0	3	20206	132	3	0	3
			5QW	21932	143	5	0	3	21976	143	5	0	3	20666	135	5	0	3
	185	174.5	2	26046	149	3	0	3	26098	150	3	0	3	24543	141	3	0	3
			3	26207	150	3	0	3	26259	150	3	0	3	24694	142	3	0	3
			4W	25797	148	3	0	4	25849	148	3	0	4	24308	139	3	0	4
			5QW	26384	151	5	0	3	26437	152	5	0	3	24861	143	5	0	3
	210	198.2	2	28848	145	3	0	4	28906	146	3	0	4	27184	137	3	0	4
			3	29027	146	3	0	4	29085	147	3	0	4	27351	138	3	0	4
			4W	28572	144	3	0	4	28630	144	3	0	4	26924	136	3	0	4
			5QW	29222	147	5	0	4	29281	148	5	0	4	27536	139	5	0	4
	240	226.9	2	32087	141	3	0	4	32151	142	3	0	4	30235	133	3	0	4
			3	32285	142	3	0	4	32350	143	3	0	4	30422	134	3	0	4
			4W	31780	140	3	0	4	31844	140	3	0	4	29946	132	3	0	4
			5QW	32503	143	5	0	4	32568	144	5	0	4	30627	135	5	0	4
	255	257.0	2	37040	144	3	0	4	36854	143	3	0	4	35373	138	3	0	4
			3	37660	147	3	0	4	37472	146	3	0	4	35966	140	3	0	4
			4W	36347	141	3	0	5	36166	140	3	0	5	34782	135	3	0	5
			5QW	37420	146	5	0	4	37233	145	5	0	4	35736	139	5	0	4
	295	294.0	2	41733	142	3	0	4	41524	141	3	0	4	39855	136	3	0	4
			3	42432	144	3	0	4	42220	144	3	0	4	40523	138	3	0	4
			4W	40953	139	3	0	5	40748	139	3	0	5	39190	133	3	0	5
			5QW	42162	143	5	0	4	41951	143	5	0	4	40264	137	5	0	4
	340	347.1	2	48392	139	4	0	5	48150	139	4	0	5	46215	133	4	0	5
			3	49203	142	3	0	4	48957	141	3	0	4	46989	135	3	0	4
			4W	47488	137	4	0	5	47261	136	4	0	5	45443	131	4	0	5
			5QW	48889	141	5	0	5	48645	140	5	0	5	46689	135	5	0	5

* Lumen values are from photometric test performed in accordance with IESNA LM-79-08. Data is considered to be representative of the configurations shown. Actual performance may differ as a result of end-user environment and application.

HUBBELL Outdoor Lighting

DATE: LOCATION:

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CATALOG #:

RATIO SERIES

AREA/SITE LIGHTER

ELECTRICAL DATA

# OF LEDS	Nominal Wattage	Input Voltage	Oper. Current (Amps)	System Power (Watts)
RAR1	25	120	0.21	25.4
		208	0.12	
		240	0.11	
		277	0.09	
	39	120	0.32	38.0
		208	0.18	
		240	0.16	
		277	0.14	
		347	0.11	
		480	0.08	
	50	120	0.42	49.8
		208	0.24	
		240	0.21	
		277	0.18	
	70	120	0.57	68.4
		208	0.33	
		240	0.29	
		277	0.25	
	100	120	0.75	90.0
		208	0.43	
		240	0.38	
		277	0.32	
	115	120	0.91	109.7
		208	0.53	
		240	0.46	
		277	0.40	
		347	0.32	
		480	0.23	
	135	120	1.11	133.3
		208	0.64	
		240	0.56	
		277	0.48	
		347	0.38	
		480	0.28	

# OF LEDS	Nominal Wattage	Input Voltage	Oper. Current (Amps)	System Power (Watts)
RAR2	110	120	0.84	100.3
		208	0.48	
		240	0.42	
		277	0.36	
	140	120	1.11	133.2
		208	0.64	
		240	0.56	
		277	0.48	
	165	120	1.28	153.6
		208	0.74	
		240	0.64	
		277	0.55	
	185	120	1.45	174.5
		208	0.84	
		240	0.73	
		277	0.63	
	210	120	1.65	198.3
		208	0.95	
		240	0.83	
		277	0.72	
	240	120	1.89	226.9
		208	1.09	
		240	0.95	
		277	0.82	
	255	120	2.14	257.0
		208	1.24	
		240	1.07	
		277	0.93	
		347	0.74	
		480	0.54	
	295	120	2.45	294.0
		208	1.41	
		240	1.23	
		277	1.06	
		347	0.85	
		480	0.61	
	340	120	2.89	347.1
		208	1.67	
		240	1.45	
		277	1.25	
		347	1.00	
		480	0.72	

LUMINAIRE AMBIENT TEMPERATURE FACTOR (LATF)

Ambient Temperature		Lumen Multiplier
0˚ C	32˚ F	1.03
10˚ C	50˚ F	1.01
20˚ C	68˚ F	1.00
25˚ C	77˚ F	1.00
30˚ C	86˚ F	0.99
40˚ C	104˚ F	0.98
50˚ C	122˚ F	0.97

Use these factors to determine relative lumen output for average ambient temperatures from 0-40°C (32-104°F).

PROJECTED LUMEN MAINTENANCE

Ambient Temperature	OPERATING HOURS					
	0	25,000	TM-21-11 L90 36,000	50,000	100,000	L70 (Hours)
25°C / 77°F	1.00	0.97	0.95	0.93	0.86	238,000
40°C / 104°F	0.99	0.96	0.95	0.93	0.85	225,000

HUBBELL Lighting

HUBBELL Outdoor Lighting

DATE: LOCATION:

TYPE: PROJECT:

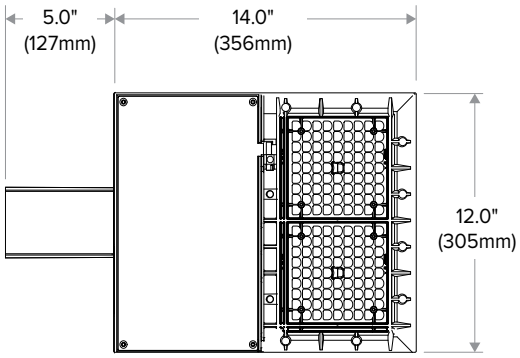
CATALOG #:

RATIO SERIES

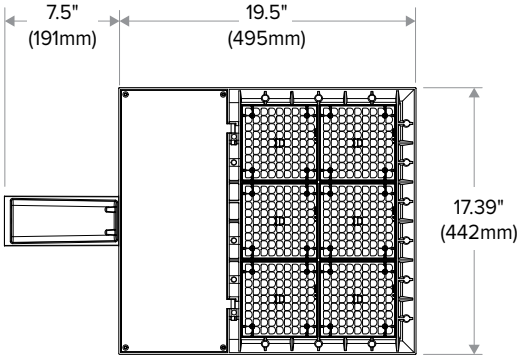
AREA/SITE LIGHTER

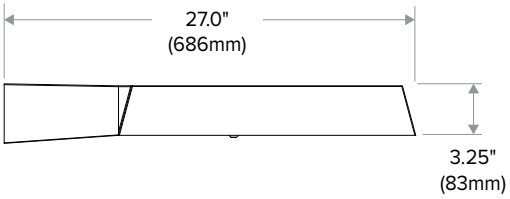
DIMENSIONS

RAR1



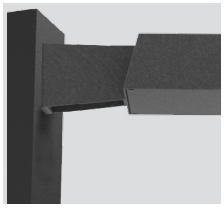
RAR2



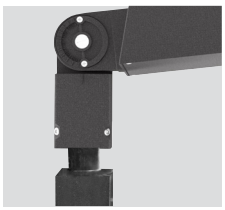


ADDITIONAL INFORMATION

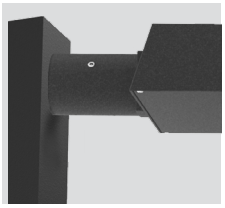
MOUNTING



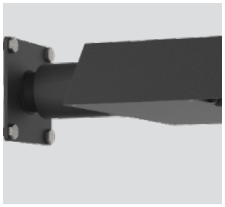
Arm Mount – Fixture ships with integral arm for ease of installation. Compatible with Hubbell Outdoor B3 drill pattern.



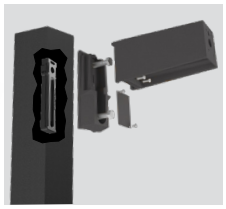
Knuckle – Knuckle mount 15° aiming angle increments for precise aiming and control, fits 2-3/8" tenons or pipes.



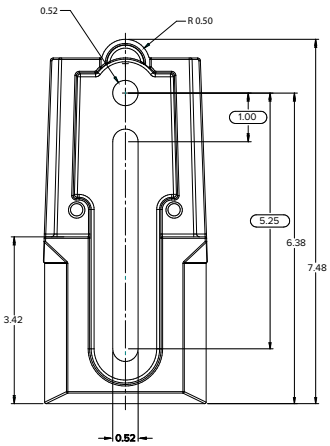
MAF – Fits 2-3/8" OD arms Roadway applications.



Wall Mount – Wall mount bracket designed for building mount applications.



Universal Mounting – Universal mounting block for ease of installation. Compatible with drill patterns from 2.5" to 4.5"



HUBBELL Lighting

DATE: LOCATION:

TYPE: PROJECT:

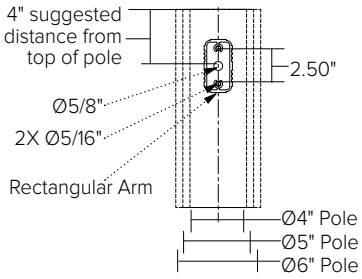
CATALOG #:

RATIO SERIES

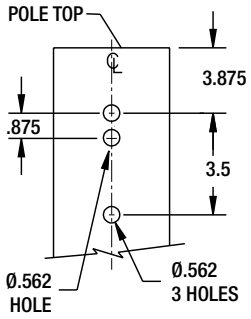
AREA/SITE LIGHTER

ADDITIONAL INFORMATION (CONT'D)

ARM MOUNT (ASQ)
Compatible with Pole drill pattern B3



UNIVERSAL MOUNTING (ASQU)
Compatible with pole drill pattern S2



SITESYNC 7-PIN MODULE

SW7PR

SiteSync LIGHTING CONTROL

- SiteSync features in a new form
- Available as an accessory for new construction or retrofit applications (with existing 7-Pin receptacle)

DATE: LOCATION:

TYPE: PROJECT:

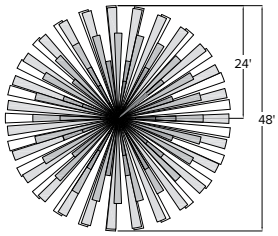
CATALOG #:

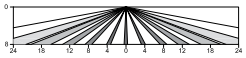
RATIO SERIES

AREA/SITE LIGHTER

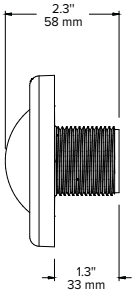
ADDITIONAL INFORMATION (CONT'D)

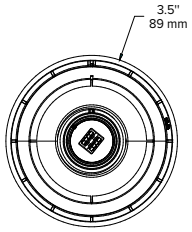
NXSP-14F



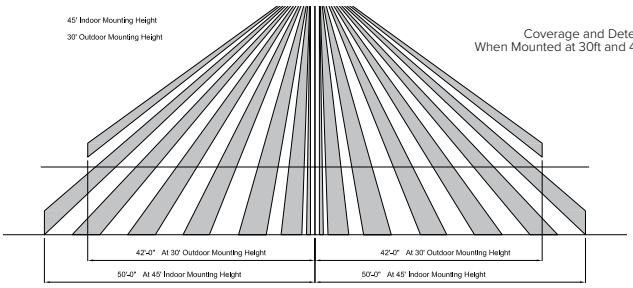


Sensor Lens Coverage and Detection Patterns
When Mounted at 8ft with Low Mount Lens

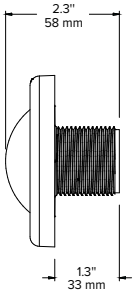


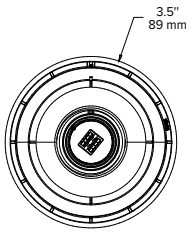


NXSP-30F

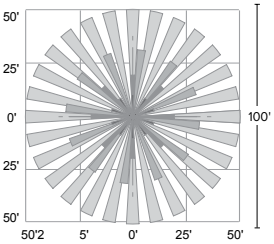


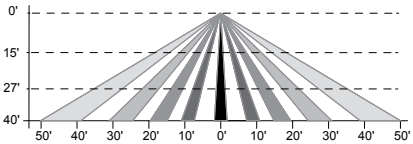
Coverage and Detection Patterns
When Mounted at 30ft and 45ft with Standard Lens

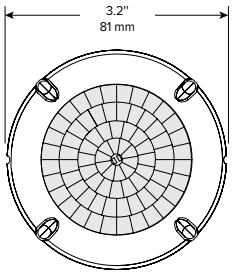


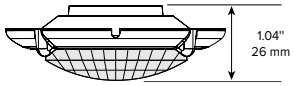


SCP-40F









RAR1 EPA

RAR-1	
EPA at 0˚	EPA at 30˚
.45ft.^{2} .13m^2	.56ft.^{2} .17m^2

RAR2 EPA

RAR-2	
EPA at 0˚	EPA at 30˚
.55ft.^{2} .17m^2	1.48ft.^{2} .45m^2

SHIPPING

Catalog Number	G.W(kg)/ CTN	Carton Dimensions		
		Length Inch (cm)	Width Inch (cm)	Height Inch (cm)
RAR1	15 (6.8)	20.75 (52.7)	15.125 (38.4)	6.9375 (17.6)
RAR2	19 (8.6)	25 (63.5)	15.125 (38.4)	6.9375 (17.6)

USE OF TRADEMARKS AND TRADE NAMES

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RND
WALL MOUNT

DATE: LOCATION:

TYPE: PROJECT:

CATALOG #:

PURSUIT DOWN

FEATURES

- 2', 3', 4', 6' & 8' Housing Lengths
- Sections can be joined for runs up to 150' with seamless lens
- IP66 Rated
- Light Engine is independently rated IP67
- Electrical Connections IP68 rated
- Symmetric, Asymmetric, Wall Graze & Wall Wash Distributions
- "L", "T" & "X" Illuminated connectors for custom shapes
- NX Distributed Intelligence & SiteSync enabled for wireless control
- Output up to 1,500 lm/ft
- Surface, Fixed arm, pendant, wall & mullion mounting options

Pursuit Down Light RND

RELATED PRODUCTS

RNI RNID

c UL us LISTED

BUY AMERICAN SOLUTIONS See Certification Specifications

IK08

CONTROL TECHNOLOGY

SiteSync Lighting Control NX DISTRIBUTED™ INTELLIGENCE

SPECIFICATIONS

CONSTRUCTION

- All housing components are die-cast aluminum 360 alloy, sealed with continuous silicone rubber gaskets
- Standard configurations do not require a flat lens, optional lenses are tempered glass
- All internal and external hardware is stainless steel
- Luminaire finish consist of a five stage pretreatment regimen with a polymer primer sealer, oven dry off, and top coated with a thermoset super TGIC polyester powder coat finish.
- Optical bezel finish shall match the luminaire housing

OPTICS

- Optical cartridge system consisting of a die cast heat sink, LED engine, LED lamps, TIR optics, gasket and bezel plate.
- Cartridge is easily disassembled to replace components. Optics are held in place without the use of adhesives.
- Molded silicone gasket ensures a weather-proof seal around each individual LED.
- Features revolutionary individual LED optical control based on high performance TIR optical designs.

INSTALLATION

- Fixtures must be grounded in accordance with national, state and/or local electrical codes. Failure to do so may result in serious personal injury.

ELECTRICAL

- Luminaires will have integral surge protection that shall be U.L. recognized and have a surge current rating of 10,000 Amps using the industry standard 8/20uSec wave and surge rating of 372J
- Drivers are U.L recognized with an inrush current maximum of <20.0 Amps maximum at 230VAC
- 100%-1% dimming range. Fixture will be wired for low voltage 0-10V dimming control
- Driver and surge suppressor are mounted to a prewired tray with quick disconnects that may be removed from the gear compartment

CONTROLS

- Button photo control for dusk to dawn energy savings
- Photocell is factory installed in accessory housing. For multiple/continuous row applications, one fixture is supplied with a photocell to operate multiple luminaires.
- Dimming Occupancy Sensor-SCP

SITESYNC™[1]

- SiteSync™ wireless control system for reduction in energy and maintenance cost while optimizing light quality 24/7. See ordering information or visit www.hubbelllighting.com/products/sitesync for more details.

CONTROLS (CONTINUED)

NX DISTRIBUTED INTELLIGENCE™

- Hubbell Control Solutions' NX Distributed Intelligence™ lighting control platform utilizes a Distributed Network Architecture (DNA) that connects intelligent devices including luminaires, controllers, panels, occupancy
- sensors, photocells, wall switches and dimmers, creating a system with an unmatched level of reliability, scalability and simplicity
- Photocell adapter includes an internal twist lock receptacle. Photocell by others.

CERTIFICATIONS

- Luminaire shall be listed with ETL for outdoor, wet location use, UL1598, UL 8750 and Canadian CSA Std. C22.2 no.250.
- IEC 66262 Mechanical Impact Code IK08.
- This product qualifies as a "designated country construction material" per FAR 52.225-11 Buy American-Construction Materials under Trade Agreements effective 5/29/202###0. See Buy American Solutions.

WARRANTY

- See HLI Standard Warranty for additional information

KEY DATA	
LUMEN RANGE	823-14,232
WATTAGE RANGE	13-163
EFFICACY RANGE (LPW)	50-115
LIFE (HOURS)	NA
INPUT CURRENT RANGE (mA)	320-2,000 mA
EPA	0.74-2.93

HUBBELL® HUBBELL Lighting

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RND

WALL MOUNT

DATE: LOCATION:

TYPE: PROJECT:

CATALOG #:

ORDERING GUIDE

Example: RND-3"-750-3K8-SM-CL-DL-347-AGN-W-EMF1

CATALOG #

HOUSING

RN

Housing		Light Engine		Row Length	Maximum Fixture Section Length		Lumen Output		CCT/CRI	
RN	Pursuit Direct	**D**	Direct (Down Light)	Manual input (150' Max length. round up to nearest whole foot)	**2**	2' Fixture [1]	**5**	500 lumens/ft	**3K8**	3000K, 80 CRI
					3	3' Fixture	**7**	750 lumens/ft	**3K9**	3000K, 90 CRI
					4	4' Fixture	**10**	1000 lumens/ft	**35K8**	3500K, 80 CRI
					6	6' Fixture	**15**	1500 lumens/ft	**4K8**	4000K, 80 CRI
					8	8' Fixture			**4K9**	4000K, 90 CRI
									5K8	5000K, 80 CRI

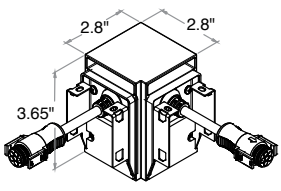
Distributions		Shielding		Voltage		Finish		Mounting		Options	
Direct Distributions		**DL**	Diffuse lens	**UNV**	120-277V	**BLS**	Black Gloss Smooth	**W**	Wall	**EMF1**	End Power Feed at one end
SM	Symmetrical	**CL**	Clear lens	**347**	347V	**BLT**	Black Matte Textured	**A3**	3" Adjustable arm	**EMF2**	End Power Feed at both ends
AS	Asymmetrical			**480**	480V	**DBS**	Dark Bronze Gloss Smooth	**A6**	6" Adjustable arm	**Photocell Options**	
WG	Wall Graze					**DBT**	Dark Bronze Matte Textured	**A12**	12" Adjustable arm	**PC**	Button Photocell [2]
WW	Wall Wash					**GTT**	Graphite Matte Textured	**F3**	3" Fixed arm	**Control Options-Not with PC [2]**	
						LGS	Light Grey Gloss Smooth	**F6**	6" Fixed arm	**SCP**	Dim Occupancy Sensor
						LGT	Light Grey Matte Textured	**F12**	12" Fixed arm	**SWP**	SiteSync Wireless
						PSS	Platinum Silver Gloss Smooth	**M**	Mullion	**SWPM**	SiteSync Wireless with SCP
						VGT	Verde Green Matte Textured	**S**	Surface	**NXWE**	NX Wireless Enabled
						WHS	White Gloss Smooth	**PSW12**	12" Pendant	**NXOSW**	NX Wireless, PIR Occupancy Sensor, Dimming Daylight Harvesting
						WHT	White Matte Textured	**PSW24**	24" Pendant	**Emergency Battery Option**	
						Color Option		**PSW36**	36" Pendant	**EM**	Battery Backup Unit (-20°C) [3]
						CC [4]	Custom Color				

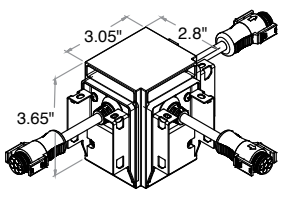
[1] 480V not available
[2] Requires auxiliary housing. Fixture length will increase.
[3] Integral battery backup for 3, 4, 6 and 8 foot versions only. Not available on 2' housing.
[4] Consult factory for custom color, marine and corrosive finish options

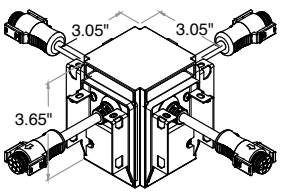
ACCESSORIES

Non Illuminated Connectors
(Enables Custom Shapes)

RNLTX-L L shape
RNLTX-T T shape
RNLTX-XX shape







HUBBELL Lighting

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RND

WALL MOUNT

DATE: LOCATION:

TYPE: PROJECT:

CATALOG #:

LUMINAIRE PERFORMANCE - DOWN LIGHT

Section Length	Lumens/ft	Lumen Package	Lens	Distribution	5K8 5000K 80CRI		4K9 4000K 90CRI		4K8 4000K 80CRI		3K9 3000K 90CRI		3K8 3000K 80CRI	
					Lumen	LPW[1]	Lumen	LPW[1]	Lumen	LPW[1]	Lumen	LPW[1]	Lumen	LPW[1]
2 FT Down	500	1,000	Diffuse	SM	1225	94	957	73	1181	90	922	70	1138	87
			Clear		1372	105	1071	82	1323	101	1033	79	1275	97
			Diffuse	AS	1093	83	854	65	1054	80	823	63	1016	78
			Clear		1234	94	973	74	1201	92	943	72	1164	89
			Diffuse	WG	1289	98	1007	77	1243	95	970	74	1198	91
			Clear		1430	109	1117	85	1379	105	1076	82	1329	101
			Diffuse	WW	1093	83	854	65	1054	80	823	63	1016	78
			Clear		1234	94	973	74	1201	92	943	72	1164	89
	750	1,500	Diffuse	SM	1771	90	1383	71	1708	87	1333	68	1646	84
			Clear		1970	101	1538	78	1899	97	1483	76	1831	93
			Diffuse	AS	1580	81	1234	63	1524	78	1190	61	1469	75
			Clear		1784	91	1393	71	1720	88	1343	69	1658	85
			Diffuse	WG	1864	95	1455	74	1797	92	1403	72	1732	88
			Clear		2067	105	1615	82	1993	102	1556	79	1921	98
			Diffuse	WW	1580	81	1234	63	1524	78	1190	61	1469	75
			Clear		1784	91	1393	71	1720	88	1343	69	1658	85
	1,000	2,000	Diffuse	SM	2265	87	1769	68	2184	84	1705	66	2105	81
			Clear		2523	97	1970	76	2432	94	1899	73	2345	90
			Diffuse	AS	2021	78	1578	61	1949	75	1521	59	1878	72
			Clear		2282	88	1782	69	2200	85	1718	66	2121	82
			Diffuse	WG	2384	92	1861	72	2298	88	1794	69	2215	85
			Clear		2644	102	2065	79	2550	98	1991	77	2457	95
			Diffuse	WW	2021	78	1578	61	1949	75	1521	59	1878	72
			Clear		2282	88	1782	69	2200	85	1718	66	2121	82
	1,500	3,000	Diffuse	SM	3048	74	2380	58	2939	71	2294	56	2832	69
			Clear		3414	83	2666	65	3291	80	2570	63	3172	77
			Diffuse	AS	2720	66	2124	52	2622	64	2047	50	2527	61
			Clear		3070	75	2398	58	2960	72	2311	56	2853	69
			Diffuse	WG	3207	78	2505	61	3092	75	2414	59	2980	73
			Clear		3558	87	2779	68	3430	83	2678	65	3306	80
			Diffuse	WW	2720	66	2124	52	2622	64	2047	50	2527	61
			Clear		3070	75	2398	58	2960	72	2311	56	2853	69

HUBBELL® Lighting

LUMINAIRE PERFORMANCE - DOWN LIGHT (CONT)

Section Length	Lumens/ft	Lumen Package	Lens	Distribution	5K8 5000K 80CRI		4K9 4000K 90CRI		4K8 4000K 80CRI		3K9 3000K 90CRI		3K8 3000K 80CRI	
					Lumen	LPW[1]	Lumen	LPW[1]	Lumen	LPW[1]	Lumen	LPW[1]	Lumen	LPW[1]
3 FT Down	500	1,500	Diffuse	SM	1838	96	1435	75	1772	93	1383	72	1708	89
			Clear		2058	108	1607	84	1984	104	1549	81	1912	100
			Diffuse	AS	1640	86	1280	67	1581	83	1234	65	1524	80
			Clear		1851	97	1445	76	1785	93	1393	73	1720	90
			Diffuse	WG	1934	101	1510	79	1864	98	1455	76	1797	94
			Clear		2145	112	1675	88	2068	108	1615	85	1993	104
			Diffuse	WW	1640	86	1280	67	1581	83	1234	65	1524	80
			Clear		1851	97	1445	76	1785	93	1393	73	1720	90
	750	2,250	Diffuse	SM	2657	93	2075	73	2561	90	2000	70	2469	86
			Clear		2955	103	2308	81	2849	100	2224	78	2746	96
			Diffuse	AS	2370	83	1851	65	2285	80	1784	62	2203	77
			Clear		2676	94	2090	73	2580	90	2014	70	2487	87
			Diffuse	WG	2795	98	2183	76	2695	94	2104	74	2598	91
			Clear		3101	108	2422	85	2990	105	2334	82	2882	101
			Diffuse	WW	2370	83	1851	65	2285	80	1784	62	2203	77
			Clear		2676	94	2090	73	2580	90	2014	70	2487	87
	1,000	3,000	Diffuse	SM	3398	88	2654	69	3276	85	2558	67	3158	82
			Clear		3785	99	2955	77	3649	95	2849	74	3517	92
			Diffuse	AS	3032	79	2368	62	2923	76	2282	59	2817	73
			Clear		3423	89	2673	70	3300	86	2577	67	3181	83
			Diffuse	WG	3576	93	2792	73	3447	90	2691	70	3323	87
			Clear		3967	103	3098	81	3824	100	2986	78	3686	96
			Diffuse	WW	3032	79	2368	62	2923	76	2282	59	2817	73
			Clear		3423	89	2673	70	3300	86	2577	67	3181	83
	1,500	4,500	Diffuse	SM	4572	75	3570	58	4408	72	3441	56	4249	69
			Clear		5121	84	3999	65	4937	81	3854	63	4759	78
			Diffuse	AS	4079	67	3186	52	3933	64	3071	50	3791	62
			Clear		4606	75	3597	59	4440	73	3467	57	4280	70
			Diffuse	WG	4811	79	3757	61	4638	76	3621	59	4471	73
			Clear		5337	87	4168	68	5146	84	4017	66	4960	81
			Diffuse	WW	4079	67	3186	52	3933	64	3071	50	3791	62
			Clear		4606	75	3597	59	4440	73	3467	57	4280	70

LUMINAIRE PERFORMANCE - DOWN LIGHT (CONT)

Section Length	Lumens/ft	Lumen Package	Lens	Distribution	5K8 5000K 80CRI		4K9 4000K 90CRI		4K8 4000K 80CRI		3K9 3000K 90CRI		3K8 3000K 80CRI	
					Lumen	LPW[1]	Lumen	LPW[1]	Lumen	LPW[1]	Lumen	LPW[1]	Lumen	LPW[1]
4 FT Down	500	2,000	Diffuse	SM	2450	98	1913	77	2362	94	1844	74	2277	91
			Clear		2744	110	2143	86	2645	106	2065	83	2550	102
			Diffuse	AS	2186	87	1707	68	2108	84	1645	66	2031	81
			Clear		2468	99	1927	77	2379	95	1858	74	2293	92
			Diffuse	WG	2578	103	2013	81	2485	99	1941	78	2396	96
			Clear		2860	114	2233	89	2757	110	2153	86	2658	106
			Diffuse	WW	2186	87	1707	68	2108	84	1645	66	2031	81
			Clear		2468	99	1927	77	2379	95	1858	74	2293	92
	750	3,000	Diffuse	SM	3542	94	2766	73	3415	90	2666	71	3292	87
			Clear		3940	104	3077	81	3799	100	2966	78	3661	97
			Diffuse	AS	3161	84	2468	65	3047	81	2379	63	2937	78
			Clear		3568	94	2787	74	3440	91	2686	71	3316	88
			Diffuse	WG	3727	99	2911	77	3593	95	2806	74	3464	92
			Clear		4135	109	3229	85	3987	105	3113	82	3843	102
			Diffuse	WW	3161	84	2468	65	3047	81	2379	63	2937	78
			Clear		3568	94	2787	74	3440	91	2686	71	3316	88
	1,000	4,000	Diffuse	SM	4531	87	3538	68	4368	84	3410	66	4210	81
			Clear		5046	97	3941	76	4865	94	3798	73	4689	91
			Diffuse	AS	4042	78	3157	61	3897	75	3043	59	3757	73
			Clear		4564	88	3564	69	4400	85	3435	66	4241	82
			Diffuse	WG	4767	92	3723	72	4596	89	3589	69	4430	86
			Clear		5289	102	4130	80	5099	98	3981	77	4915	95
			Diffuse	WW	4042	78	3157	61	3897	75	3043	59	3757	73
			Clear		4564	88	3564	69	4400	85	3435	66	4241	82
	1,500	6,000	Diffuse	SM	6096	75	4760	58	5877	72	4589	56	5665	69
			Clear		6828	83	5332	65	6582	80	5139	63	6345	78
			Diffuse	AS	5439	66	4248	52	5244	64	4094	50	5055	62
			Clear		6141	75	4795	59	5920	72	4622	57	5707	70
			Diffuse	WG	6414	78	5009	61	6184	76	4828	59	5961	73
			Clear		7116	87	5557	68	6861	84	5357	65	6613	81
			Diffuse	WW	5439	66	4248	52	5244	64	4094	50	5055	62
			Clear		6141	75	4795	59	5920	72	4622	57	5707	70

DATE: LOCATION:

TYPE: PROJECT:

CATALOG #:

LUMINAIRE PERFORMANCE - DOWN LIGHT (CONT)

Section Length	Lumens/ft	Lumen Package	Lens	Distribution	5K8 5000K 80CRI		4K9 4000K 90CRI		4K8 4000K 80CRI		3K9 3000K 90CRI		3K8 3000K 80CRI	
					Lumen	LPW[1]	Lumen	LPW[1]	Lumen	LPW[1]	Lumen	LPW[1]	Lumen	LPW[1]
6 FT Down	500	3,000	Diffuse	SM	3675	99	2870	77	3543	95	2766	74	3415	92
			Clear		4116	111	3214	86	3968	107	3098	83	3825	103
			Diffuse	AS	3279	88	2561	69	3161	85	2468	66	3047	82
			Clear		3702	100	2891	78	3569	96	2787	75	3440	92
			Diffuse	WG	3867	104	3020	81	3728	100	2911	78	3594	97
			Clear		4290	115	3350	90	4136	111	3229	87	3987	107
			Diffuse	WW	3279	88	2561	69	3161	85	2468	66	3047	82
			Clear		3702	100	2891	78	3569	96	2787	75	3440	92
	750	4,500	Diffuse	SM	5313	95	4149	74	5123	91	3999	71	4938	88
			Clear		5910	106	4615	82	5698	102	4449	79	5492	98
			Diffuse	AS	4741	85	3702	66	4571	82	3569	64	4406	79
			Clear		5352	96	4180	75	5160	92	4029	72	4974	89
			Diffuse	WG	5591	100	4366	78	5390	96	4208	75	5196	93
			Clear		6202	111	4844	86	5980	107	4669	83	5764	103
			Diffuse	WW	4741	85	3702	66	4571	82	3569	64	4406	79
			Clear		5352	96	4180	75	5160	92	4029	72	4974	89
	1,000	6,000	Diffuse	SM	6796	89	5307	70	6552	86	5116	67	6316	83
			Clear		7569	100	5911	78	7297	96	5697	75	7034	93
			Diffuse	AS	6064	80	4735	62	5846	77	4564	60	5635	74
			Clear		6846	90	5346	70	6600	87	5153	68	6362	84
			Diffuse	WG	7151	94	5584	73	6894	91	5383	71	6645	87
			Clear		7933	104	6195	82	7649	101	5972	79	7372	97
			Diffuse	WW	6064	80	4735	62	5846	77	4564	60	5635	74
			Clear		6846	90	5346	70	6600	87	5153	68	6362	84
	1,500	9,000	Diffuse	SM	9144	74	7141	58	8816	71	6883	56	8497	69
			Clear		10241	83	7998	64	9874	80	7709	62	9517	77
			Diffuse	AS	8159	66	6371	51	7866	63	6141	50	7582	61
			Clear		9211	74	7193	58	8880	72	6934	56	8560	69
			Diffuse	WG	9622	78	7514	61	9276	75	7243	58	8941	72
			Clear		10674	86	8336	67	10291	83	8035	65	9919	80
			Diffuse	WW	8159	66	6371	51	7866	63	6141	50	7582	61
			Clear		9211	74	7193	58	8880	72	6934	56	8560	69

DATE: LOCATION:

TYPE: PROJECT:

CATALOG #:

LUMINAIRE PERFORMANCE - DOWN LIGHT (CONT)

Section Length	Lumens/ft	Lumen Package	Lens	Distribution	5K8 5000K 80CRI		4K9 4000K 90CRI		4K8 4000K 80CRI		3K9 3000K 90CRI		3K8 3000K 80CRI	
					Lumen	LPW[1]	Lumen	LPW[1]	Lumen	LPW[1]	Lumen	LPW[1]	Lumen	LPW[1]
8 FT Down	500	4,000	Diffuse	SM	4900	99	3827	77	4724	95	3688	74	4554	92
			Clear		5488	110	4286	86	5291	106	4131	83	5100	103
			Diffuse	AS	4372	88	3414	69	4215	85	3291	66	4063	82
			Clear		4936	99	3855	78	4759	96	3715	75	4587	92
			Diffuse	WG	5156	104	4026	81	4971	100	3881	78	4791	96
			Clear		5720	115	4467	90	5515	111	4306	87	5316	107
			Diffuse	WW	4372	88	3414	69	4215	85	3291	66	4063	82
			Clear		4936	99	3855	78	4759	96	3715	75	4587	92
	750	6,000	Diffuse	SM	7084	95	5532	74	6830	91	5333	71	6583	88
			Clear		7880	105	6154	82	7597	102	5931	79	7323	98
			Diffuse	AS	6321	85	4936	66	6094	81	4758	64	5874	79
			Clear		7136	95	5573	75	6880	92	5372	72	6632	89
			Diffuse	WG	7455	100	5821	78	7187	96	5611	75	6927	93
			Clear		8270	111	6458	86	7973	107	6225	83	7685	103
			Diffuse	WW	6321	85	4936	66	6094	81	4758	64	5874	79
			Clear		7136	95	5573	75	6880	92	5372	72	6632	89
	1,000	8,000	Diffuse	SM	9061	87	7076	68	8736	84	6821	66	8421	81
			Clear		10092	97	7881	76	9730	94	7597	73	9378	91
			Diffuse	AS	8085	78	6314	61	7795	75	6086	59	7513	73
			Clear		9128	88	7128	69	8800	85	6871	66	8483	82
			Diffuse	WG	9535	92	7446	72	9192	89	7177	69	8861	86
			Clear		10578	102	8260	80	10198	98	7962	77	9830	95
			Diffuse	WW	8085	78	6314	61	7795	75	6086	59	7513	73
			Clear		9128	88	7128	69	8800	85	6871	66	8483	82
	1,500	12,000	Diffuse	SM	12192	75	9521	58	11754	72	9177	56	11330	69
			Clear		13655	84	10664	65	13165	81	10279	63	12690	78
			Diffuse	AS	10878	67	8495	52	10488	64	8188	50	10109	62
			Clear		12282	75	9591	59	11841	73	9245	57	11413	70
			Diffuse	WG	12829	79	10018	61	12368	76	9657	59	11922	73
			Clear		14232	87	11114	68	13721	84	10713	66	13226	81
			Diffuse	WW	10878	67	8495	52	10488	64	8188	50	10109	62
			Clear		12282	75	9591	59	11841	73	9245	57	11413	70

PHOTOMETRY

RN-D-4-15-4K8-AS-CL

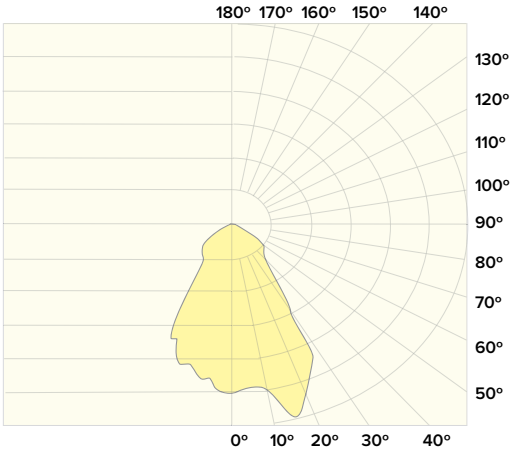
LUMINAIRE DATA

Description	**4000 K, 80CRI**
Delivered Lumens	**5920**
Watts	**82**
Efficacy	**72.2**

ZONAL LUMEN SUMMARY

Zone	Lumens	% Luminaire
0-30	2,616.40	44.20%
0-40	3,845.20	65%
0-60	5,439.50	91.90%
60-90	477.2	8.10%
Total Flux	5,920	100%

ISOFOOT CANDLE PLOT



RN-D-4-15-4K8-SM-CL

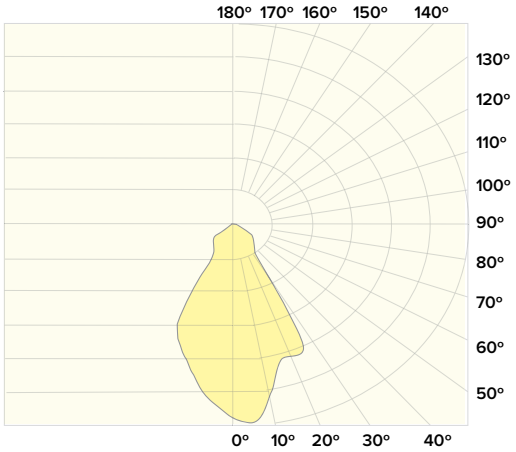
LUMINAIRE DATA

Description	**4000K, 80CRI**
Delivered Lumens	**6582**
Watts	**82**
Efficacy	**80.3**

ZONAL LUMEN SUMMARY

Zone	Lumens	% Luminaire
0-30	3,111.40	47.30%
0-40	4,421.00	67.20%
0-60	6,080.20	92.40%
60-90	496.8	7.60%
Total Flux	6,582	100%

ISOFOOT CANDLE PLOT



PHOTOMETRY

RN-D-4-15-4K8-WG-CL

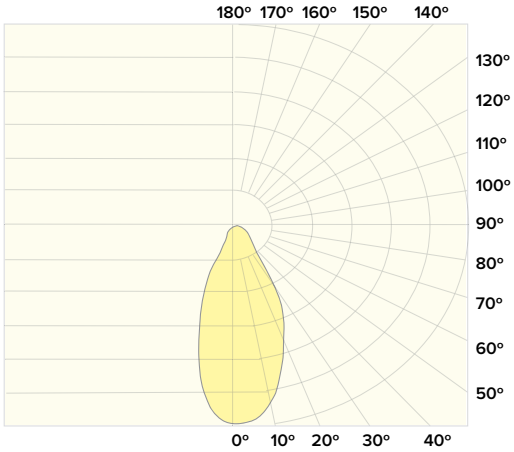
LUMINAIRE DATA

Description	**4000K, 80CRI**
Delivered Lumens	**6860**
Watts	**82**
Efficacy	**83.7**

ZONAL LUMEN SUMMARY

Zone	Lumens	% Luminaire
0-30	3,554.00	51.90%
0-40	4,892.20	71.40%
0-60	6,460.10	94.30%
60-90	393.4	5.70%
Total Flux	6,860	100%

ISOFOOT CANDLE PLOT



RN-D-4-15-4K8-WW-CL

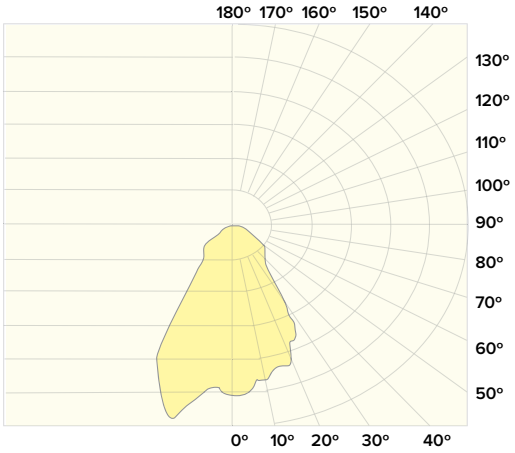
LUMINAIRE DATA

Description	**4000K, 80CRI**
Delivered Lumens	**5920**
Watts	**82**
Efficacy	**72.2**

ZONAL LUMEN SUMMARY

Zone	Lumens	% Luminaire
0-30	2,616.50	44.20%
0-40	3,845.00	65%
0-60	5,439.20	91.90%
60-90	477.2	8.10%
Total Flux	5,920	100%

ISOFOOT CANDLE PLOT



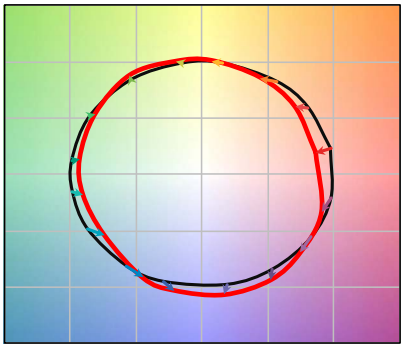
DATE: LOCATION:

TYPE: PROJECT:

CATALOG #:

TM-30 DATA

COLOR VECTOR GRAPHIC



Reference Illuminant — Test Source

TEST SOURCE

MBM TEST RESULTS	
R_f	81
R_g	96
CCT (K)	4038
D_{uv}	0.0022
x	0.3803
y	0.3814
CIE R_a	82

ELECTRICAL DATA

Section Length	Number of Drivers	System Current	Line Voltage (V)	System Power (W)	Current (A)
2FT	1	320	120	13.1	0.109
			277		0.047
			347		0.038
			480		0.027
		480	120	19.6	0.163
			277		0.071
			347		0.056
			480		0.041
		640	120	26.0	0.217
			277		0.094
			347		0.075
			480		0.054
		1000	120	41.1	0.343
			277		0.148
			347		0.118
			480		0.086

CRI LUMEN MULTIPLIER		
CCT	80 CRI	90 CRI
3000K	1	0.834
4000K	1	0.855
5000K	1	0.862

DATE: LOCATION:

TYPE: PROJECT:

CATALOG #:

ELECTRICAL DATA (CONT)

Section Length	Number of Drivers	System Current	Line Voltage (V)	System Power (W)	Current (A)
3FT	1	480	120	19.1	0.159
			277		0.069
			347		0.055
			480		0.040
		720	120	28.6	0.238
			277		0.103
			347		0.082
			480		0.060
		960	120	38.4	0.320
			277		0.139
			347		0.111
			480		0.080
		1500	120	61.2	0.510
			277		0.221
			347		0.176
			480		0.128
4FT	1	640	120	25.0	0.208
			277		0.090
			347		0.072
			480		0.052
		960	120	37.8	0.315
			277		0.136
			347		0.109
			480		0.079
		1280	120	51.8	0.432
			277		0.187
			347		0.149
			480		0.108
		2000	120	81.8	0.682
			277		0.295
			347		0.236
			480		0.170

DATE: LOCATION:

TYPE: PROJECT:

CATALOG #:

ELECTRICAL DATA (CONT)

Section Length	Number of Drivers	System Current	Line Voltage (V)	System Power (W)	Current (A)
6FT	1	960	120	37.2	0.310
			277		0.134
			347		0.107
			480		0.078
		1440	120	56.0	0.467
			277		0.202
			347		0.161
			480		0.117
		1920	120	76.0	0.633
			277		0.274
			347		0.219
			480		0.158
		1000	120	124.0	1.033
			277		0.448
			2000		0.357
			480		0.258
8FT	1	1280	120	49.7	0.414
			277		0.179
			347		0.143
			480		0.104
		1920	120	74.8	0.623
			277		0.270
			347		0.216
			480		0.156
		1280	120	103.6	0.863
			277		0.374
			347		0.299
			480		0.216
		2000	120	163.1	1.359
			277		0.589
			347		0.470
			480		0.340

architectural arealighting

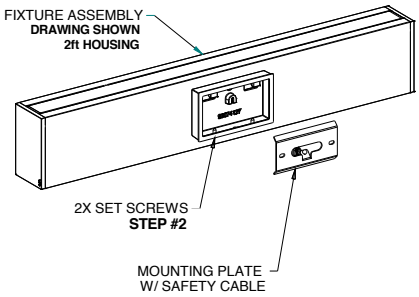
RND

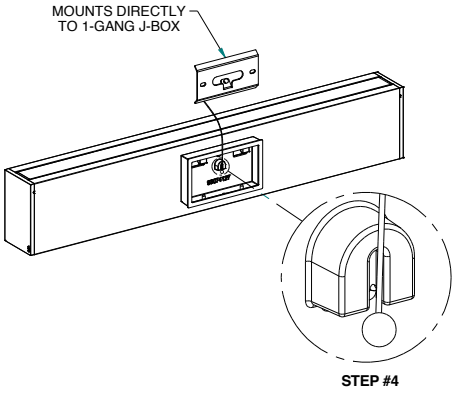
WALL MOUNT

DATE: LOCATION:

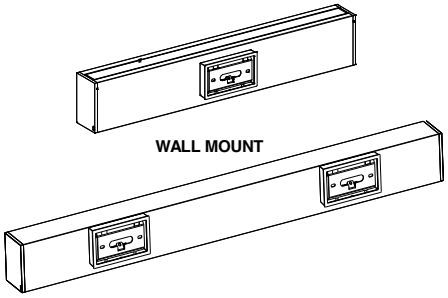
TYPE: PROJECT:

CATALOG #:



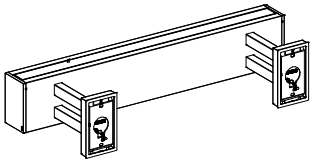


STEP #4

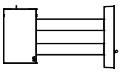


WALL MOUNT

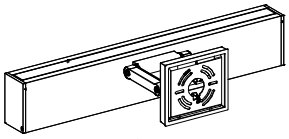
SIDE VIEW
WALL MOUNT



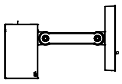
FIXED ARM MOUNT



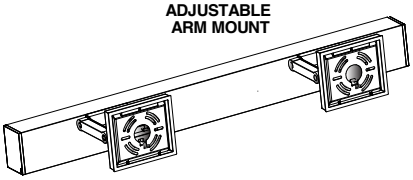
SIDE VIEW
FIXED ARM MOUNT

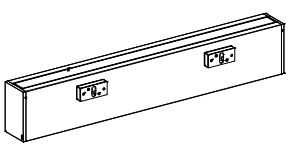


ADJUSTABLE
ARM MOUNT



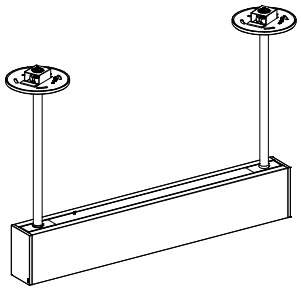
SIDE VIEW
ADJUSTABLE ARM MOUNT



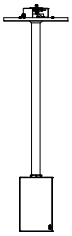


MULLION MOUNT

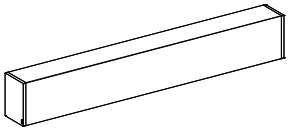
SIDE VIEW
MULLION MOUNT



PENDANT ARM MOUNT

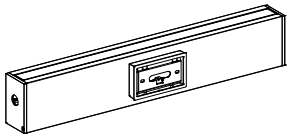


SIDE VIEW
PENDANT ARM MOUNT



SURFACE MOUNT

SIDE VIEW
SURFACE MOUNT



WALL MOUNT SHOWN
WITH EMF OPTION

SIDE VIEW
WITH EMF OPTION

HUBBELL Lighting

architectural arealighting

RND

WALL MOUNT

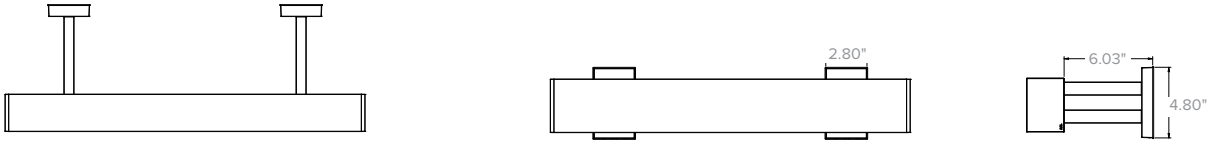
DATE: LOCATION:

TYPE: PROJECT:

CATALOG #:

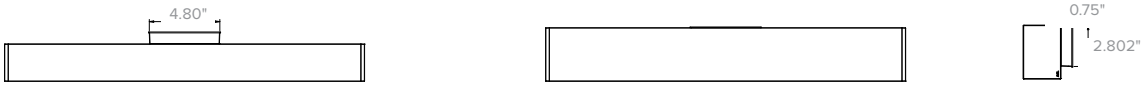
FIXTURE

FIXED ARM



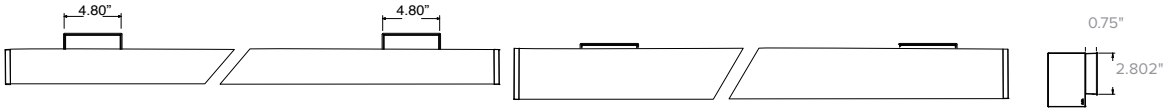
WALL

2ft fixture has 1 mounting point



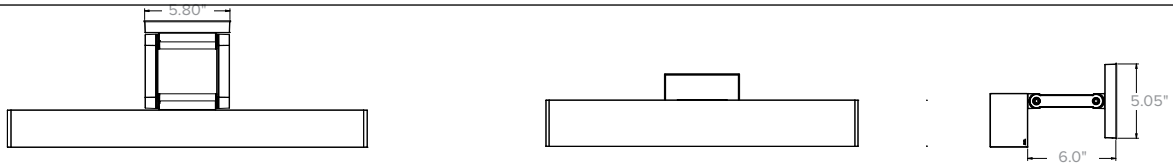
WALL

3, 4, 6 & 8ft fixtures have 2 mounting points



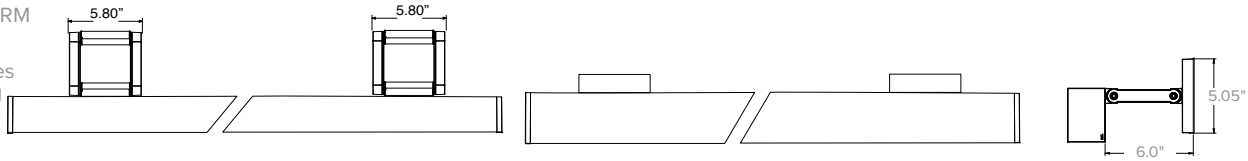
ADJUSTABLE ARM

2ft fixture has 1 mounting point

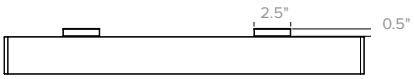


ADJUSTABLE ARM

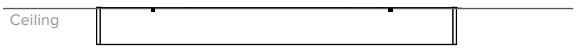
3, 4, 6 & 8ft fixtures have 2 mounting points



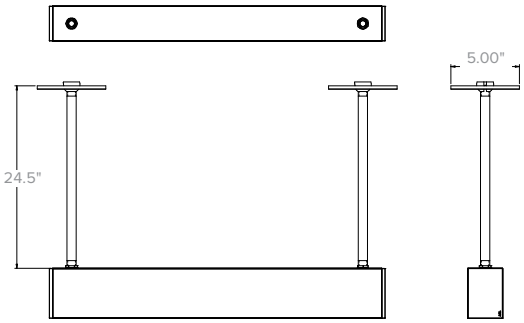
MULLION



SURFACE



PENDANT



HUBBELL® Lighting

tivoli®

TRACE

VERTICAL

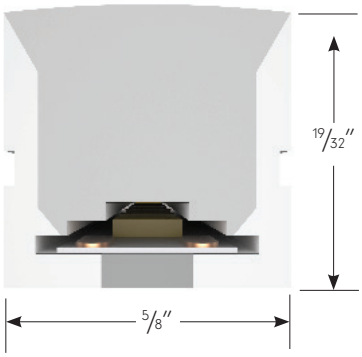
Project: _____ Type: _____

Product Features

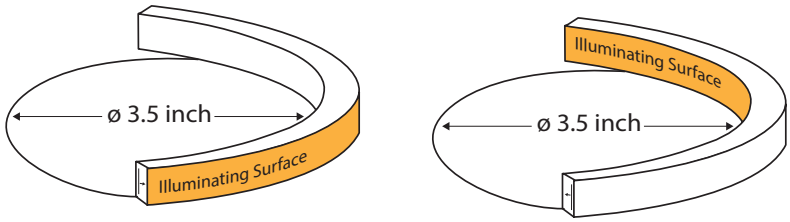
- Constructed using flexible SMD LEDs with zero voltage drop for reliability and uniformity of light
- Used to outline structures or applications where traditional glass neon is used
- Low Voltage 24V DC
- Long-life LEDs with tight cutting increments for precise field installation
- UV Stabilized for exterior use with silicone housing (no yellowing or cracking)
- IP67 Rating
- IK07 Rating - protected against 2 joules impact
- 1 Bin, 1.5 step color consistency

IK07 IP67 UL LISTED

Dimensions



TRACE Vertical Bending Direction



Convex/Concave Bending

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Order Specification Guide

NOTE: Lengths and quantity of each run must be submitted at time of order.
TRACE is factory prep only. In-field cutting will void warranty.

PRODUCT CODE		INTENSITY		PROFILE		LED COLOR		VOLTAGE
TRCE	-		-	**V**	-		-	**24**
TRCE = Trace Flexible Light		**L** = Low Output **S** = Standard Output **H** = High Output		**V** = Vertical		**24** = 2400K **27** = 2700K **30** = 3000K **35** = 3500K* **40** = 4000K **50** = 5000K* **GR** = Green* **BL** = Blue **RD** = Red **AM** = Amber*		**24** = 24V DC

*Special Order Option. Consult factory for lead time and MOQ.

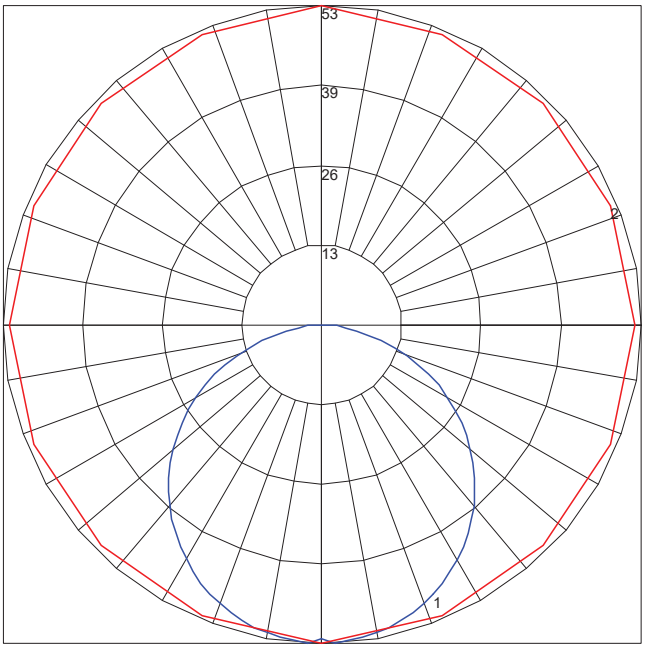
Specifications

Output (2700K)			
LED Intensity	**Low Output**	**Standard Output**	**High Output**
Lumens (lm/ft)	87	174	261
Beam Angle	115.8°		
Efficacy (lm/W)	58		
LEDs	2835		
CRI	>80		
Electrical			
Dimming	TRIAC, ELV, MLV, 0-10V, DMX		
Input Voltage	24V DC		
Power Consumption (W/ft)	1.5	3	4.5
Maximum Run	58'	29'	19'
Physical			
Dimensions	5/8" X 19/32"		
Cutting Increments	1.97"		
Material	UV, Solvent, Saltwater resistant silicone		
Wire Exit Options	Front, Side, Bottom		
LED PIN Temperature	60.9°C / 141.6°F		
Storage Temperature	-25°C / -13°F - 60°C / 140°F		
Ambient Temperature	Ta_{min} = -25°C / -13°F, Ta_{max}		
Certification and Testing			
Certification	UL		
Environment	Wet Location		
IP Rating	IP67		
IK Rating	IK07		
Warranty	3 Years		

- Maximum Run length refers to single side feed in serial connection
- The given color temperature is the strip (after coating) color temperature
- The given data are typical values due to the tolerances of the production process and electrical components; values for the light output and electrical power can vary up to 10%

Photometrics

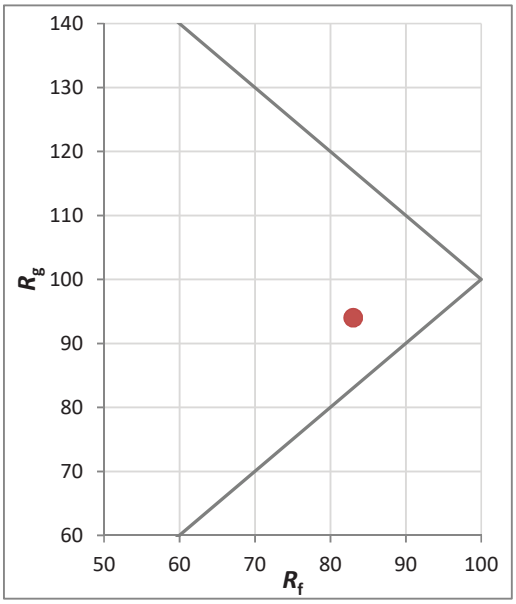
TRACE Vertical: Based on 2700K



Maximum Candela = 52.6
Located At Horizontal Angle = 90
Vertical Angle = 2.5
#1 Vertical Plane Through Horizontal Angles (90-270) (Through Max. Cd.)
#2 Vertical Cone Through Vertical Angle (2.5) (Through Max. Cd.)

TM-30

		Graphic Shifts (%)	
Hue Bin	R_f	Chroma	Hue
1	77	-11%	1%
2	80	-8%	6%
3	80	-4%	9%
4	89	-3%	3%
5	92	-2%	3%
6	94	-1%	-2%
7	85	-7%	-3%
8	91	-5%	2%
9	84	-6%	7%
10	78	-3%	13%
11	80	2%	13%
12	84	7%	1%
13	85	3%	-9%
14	78	4%	-16%
15	83	-5%	-7%
16	73	-9%	-16%



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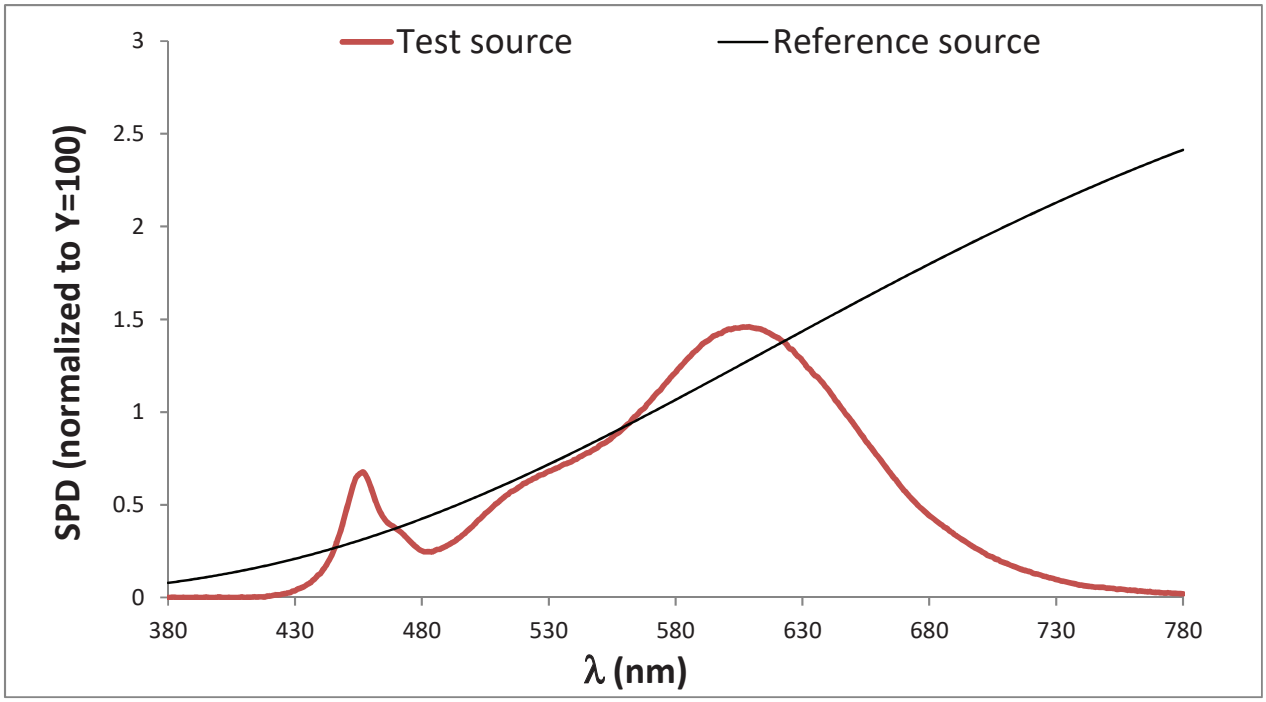
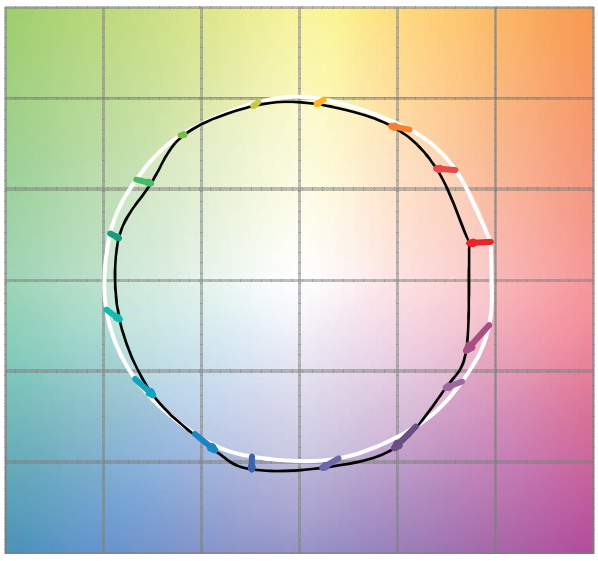
TM-30

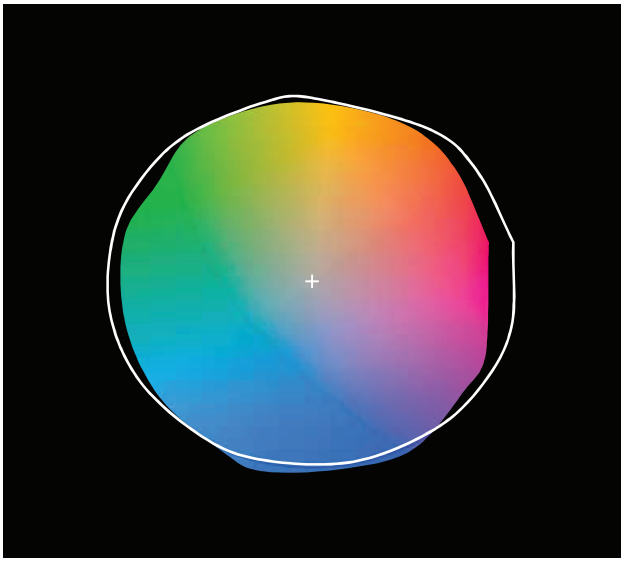
TRACE Vertical: Based on 2700K



Color Vector Graphic



Color Distortion Graphic



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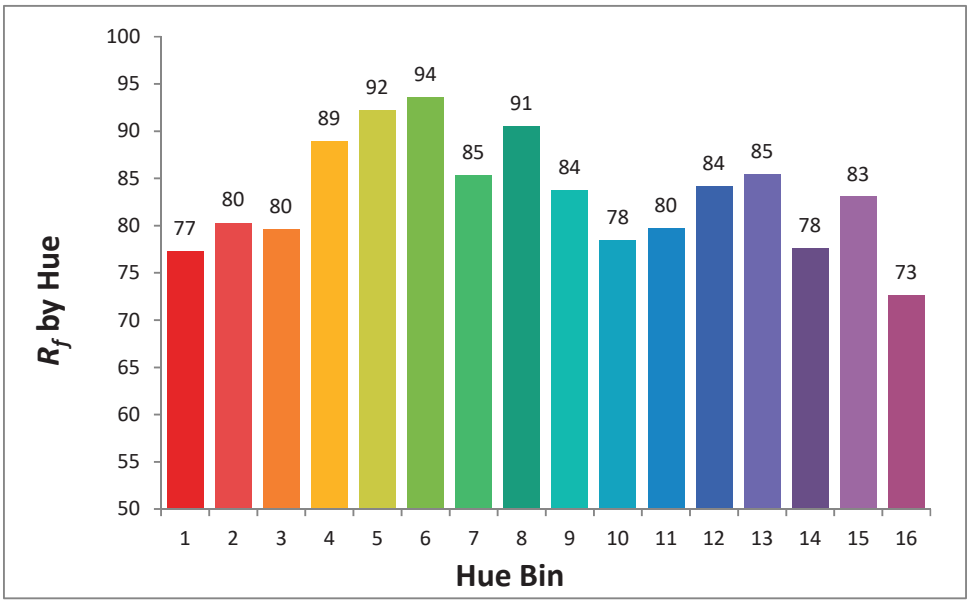
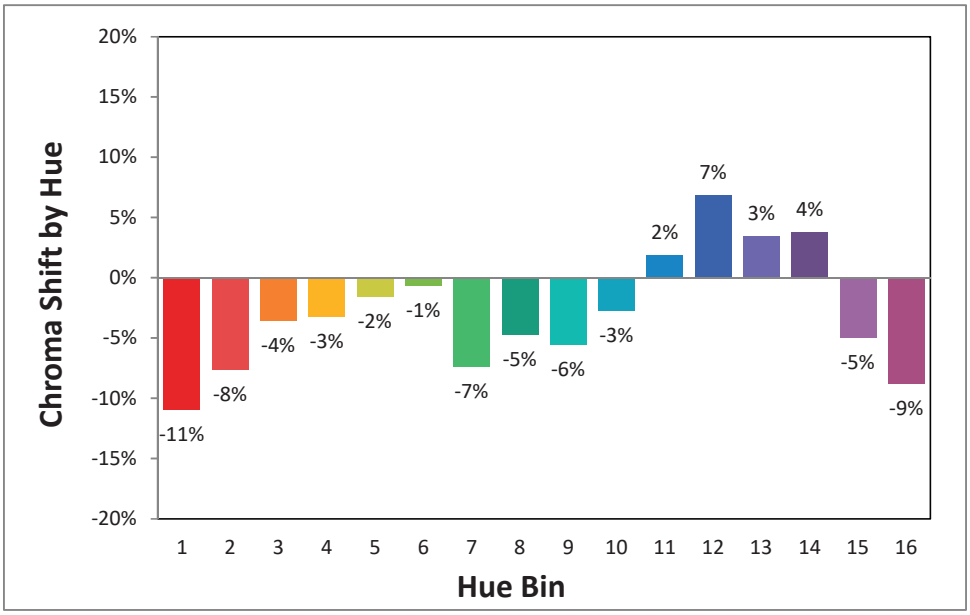
TM-30

TRACE Vertical: Based on 2700K

Hue Angle Bin vs. Fidelity Index

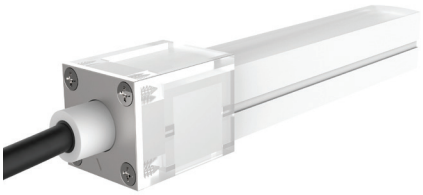


Hue Angle Bin vs. Change of Chroma



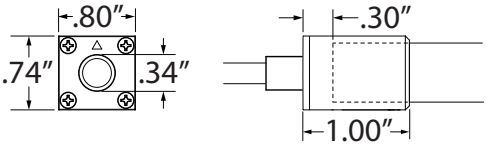
Power Lead Options - Vertical

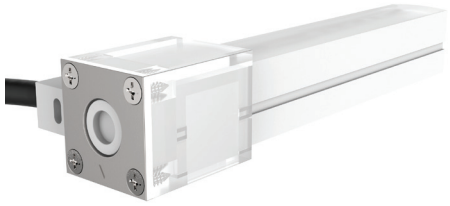
IP67: Rated for outdoor use and factory assembled.
Note: The end cap is made of UV stabilized polycarbonate, which produces no yellowing and cracking over time.



TRACE LEAD - FRONT

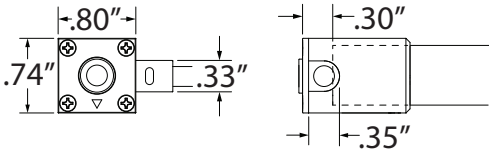
Vertical Front Lead Entry
5' Power Lead Cable with End Cap





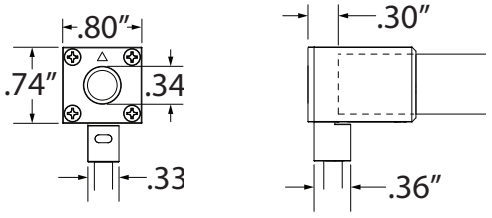
TRACE LEAD - SIDE

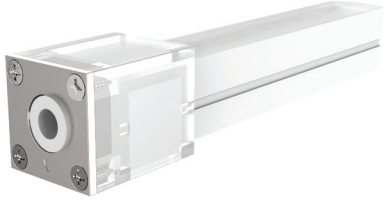
Vertical Side Lead Entry
5' Power Lead Cable with End Cap



TRACE LEAD - BOTTOM

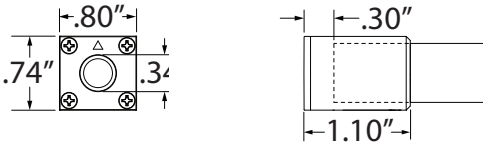
Vertical Bottom Lead Entry
5' Power Lead Cable with End Cap





TRACE END CAP

Vertical End Cap (No Lead)
1 pc End Cap with 4 Screws



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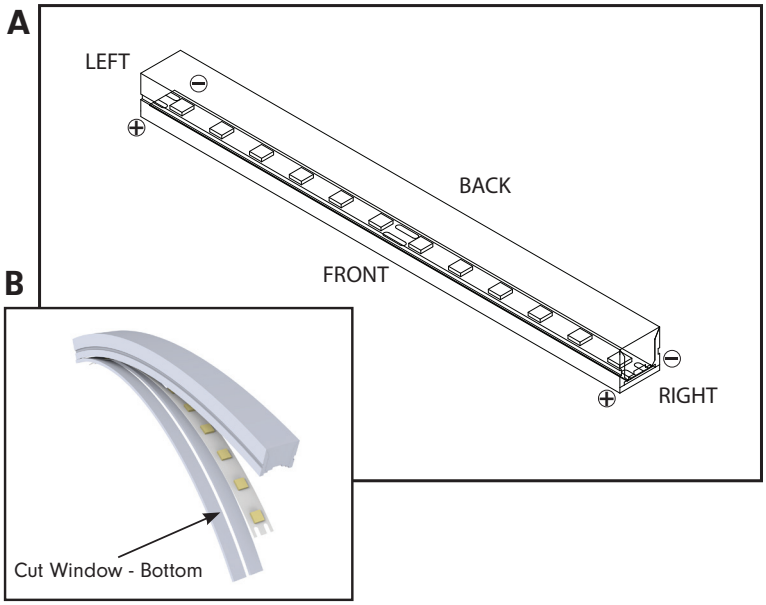
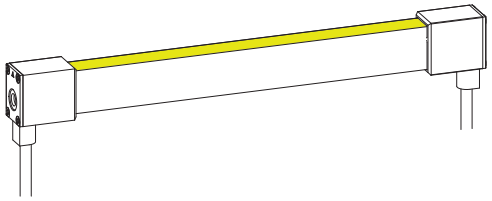
Power Leads - How to Configure

It is important to note the orientation of TRACE and what is considered Left Facing and Right Facing. TRACE is polarity specific and proper submission of power leads for each run is necessary for factory prep standards.

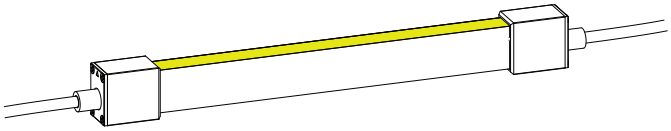
VERTICAL TRACE - The cut window will always indicate as Bottom (Image B) and positive (+) politarity will indicate front facing (Image A).



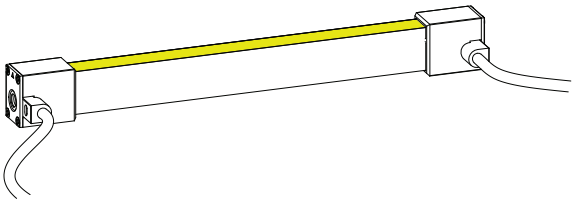
Power Lead Configurations



TRCE-V-LEAD-B-B
Left Facing Bottom Lead with 5' Power Cable to Right Facing Bottom Lead with 5' Power Cable



TRCE-V-LEAD-F-F
Left Facing Front Lead with 5' Power Cable to Right Facing Front Lead with 5' Power Cable



TRCE-V-LEAD-S-S
Left Facing Side Lead with 5' Power Cable to Right Facing Side Lead with 5' Power Cable

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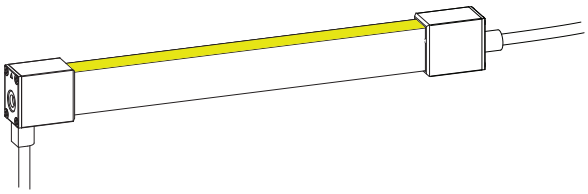
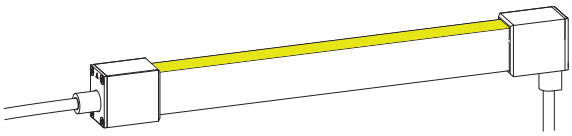
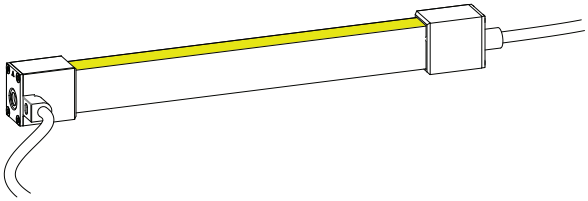
Power Lead Configurations



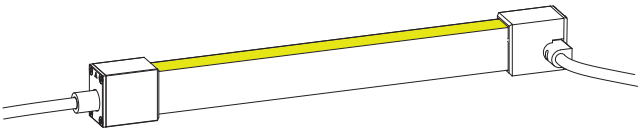
TRCE-V-LEAD-B-F
Left Facing Bottom Lead with 5′ Power Cable to
Right Facing Front Lead with 5′ Power Cable



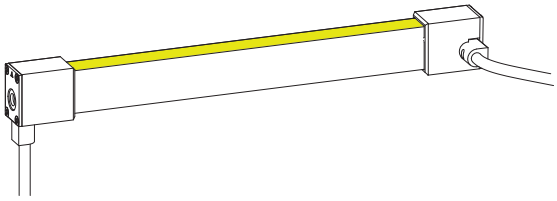
TRCE-V-LEAD-F-B
Left Facing Front Lead with 5′ Power Cable to
Right Facing Bottom Lead with 5′ Power Cable



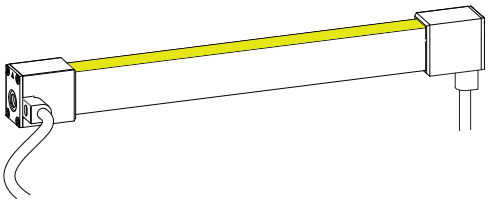
TRCE-V-LEAD-S-F
Left Facing Side Lead with 5′ Power Cable to
Right Facing Front Lead with 5′ Power Cable



TRCE-V-LEAD-F-S
Left Facing Front Lead with 5′ Power Cable to
Right Facing Side Lead with 5′ Power Cable

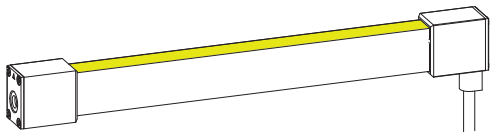


TRCE-V-LEAD-B-S
Left Facing Bottom Lead with 5′ Power Cable to
Right Facing Side Lead with 5′ Power Cable

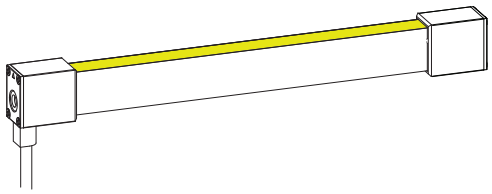


TRCE-V-LEAD-S-B
Left Facing Side Lead with 5′ Power Cable to
Right Facing Bottom Lead with 5′ Power Cable

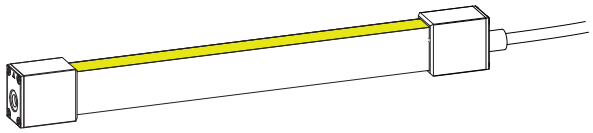
Power Lead Configurations



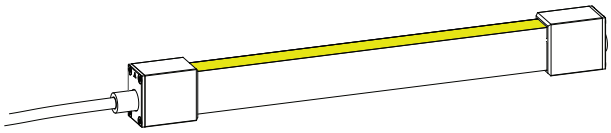
TRCE-V-LEAD-E-B
Left End Cap Lead to Right Facing Bottom Lead with 5' Power Cable



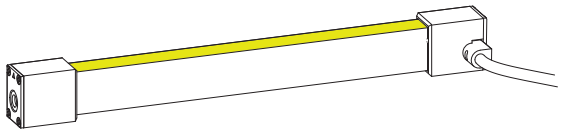
TRCE-V-LEAD-B-E
Left Facing Bottom Lead with 5' Power Cable to Right End Cap



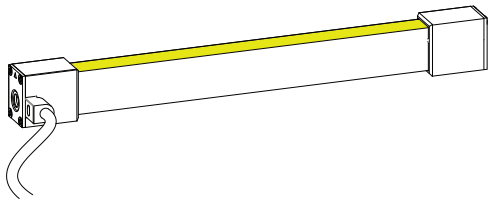
TRCE-V-LEAD-E-F
Left End Cap Lead to Right Facing Front Lead with 5' Power Cable



TRCE-V-LEAD-F-E
Left Facing Front Lead with 5' Power Cable to Right End Cap



TRCE-V-LEAD-E-S
Left Facing End Cap Lead to Right Facing Side Lead with 5' Power Cable



TRCE-V-LEAD-S-E
Left Facing Side Lead with 5' Power Cable to Right Facing End Cap

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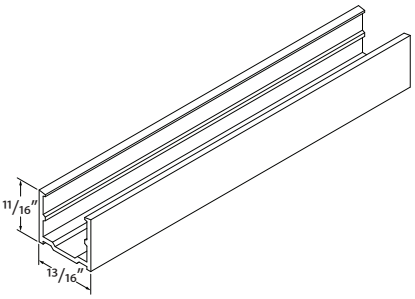
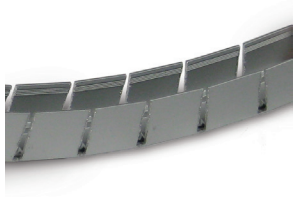
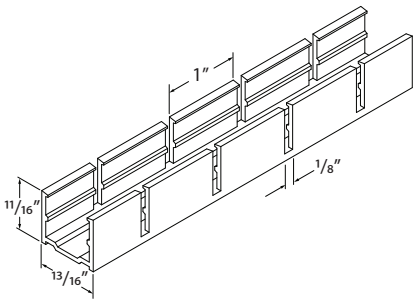
Mounting Options

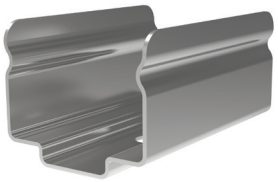
TRCE-V-SLV-SCHAN-6.5
Straight Channel
Vertical Profile Only
6.56' Length, Aluminum



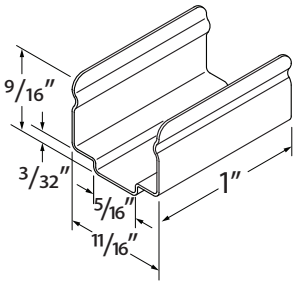


TRCE-V-SLV-NCHAN-6.5
Notched Channel
Vertical Profile Only
Radius Bend: 11"
6.56' Length, Aluminum





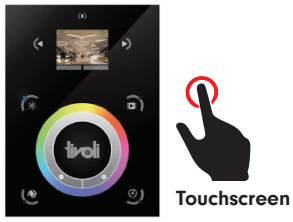
TRCE-V-SLS-MTCLIPS
Mounting Clips
Vertical Profile Only
2 Stainless Steel Clips with 2 Screws



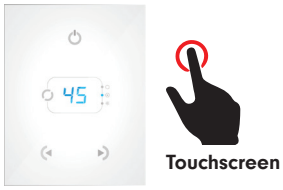
FLXD-SIL-GE-10
GE Silicone 10oz Tube
Use to adhere TRACE into entire run length of channel
25' estimated bead length per 10oz tube

Controls & Software

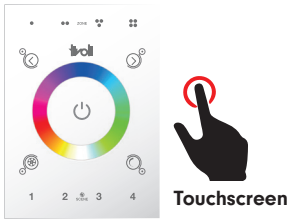
CONTROLS



TVOQ-10-XX-7
XX = BK (black), WH (white)
1024 DMX channel, 500 scene,
10 zone, glass touch screen



TVOQ-2-XX
XX = BK (black), WH (white)
512 DMX channel, 99 scene,
1 zone, glass touch screen



TVOQ-1-WHT
512 DMX channel, 16 scene,
4 zone, glass touch screen

SOFTWARE

Cue™ and CuePro™ softwares are specifically designed for the TivoCUE™ in-wall DMX controls and includes an array of tools required by the latest DMX lighting fixtures. Intuitive, with easy-to-use effects that can be dropped into timelines, and multi-zone synchronization capabilities allow you to program a project effortlessly.

Power Supplies - Indoor

ADUL - NON DIMMING

DESCRIPTION	CAT NO	APPLICATION	PRIMARY VOLTAGE	SECONDARY VOLTAGE	CIRCUIT BREAKERS	MAX LOAD	CIRCUIT CAPACITY
ADUL Series Class 2 Transformer	ADUL-120-1-4-24-D	Indoor / Damp	100-277V AC 50⁄60 HZ	24V DC	1	96W	4A
	ADUL-240-2-4-24-D				2	2x96W	2x4A
	ADUL-320-3-4-24-D				3	3x96W	3x4A

ADUL - 0-10V DIMMING

DESCRIPTION	CAT NO	APPLICATION	PRIMARY VOLTAGE	SECONDARY VOLTAGE	CIRCUIT BREAKERS	MAX LOAD	CIRCUIT CAPACITY
ADUL Series Class 2 Transformer	ADUL-120-1-4-24-DOT	Indoor / Damp	100-277V AC 50⁄60 HZ	24V DC	1	96W	4A
	ADUL-240-2-4-24-DOT				2	2x96W	2x4A
	ADUL-320-3-4-24-DOT				3	3x96W	3x4A

ADUL - DMX SINGLE ADDRESS

DESCRIPTION	CAT NO	APPLICATION	PRIMARY VOLTAGE	SECONDARY VOLTAGE	CIRCUIT BREAKERS	MAX LOAD	CIRCUIT CAPACITY
ADUL Series Class 2 Transformer	ADUL-120-1-4-24-DIN	Indoor / Damp	100-277V AC 50⁄60 Hz	24V DC	1	96W	4A
	ADUL-240-2-4-24-DIN				2	2x96W	2x4A
	ADUL-320-3-4-24-DIN				3	3x96W	3x4A

ADUL - DMX MULTI ADDRESS

DESCRIPTION	CAT NO	APPLICATION	PRIMARY VOLTAGE	SECONDARY VOLTAGE	CIRCUIT BREAKERS	MAX LOAD	CIRCUIT CAPACITY
ADUL Series Class 2 Transformer	ADUL-240-2-4-24-DIN-2	Indoor / Damp	100-277V AC 50⁄60 Hz	24V DC	2	2x96W	2x4A
	ADUL-320-3-4-24-DIN-3				3	3x96W	3x4A

Power Supplies - Outdoor

ADNM - NON DIMMING

DESCRIPTION	CAT NO	APPLICATION	PRIMARY VOLTAGE	SECONDARY VOLTAGE	CIRCUIT BREAKERS	MAX LOAD	CIRCUIT CAPACITY
ADNM Series Class 2 Transformer	ADNM-90-1-4-24-D	Indoor / Outdoor	100-277V AC 50/60 Hz	24V DC	1	90W	3.75A
	ADNM-120-1-4-24-D				1	96W	4A
	ADNM-240-2-4-24-D				2	2x96W	2x4A
	ADNM-320-3-4-24-D				3	3x96W	3x4A

ADNM - 0-10V DIMMING

DESCRIPTION	CAT NO	APPLICATION	PRIMARY VOLTAGE	SECONDARY VOLTAGE	CIRCUIT BREAKERS	MAX LOAD	CIRCUIT CAPACITY
ADNM Series Class 2 Transformer	ADNM-90-1-4-24-DOT	Indoor / Outdoor	100-277V AC 50/60 Hz	24V DC	1	90W	3.75A
	ADNM-120-1-4-24-DOT				1	96W	4A
	ADNM-240-2-4-24-DOT				2	2x96W	2x4A
	ADNM-320-3-4-24-DOT				3	3x96W	3x4A

ADNM - DMX SINGLE ADDRESS

DESCRIPTION	CAT NO	APPLICATION	PRIMARY VOLTAGE	SECONDARY VOLTAGE	CIRCUIT BREAKERS	MAX LOAD	CIRCUIT CAPACITY
ADNM Series Class 2 Transformer	ADNM-90-1-4-24-DIN	Indoor / Outdoor	100-277V AC 50/60 Hz	24V DC	1	90W	3.75A
	ADNM-120-1-4-24-DIN				1	96W	4A
	ADNM-240-2-4-24-DIN				2	2x96W	2x4A
	ADNM-320-3-4-24-DIN				3	3x96W	3x4A

ADNM - DMX MULTI ADDRESS

DESCRIPTION	CAT NO	APPLICATION	PRIMARY VOLTAGE	SECONDARY VOLTAGE	CIRCUIT BREAKERS	MAX LOAD	CIRCUIT CAPACITY
ADNM Series Class 2 Transformer	ADNM-240-2-4-24-DIN-2	Indoor / Outdoor	100-277V AC 50/60 Hz	24V DC	2	2x96W	2x4A
	ADNM-320-3-4-24-DIN-3				3	3x96W	3x4A

ADNM - DMX/DALI FLICKER-FREE FOR TV STUDIO

DESCRIPTION	CAT NO	APPLICATION	PRIMARY VOLTAGE	SECONDARY VOLTAGE	CIRCUIT BREAKERS	MAX LOAD	CIRCUIT CAPACITY
ADNM Series Class 2 Transformer	ADNM-120-1-4-24-DTV	Indoor / Outdoor	100-277V AC 50/60 Hz	24V DC	1	1x96W	1x4A
	ADNM-240-2-4-24-DTV				2	2x96W	2x4A
	ADNM-320-3-4-24-DTV				3	3x96W	3x4A

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Power Supplies - Outdoor

INFINITY - MLV / ELV / 0-10V / PWM / TRIAC

DESCRIPTION	CAT NO	APPLICATION	PRIMARY VOLTAGE	SECONDARY VOLTAGE	CIRCUIT BREAKERS	MAX LOAD	MIN LOAD	CIRCUIT CAPACITY
Infinity Series Class 2 Transformer	INF-J-30-1-1.3-24	Indoor / Outdoor	100 - 277V AC	24VDC	1	30W	3W	1.3A
	INF-J-60-1-2.5-24				1	60W	6W	2.5A
	INF-J-96-1-4-24				1	96W	9W	4A
	INF-J-192-2-4-24				2	2x96W	2x9W	2x4A
	INF-J-288-3-4-24				3	3x96W	3X9W	3x4A

Dimmers

DIMMING - 0-10V

DESCRIPTION	CAT NO	APPLICATION	INPUT VOLTAGE	OUTPUT VOLTAGE	MAX LOAD
0-10V Dimmer	DIM-LD-010	Indoor	24V DC	24V DC	30 mA max. output (sink only)

DIMMING - MLV

DESCRIPTION	CAT NO	APPLICATION	INPUT VOLTAGE	OUTPUT VOLTAGE	MAX LOAD
MLV Dimmer	N-600	Indoor	120V AC	120V AC	450W
	N-1000				800W
	N-1500				1200W
	D-600				450W
	M-600				450W
	M-1000				800W

DIMMING - ELV

DESCRIPTION	CAT NO	APPLICATION	INPUT VOLTAGE	OUTPUT VOLTAGE	MAX LOAD
ELV Dimmer	ME-600	Indoor	120V AC	120V AC	450W
	DE-300				300W

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HPNFC-HO

Shallow Profile Linear LED Strip Fixture

Customer: Date: Type:

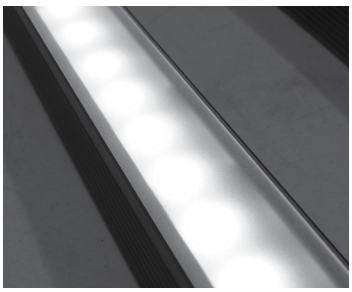
Project:

- Compact, variable light fixture for dry, damp or wet location use.
- Fixture comes in 6" increments (12" minimum)
- Many options in optics, color temperature and accessories.
- EMI Filter integral.
- Boca Flasher's patented CleanDim® technology ensures even dimming from 0-100%.
- Fixtures are compatible with both forward and reverse phase dimming or can use Boca's SDS module for 0-10V DALI or DMX dimming.
- Uses standard line voltage dimmers.
- White or black finish standard.
- Total linear foot per power feed: 8W = 80 ft., 10W = 65 ft.
- Contact Boca Flasher for tips with custom installations.

PRODUCT SPECIFICATIONS:

	LED SPACING	COLOR OPTION	OPTIC	VOLTAGE	FINISH	LOCATION	MOUNTING	LENS	OPTIONS
HPNFC									
	HO8 5W/FT	**2700K**	**10°**	**120V**	**W** White	**I** Interior-IP50	**F** Fixed	**C** Clear	**SB** Square Baffle
	HO8 8W/FT	**3000K**	**30°**	**277V**	**B** Black	**E** Exterior-IP65	**S** Swivel	**D** Diffused	**ASYM** Asymmetric Baffle
	HO8 10W/FT	**3500K**	**60°**			**W** Wet-IP68	**H** Hinge	**SI** Satin Ice (Interior Use Only)	**SKB** Kicker Baffle
		4000K	**10°x60°**				**3Arc** 3" Arc Swivel		**HL** Hexcell Louver (Cannot be used with Satin Ice White or 120° optic)
		5000K	**30°x60°**				**6Arc** 6" Arc Swivel	**OW** Opal White (Exterior Use Only)	
		Amber	**120°**						
		Red							
		Green							
		Blue							

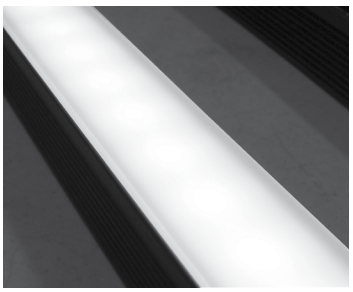
LENS OPTIONS:



Diffused*

- Interior or exterior use.
- 87% transmission.
- Lens is 1/8" (.09) thick, adds 1/16" to overall height of fixture. Call factory for more information.

*Additional charges apply.



Satin Ice White*

- Interior use only.
- Best for direct view use.
- 42% transmission.
- Lens is 1/4" (.25) thick, adds 1/8" to overall height of fixture. Call factory for more information.

*Additional charges apply.

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HPNFC-HO

Shallow Profile Linear LED Strip Fixture

TECHNICAL SPECIFICATIONS:

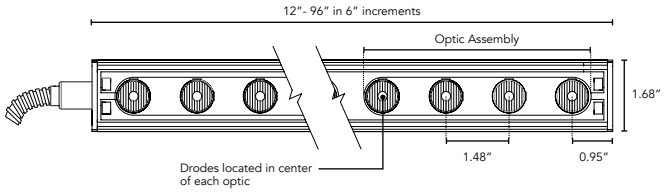
WATTAGE	5, 8 or 10 watts per linear ft.
INPUT VOLTAGE	90-120V or 230-277V
CONTROL	Leading Edge/Trailing Edge line dimmer 0-10V, DALI, DMX*
LED SPACING	1.5" on center
LENGTH	12"- 96", 6" increments
TOTAL HEIGHT	1.04" (not including clip)
TOTAL WIDTH	1.68"
COLOR OPTIONS	2700K,3000K, 3500K, 4000K, 5000K, amber, red, green, blue
MOUNTING	Fixed, swivel, 3" Arc or 6" Arc
AVAILABLE OPTICS	10°, 30°, 60°, 10° x 60°, 30° x 60°, 120°
RATING	IP50, IP65, IP68
COLOR RENDERING INDEX (CRI)	90 + CRI
POWER CABLE	UL Standard 6.5 ft.
ENVIRONMENTAL	Operating temperature--40°F-140°F Ambient(-40°C-60°C)** Storage temperature -40°F-140°F Ambient indoor fixtures operation limited to =<50% relative humidity

** Military spec available under special request-lead times may be impacted.

DIMENSIONS:

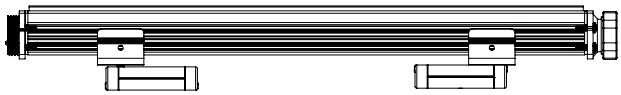
- For vertical installation please contact the factory for specific mounting instructions.
- For installations above 4' please contact the factory.

Plan View

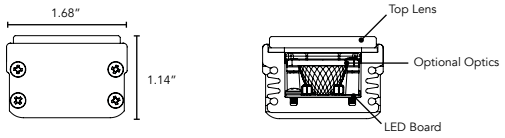


Elevation View

Hinge View

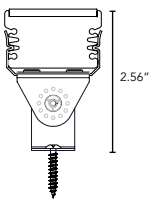


End View

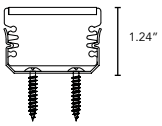


MOUNTING INFORMATION:

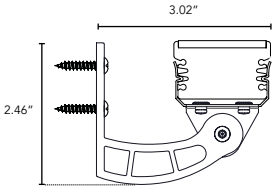
- For vertical installation please contact the factory for specific mounting instructions.



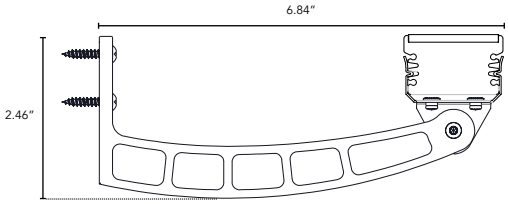
Swivel



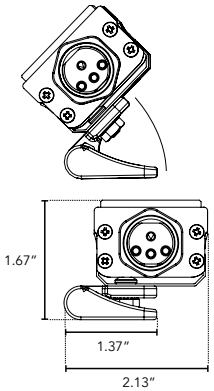
Fixed



3" Arc



6" Arc



Hinge

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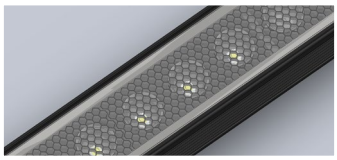
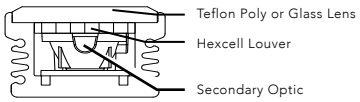
HPNFC-HO

Shallow Profile Linear LED Strip Fixture

BODY CHOICES:

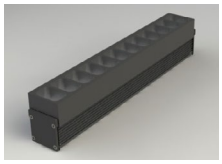




Hexcell Louver

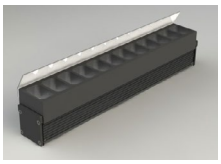
- Economical solution to off axis glare issues.
- Louver is located flush to secondary optic, preventing unwanted striation.
- Louver cannot be utilized when no optic (120°) is specified.
- Louver is behind lens to ensure no damage is done during installation or after. This also ensures no dust build-up.
- Louver ships pre-fitted making on site fixture installation easy.
- No unsightly clips, screws, or brackets.
- Can be used with other baffles.
- Adds nothing to overall height.
- To specify add "HL" in options box.

*Additional charges may apply.



SB - Square Baffle

SSB - Sq. Slanted Baffle



SKB - Sq. Kicker Baffle

Baffle Square Design

- Design cuts off light at 90°
- Baffles are lightweight black PVC with non-reflective surfaces to avoid glare from interior sections.
- One piece baffle slides onto the extruded housing making installation easy.
- SB only adds .75" to overall height
  SSB adds .90" to overall height
  SKB adds 1.625" to overall height
- To specify add "SB" or "SSB" for slanted version or "SKB" for kicker version in options box.

LUMINAIRE INFORMATION:

LUMENS PER LAMP -3500K 30X60	936 (1 lamp)
TOTAL LAMP LUMENS	936
LUMINAIRE LUMENS	936
TOTAL LUMINAIRE EFFECIENCY	100%
LUMEN EFFECACY RATING	94
TOTAL LUMINAIRE WATTS	10.02
BALLAST FACTOR	1.00
CIE TYPE	Direct
SPACING CRITERION (0-180)	0.58
SPACING CRITERION (90-270)	0.62
SPACING CRITERION (Diagonal)	0.60
BASIC LUMINOUS SHAPE	Rectangular
LUMINOUS LENGTH (0-180)	0.31m
LUMINOUS WIDTH (90-270)	0.04m
LUMINOUS HEIGHT	0.03m

- Lo8 Data - 10W for 6W use 0.65 multiplier
- Specific Files Available On Request

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REV 04012022

HUBBELL Outdoor Lighting

DATE: LOCATION:

TYPE: PROJECT:

CATALOG #:

RATIO Flood

COMPACT

RATIO

FEATURES

- Compact LED flood with a variety of NEMA distributions for lighting applications such as: safety/security, accent, flag pole, columns or signs
- Part of the Ratio flood series, this luminaire was designed in cohesion with the site/area products to provide a sleek and timeless look
- Features a dense optical array, providing reduced pixelation and increased visual comfort without compromising performance

RFL2

RFL3

IP66

DLC QPL LISTED

DLC QPL LISTED PREMIUM

BUY AMERICAN SOLUTIONS

See Certification Specifications

RELATED PRODUCTS

RATIO Family Boxes and Covers

BROCHURE

CATALOG PAGE

INSTALL GUIDE

SPECIFICATIONS

CONSTRUCTION

- Corrosion resistant, rugged die-cast aluminum housing with powder coat paint finish
- High impact UV stabilized acrylic outer lens protects LEDs and allows for cleaning and debris removal
- Internal venting fins create optimal heat dissipation and allow all water to drain from the face of the luminaire
- Lens hardware is internal to the fixture allowing for uniform pressure on the gasket for an optimal water tight seal

OPTICS

- 44 or 90 midpower LEDs
- Stock Versions: 4000K and 5000K CCT
- Variety of NEMA distributions: - N (2x2), M (4x4) and W (6x6) - Stock version Wide (6x6) only
- Entire optical aperture illuminates to create a larger luminous surface area resulting in a low glare appearance without sacrificing optical performance

INSTALLATION

- Traditional ½" x 14 NPS threaded adjustable knuckle mounting
- Easy maintenance access to electrical components with removal of 4 screws from back of fixture housing
- Trunnion mount available (sold separately)

ELECTRICAL

- 120–277V operation, 50/60Hz
- Driver IP66 and RoHS compliant driver
- 10kV surge protector optional
- 0–10V dimming driver standard, continuous dimming option to have leads pulled out for easy connection
- Drivers have 90% power factor and less than 20% THD
- LED drivers have output power over-voltage, over-current protection and short circuit protection with auto recovery
- Dimming drivers are standard, but must contact factory to request wiring leads for purpose of external dimming controls

CERTIFICATIONS

- Fixture is IP66 rated
- Listed to UL1598 for use in wet locations
- This product qualifies as a "designated country construction material" per FAR 52.225-11 Buy American-Construction Materials under Trade Agreements effective 04/23/2020. See Buy American Solutions

WARRANTY

- 5 year limited warranty
- See HLI Standard Warranty for additional information

KEY DATA	
Lumen Range	3245–6823
Wattage Range	26–52
Efficacy Range (LPW)	126–142
Fixture Projected Life (Hours)	L70>191,000
Weights lbs. (kg)	3.7–5.5 (6.12–10.8)

HUBBELL Lighting

HUBBELL Outdoor Lighting

DATE: LOCATION:

TYPE: PROJECT:

CATALOG #:

RATIO Flood

COMPACT

STOCK ORDERING INFORMATION

Catalog Number	Mounting	Distribution	Wattage	Voltage	CCT	Lumens	LPW	Weight lbs. (KG)	Finish
RFL2-25-4K	Knuckle	Wide	26	120–277V	4000K	3327	127	3.7 (1.68)	Bronze
RFL2-25-5K	Knuckle	Wide	26	120–277V	5000K	3245	124	3.7 (1.68)	Bronze
RFL2-25-4K-PC	Knuckle	Wide	26	120–277V	4000K	3327	127	3.7 (1.68)	Bronze
RFL2-25-5K-PC	Knuckle	Wide	26	120–277V	5000K	3245	124	3.7 (1.68)	Bronze
RFL3-40-4K	Knuckle	Wide	34	120–277V	4000K	4551	134	5.5 (2.50)	Bronze
RFL3-40-5K	Knuckle	Wide	34	120–277V	5000K	4439	131	5.5 (2.50)	Bronze
RFL3-40-4K-PC	Knuckle	Wide	34	120–277V	4000K	4551	134	5.5 (2.50)	Bronze
RFL3-40-5K-PC	Knuckle	Wide	34	120–277V	5000K	4439	131	5.5 (2.50)	Bronze
RFL3-50-4K	Knuckle	Wide	52	120–277V	4000K	6823	131	5.5 (2.50)	Bronze
RFL3-50-5K	Knuckle	Wide	52	120–277V	5000K	6654	128	5.5 (2.50)	Bronze
RFL3-50-4K-PC	Knuckle	Wide	52	120–277V	4000K	6823	131	5.5 (2.50)	Bronze
RFL3-50-5K-PC	Knuckle	Wide	52	120–277V	5000K	6654	128	5.5 (2.50)	Bronze

ORDERING GUIDE

Example: RFL2–44L-25–4K7–M–UNV–K–DBT–CD–SP

CATALOG #

Model		Nominal Lumens		CCT/CRI		Distribution		Voltage		Mounting		Color	
RFL2	Ratio Flood Size 2	**44L–25**	44 LED–3000lm	**3K7**	3000K, 70 CRI	**N**	Narrow, 2x2	**UNV**	Universal 120–277	**K**	Knuckle	**BLT**	Black Matte Textured
RFL3	Ratio Flood Size 3	**90L–40**	90 LED–5000lm	**4K7**	4000K, 70 CRI	**M**	Medium Flood, 4x4					**BLS**	Black Gloss Smooth
		90L–50	90 LED–7000lm	**5K7**	5000K, 70 CRI	**W**	Wide Flood, 6x6					**DBT**	Dark Bronze Matte Textured
												DBS	Dark Brone Gloss Smooth
												GTT	Graphite Matte Textured
												LGS	Light Grey Gloss Smooth
												PSS	Platinum Silver Smooth
												WHT	White Matte Textured
												WHS	White Gloss Smooth
												VGT	Verde Green Textured
												Color Option	
												CC	Custom Color

Control Options		Options	
CD	Continuous Dimmable	**SP**	Surge Protector, 10kA Surge Protector
PC	Button Photcontrol		

ACCESSORIES AND REPLACEMENT PARTS (ORDERED SEPARATELY)

	Catalog Number	Description
☐	**TRN–XX**[1]	Trunnion adapter for ½" threaded knuckle mount

1 Specify finish color to match fixture, e.g. DB - Bronze

TRN-XX

HUBBELL Lighting

HUBBELL Outdoor Lighting

DATE: LOCATION:

TYPE: PROJECT:

CATALOG #:

RATIO Flood

COMPACT

PERFORMANCE DATA

					5K (5000K nominal, 70 CRI)			4K (4000K nominal, 70 CRI)			3K (3000K nominal, 70 CRI)		
Series	Nominal Watts	Dist. Type	NEMA	Field Angle H° X V°	Lumens	LPW[1]	Max Beam Candlepower	Lumens	LPW[1]	Max Beam Candlepower	Lumens	LPW[1]	Max Beam Candlepower
RFL2	25	N	2 x 2	20 x 20	3308	129	56009	3391	132	57425	3285	128	55632
		M	4 x 4	57 x 57	3124	121	7180	3203	124	7588	3103	120	7426
		W	6 x 6	105 x 105	3245	124	1848	3327	127	1895	3223	123	1836
RFL3	40	N	2 x 2	20 x 20	4525	136	76622	4639	139	69924	4494	135	76107
		M	4 x 4	57 x 57	4273	127	10228	4382	130	10486	4245	126	10159
		W	6 x 6	105 x 105	4439	131	2528	4551	134	2592	4409	130	2511
	50	N	2 x 2	20 x 20	6784	133	114868	6956	136	117772	6739	132	114095
		M	4 x 4	57 x 57	6408	125	17055	6569	128	17486	6364	124	16940
		W	6 x 6	105 x 105	6654	128	3791	6823	131	3886	6610	127	3765

1 Lumen values are from photometric tests performed in accordance with IESNA LM–79–08. Data is considered to be representative of the configurations shown. Actual performance may differ as a result of end-user environment and application.

ELECTRICAL DATA

# LEDS	Nominal Wattage	Input Voltage	Oper. Current (Amps)	System Power (W)
RFL2	25	120	0.22	26.0
		208	0.13	
		240	0.11	
		277	0.09	
RFL3	40	120	0.28	33.8
		208	0.16	
		240	0.14	
		277	0.12	
	50	120	0.43	51.7
		208	0.25	
		240	0.22	
		277	0.19	

PROJECTED LUMEN MAINTENANCE

Ambient Temperature	OPERATING HOURS					
	0	25,000	50,000	TM–21–11 60,000[1]	100,000	Calculated L70 (Hours)
25°C / 77°C	1.00	0.96	0.94	0.91	0.83	> 191,000
40°C / 104°F	0.99	0.95	0.93	0.93	0.81	> 173,000

LUMINAIRE AMBIENT TEMPERATURE FACTOR (LATF)

Ambient Temperature		Lumen Multiplier
0° C	32° F	1.03
10° C	50° F	1.01
20° C	68° F	1.00
25° C	77° F	1.00
30° C	86° F	0.99
40° C	104° F	0.98
50° C	122° F	0.97

Use these factors to determine relative lumen output for average ambient temperatures from 0–40°C (32–104°F)

HUBBELL Lighting

HUBBELL Outdoor Lighting

DATE: LOCATION:

TYPE: PROJECT:

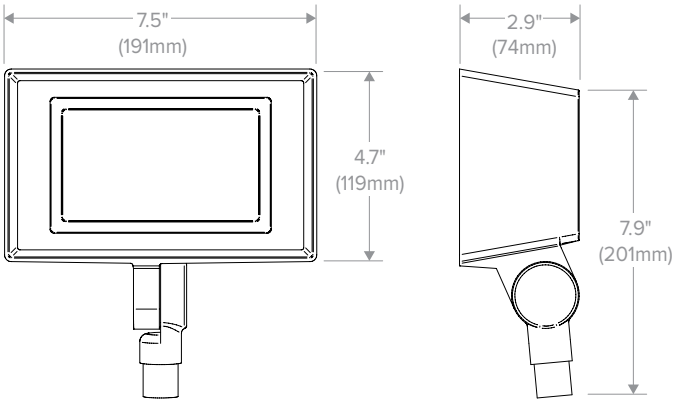
CATALOG #:

RATIO Flood

COMPACT

DIMENSIONS

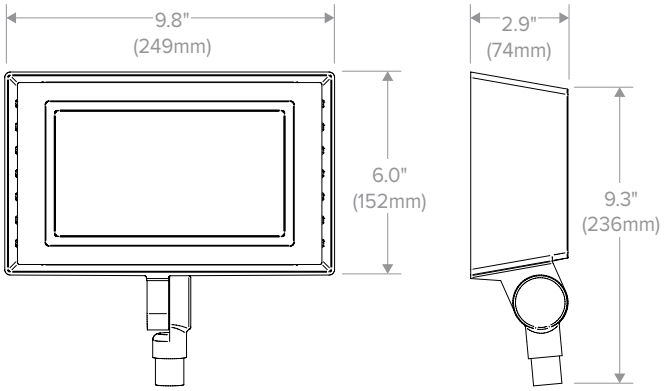
RFL2



RFL2 EPA(Front/Side)

0.34ft² / 0.17ft²

RFL3



RFL3 EPA(Front/Side)

0.97ft² / 0.20ft²

ADDITIONAL INFORMATION

SHIPPING INFORMATION

Catalog Number	G.W (kg)/CTN	Carton Dimensions		
		Length Inch (cm)	Width Inch (cm)	Height Inch (cm)
RFL2	3.7lbs (1.68kg)	20.75 (52.7)	15.125 (38.4)	6.9375 (17.6)
RFL3	5.5lbs (2.50kg)	25 (63.5)	15.125 (38.4)	6.9375 (17.6)

HUBBELL Lighting

Date: _____ Customer: _____

Project: _____

Type: _____ Qty: _____

selux

MTR Square Bollard LED

Order Code: BSMFL - _____ - _____ - _____ - _____ - _____ - _____ - _____ - _____ - _____

BSMFL	Series	**BSMFL** MTR Square Bollard LED Flat Top							
_____	Height	**2.5** 2 1/2 feet	**3** 3 feet	**3.5** 3 1/2 feet	**4** 4 feet				
_____	Light Engine	**1B30**	**2B30**	**3B30**	**4B30**				
_____	CCT	**27** 2700K	**30** 3000K	**35** 3500K	**40** 4000K	for other CCTs please consult factory			
_____	Finish	**WH** White	**BK** Black	**BZ** Bronze	**SV** Silver	**SP** Specify Premium Color			
_____	Voltage	**UNV** 120-277V	**120**	**208**	**240**	**277**	**347**[1]	**480**[1]	[1] Requires step down transformer
_____	Options	**DM** Dimming (0-10V)	**HL50**[2] Hi-Lo Switching	**REC** [2,3] GFCI Receptacle w/ weather-proof cover	**REC2** [2,3] GFCI Receptacle w/ padlockable in-use cover				[2] 120V, 240V, and 277V only [3] Only available in 3.5 and 4 ft. heights, 120V only

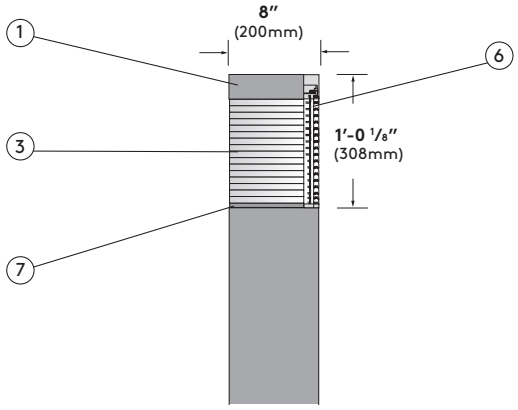
Product Modifications

Please list modification requirements for review by factory:

Approvals

Date:

BSMFL



Net Weight (4' = 40lbs)

Specifications

1. Luminaire Cover - Die-cast, aluminum cover, with smooth crisp form to reflect and complement the bollard design. Removes by loosening four stainless steel screws for easy access to LED chamber.

2. Gasketing - (not shown) Continuous gaskets provide weather-proofing, dust, and insect control at shielding base, fixture cover and between MTR rings.

3. Shielding - Consists of 8" (200mm) square injection-molded acrylic multi-prisms for total reflection (MTR). MTR rings have a wall thickness of .591" and are patterned after the light-bending characteristics of a prism.

4. LED Light Engine - (not shown) High efficiency LED light engine equipped with brand-name LEDs, available in 2700K, 3000K, 3500K, or 4000K CCT tolerance within a 3-step MacAdam ellipse.

5. Drivers - (not shown) Electronic universal 120-277V, PFC > 0.95

6. Diffuser - (not shown) LED optimized UV resistant material ensures evenly lit MTR rings at high transmittance.

7. Bollard Fitter - Die-cast aluminum fitter, with built-in gasketing ridges, for smooth transition to column.

8. Surge Protector - (not shown) Designed to protect luminaire from electrical surge (10kA).

9. Hi-Lo Switching Option - (not shown) Please see p. 3 for details.

Exterior Luminaire Finish - Selux utilizes a high quality Polyester Powder Coating. All Selux luminaires and poles are finished in our Tiger Drylac certified facility and undergo a five stage intensive pretreatment process where product is thoroughly cleaned, phosphated and sealed. Selux powder coated products provide excellent salt and humidity resistance as well as ultraviolet resistance for color retention. All products are tested in accordance with test specifications for coatings from ASTM and PCI.

Standard exterior colors are White (WH), Black (BK), Bronze (BZ), and Silver (SV). Selux premium colors (SP) are available, please specify from your Selux color selection guide.

5 Year Limited LED Luminaire Warranty - Selux offers a 5 Year Limited Warranty to the original purchaser that the MTR Bollard LED luminaire shall be free from defects in material and workmanship for up to five (5) years from date of shipment. This limited warranty covers the LED driver and LED array when installed and operated according to Selux instructions. For details, see "Selux Terms and Condition of Sale."

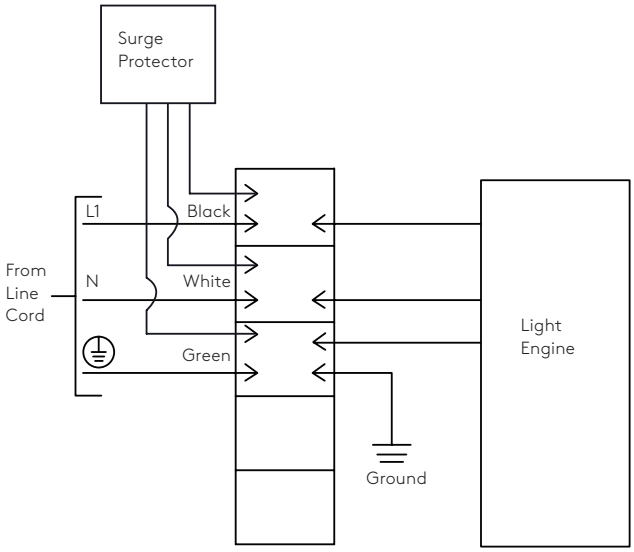
Listings and Ratings: Tested to INRTL Wet Location and IESNA LM-79-08 standards. LED tested to LM-80 standards. Luminaire and LED tested at 25°C (77°F) ambient temperature.

NRTL Listed for Wet Location (i.e. UL, CSA)

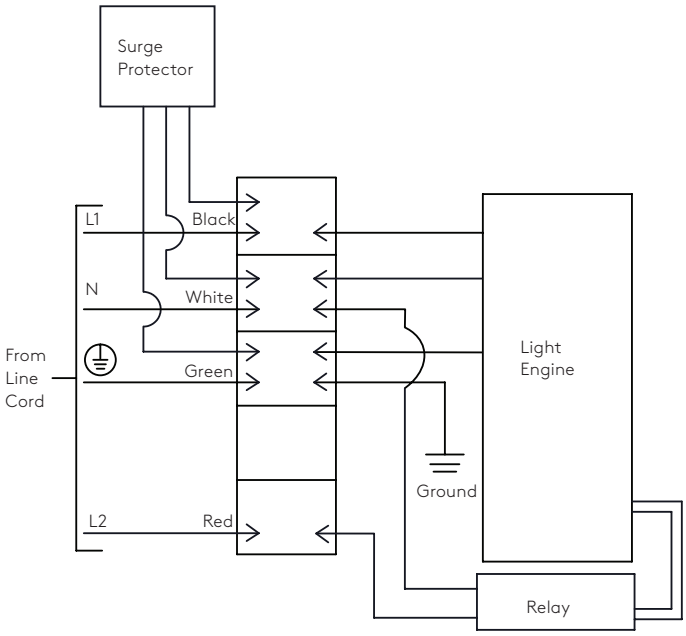
Visit selux.us for our LED End of Life recycling policy.

Wiring

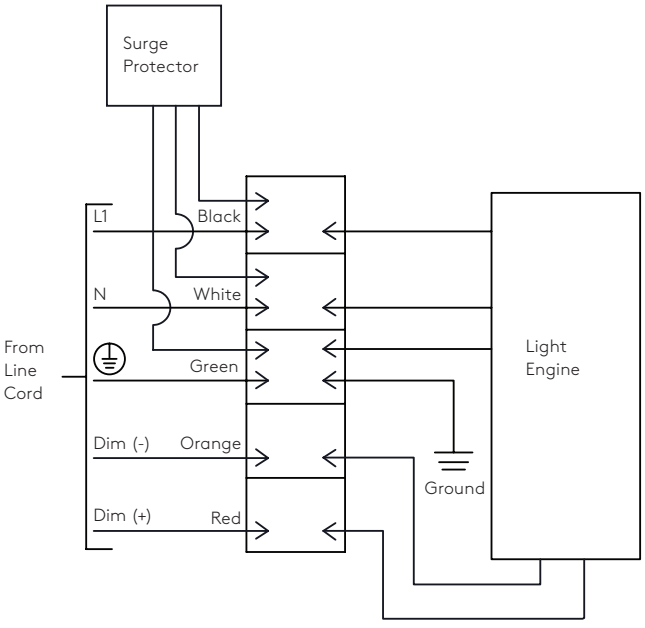
Standard Single Wiring
For 120-277V



Hi-Lo Switching Option (HL) Wiring
For 120-277V. When red is energized, light output will be at "Lo" level. Standard HL level: HL50 = low output, 50%. For other combinations, consult factory.

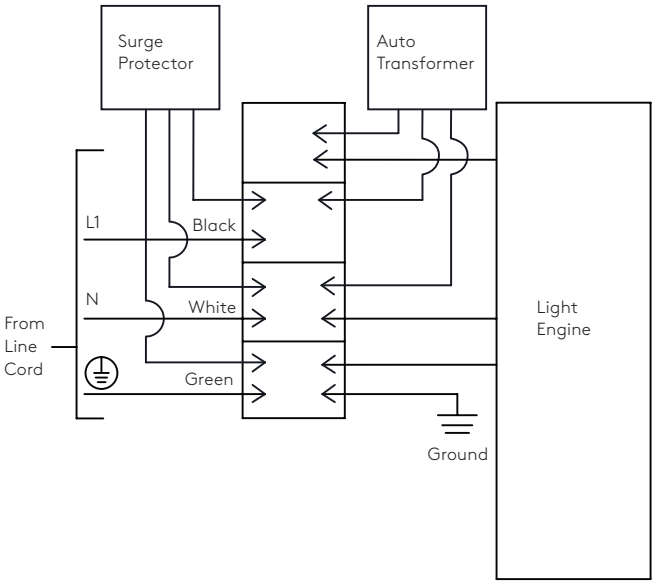


0-10V Dimming Option (DM) Wiring
For 120-277V

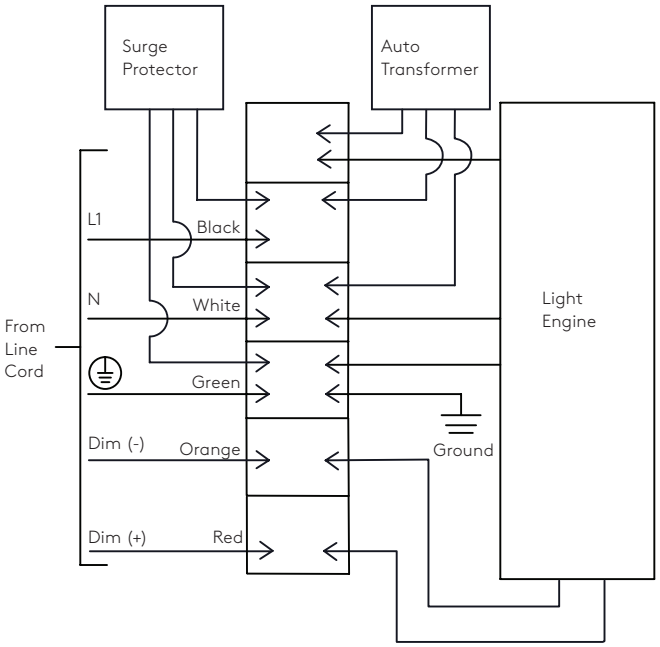


Wiring

347/480V (Standard)

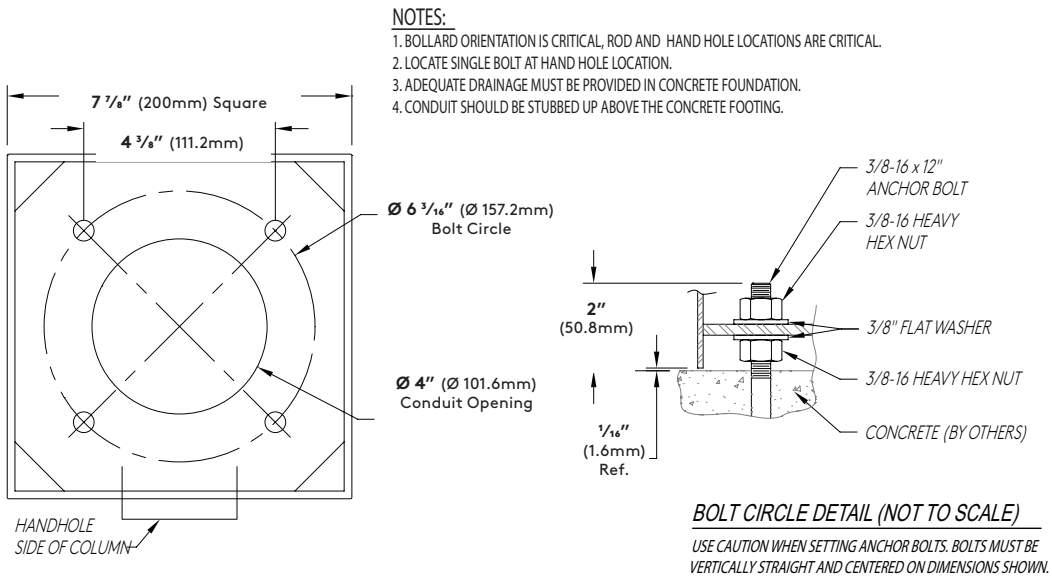


347/480V with 0-10V Dimming Option

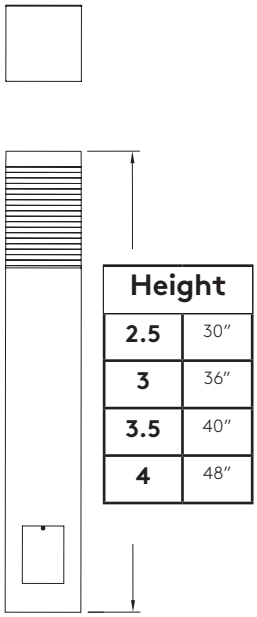


Mounting

Anchorage Information



Profiles

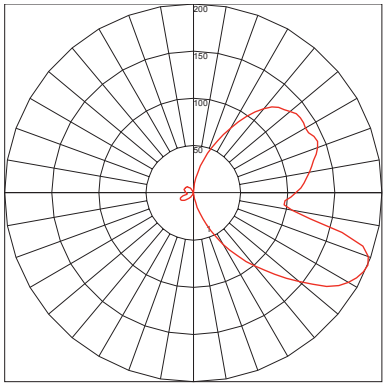


Height	
2.5	30"
3	36"
3.5	40"
4	48"

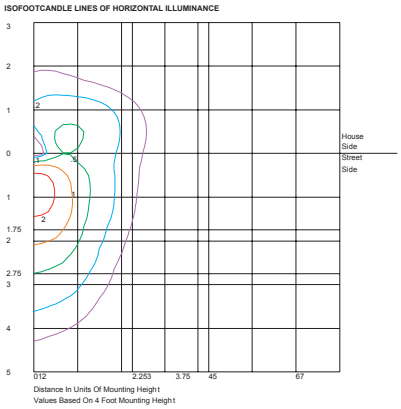
Photometry

1B30 / 7W LED / 3000K CCT

Catalog #: BSMFL-X-1B30-30-XX-UNV
Delivered Lumens: 505
Input Watts: 6.9905W
Efficacy: 72 lm/W
CCT: 2947K
CRI (Ra): 94.9
Maximum candela of 200 at 67.5° from vertical.
IES classification: Type IV
Mounting Height: 4' (1.22m)
BUG Rating: B0-U3-G1
Power Factor: 0.916
Total Harmonic Distortion: 15.4%

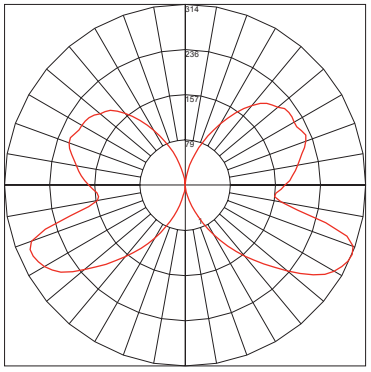


Maximum Candela = 200.175 Located At Horizontal Angle = 0, Vertical Angle = 67.5
1 - Vertical Plane Through Horizontal Angles (0 - 180) (Through Max. Cd.)

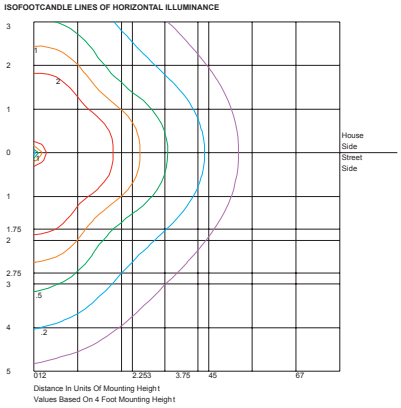


4B30 / 26W LED / 3000K CCT

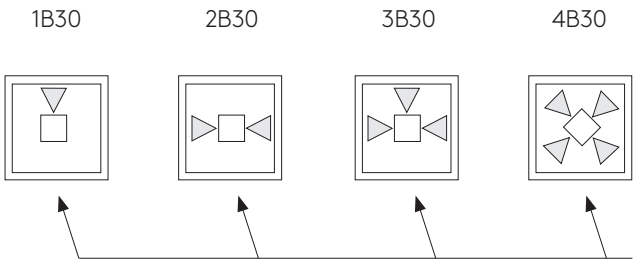
Catalog #: BSMFL-X-4B30-30-XX-UNV
Delivered Lumens: 2207
Input Watts: 26.5947W
Efficacy: 83 lm/W
CCT: 2947K
CRI (Ra): 94.9
Maximum candela of 314 at 67.5° from vertical.
IES classification: Type VS
Mounting Height: 4' (1.22m)
BUG Rating: B1-U4-G1
Power Factor: 0.980
Total Harmonic Distortion: 10.4%



Maximum Candela = 314.4 Located At Horizontal Angle = 0, Vertical Angle = 67.5
1 - Vertical Plane Through Horizontal Angles (0 - 180) (Through Max. Cd.)



LED Light Engine Distribution Guide



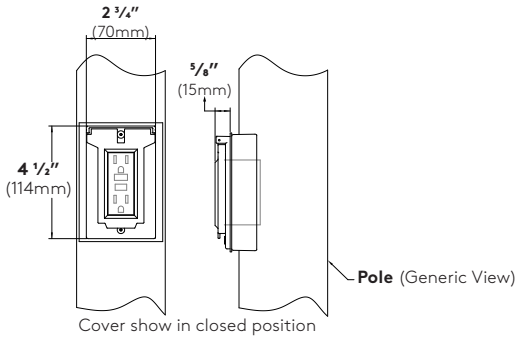
Energy Consumption				
Light Engine	1B30	2B30	3B30	4B30
Power Input	7W	13W	19W	27W

MTR Square LED Bollard Photometry Multiplier Table		
CCT Multiplier		
4000K	1.000	
3500K	1.010	
3000K	0.942	
2700K	0.884	
Light Engine Multiplier		
Light Engine	Lumens	Wattages
1B30	0.243	0.263
2B30	0.459	0.479
3B30	0.680	0.711
4B30	1.000	1.000

Optional Accessories

GFCI Receptacle (REC)

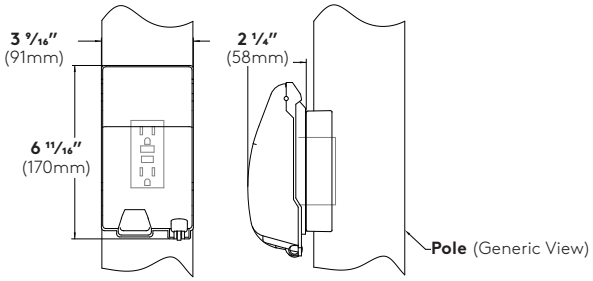
120V 15A GFCI duplex receptacle with weather-proof, self-closing cover; located 18" (457mm) from base of pole, inline with handhole. Receptacle is intended only for portable tools or other portable equipment to be connected to outlet only when attended by operating personnel.



Cover show in closed position

GFCI Receptacle (REC2)

120V 15A GFCI duplex receptacle with weather-proof, self-closing, padlockable in-use cover; located 18" (457mm) from base of pole, inline with handhole. Receptacle is intended only for portable tools or other portable equipment to be connected to outlet only when attended by operating personnel.



Cover shown in the closed position

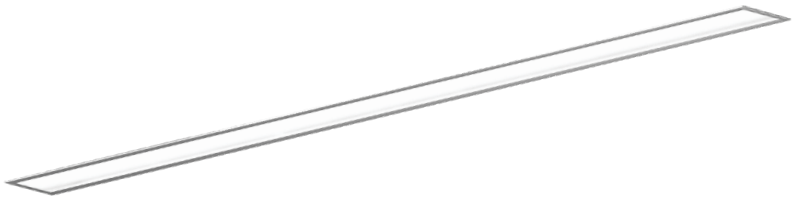
Date: _____ Customer: _____

Project: _____

Type: _____ Qty: _____

selux

M60
LED Recessed



Order Code: _____ - _____ - _____ - _____ - _____ - _____ - _____ - _____ - _____ - _____ - _____ - _____ - _____ - _____

Series

L60 Multi-Mount Form	**L6R1** Continuous Flange (Flanged Endcaps)	**L6R2** Continuous Flange (Flangeless Endcaps)

Light Engine

1C45[1,2,3]	1C40[1,2,3]	1C35[1]	1C30[1,2]	1C25[1,2]	1C20[1,2]
80CRI-1018lm 90CRI-855lm 11.1W per foot	80CRI-954lm 90CRI-802lm 9.9W per foot	80CRI-834lm 90CRI-701lm 8.7W per foot	80CRI-746lm 90CRI-627lm 7.3W per foot	80CRI-594lm 90CRI-500lm 6.1W per foot	80CRI-494lm 90CRI-415lm 4.9W per foot

[1] Values calculated from a 4' fixture at 3500K, 90+ CRI using LW shielding and DIM driver. For additional information please see page 2.
[2] Available starting at 2' and up
[3] Not available with Lutron

CCT

927	930	935	940	827[4]	830[4]	835[4]	840[4]	RGBW
2700K 90+ CRI	3000K 90+ CRI	3500K 90+ CRI	4000K 90+ CRI	2700K 80+ CRI	3000K 80+ CRI	3500K 80+ CRI	4000K 80+ CRI	(consult factory)

[4] Consult factory for lead times.

Shielding

LW	MI	NB	A2	A5	BW
LED Optimized White Lens	Clear Lens with Microprism	LMO Symmetric with Satine Lens	LMO Asymmetric 20° Wall Washer with Satine Lens	LMO Asymmetric 5° Wall Grazer with Satine Lens	LMO Batwing with Satine Lens

Mounting L60 or Mounting L6R1 or L6R2

SF1	SF2	SF3	SG	DC
Spackle Flange (½" Drywall)	Spackle Flange (⅝" Drywall)	Spackle Flange (After Drywall)	Slot Grid (9/16") (Wire Suspension or ¼"-20 stud)	Decoustic Ceiling (up to 2" thick)

TB[5]	TBS[5]	PMT[5]	RC[6]	TS	PM
T-Bar Length with suspension clips	T-Bar Length with 1" ¼"-20 Stud	T-Bar Length Perimeter Mount	Rotating Crossbar (Ceilings ¼" to 2" thick)	1" ¼"-20 Stud	Perimeter Mount

[5] L6R1 only
[6] Consult factory for lengths under 2'

Nominal Fixture Length

01*	02[7]	03	04[7]	05[7]	06[7]	07	08[7]	XX
1 ft.	2 ft.	3 ft.	4 ft.	5 ft.	6 ft.	7 ft.	8 ft.	Runs (over 8') and Configurations, round up to the nearest foot and replace the "xx" with the # (i.e. 09=09' nominal)

**1' fixture only available with 1C35 light engine.*
Individual fixtures, Runs and Configurations are supplied in nominal lengths to ensure full, even, illumination. See pages 2 through 6 for additional details.

[7] Length intended to fit centered between the grid for SG, TB, TBS, PMT mountings

Finish

WH	BL	SV	SP
White	Semi-Matte Black	Silver	Specify Premium Color

** Custom colors are available, please consult factory*

Voltage

1	2	U	3[8]
120V	277V	120V through 277V 50/60hz capable	347V (consult factory)

[8] 347V not available with EM integral battery option

Driver

DIM[9]	DIL[9,10]	DED[9,10]	D01[9,10]	DL01[9,10]	DC2[9,10,11]	DE1[9,10]	DC5	DC3
0-10V 1% (Linear)	eldoLED 1% ECOdrive 0-10V (Logarithmic)	eldoLED 1% ECOdrive DALI (Logarithmic)	eldoLED 0.1% SOLOdrive 0-10V (Linear)	eldoLED 0.1% SOLOdrive 0-10V (Logarithmic)	Lutron 1% 2-Wire	Lutron 1% EcoSystem	Lutron 5% 5-Series (consult factory)	Lutron 1% 3-Wire (consult factory)

[9] See page 7 for full details
[10] Not available for 1' length
[11] 120V only

Fixture Options

DL	FS	SS[12]	CCEA
Damp Location Rated	In-line Fuse	Separate Switching	CCEA approved

[12] See page 10 for details

Sensor Options

xE[13,14]	xS1[13,14]	xS2[13,14]	xS3[13,14]	xSN	xV
Enlighted	Sensor Switch Daylight	Sensor Switch Occ/Vac/ Daylight	Sensor Switch Occ/Vac/ Daylight	nLight Enabled (consult factory)	Lutron Vive (consult factory)

Replace "x" with quantity

[13] Minimum fixture length 2'. See page 10 for full details and restrictions
[14] Requires DIM driver (0-10V)

Emergency Options

EC[15,16]	EMR	EM[15,16,17]
Emergency Circuit Wiring	Remote Micro Inverter (consult factory)	Integral EM Battery Pack (Non-IC rated)

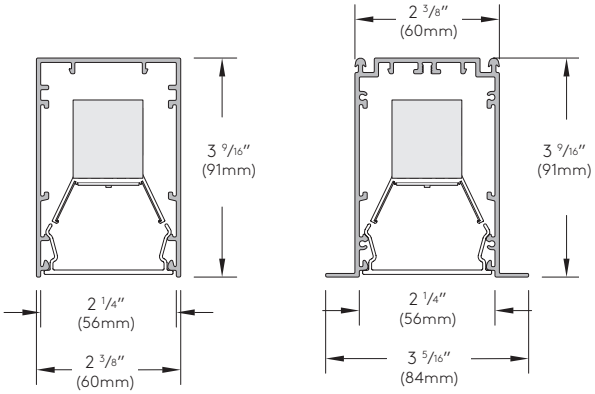
[15] See page 8 for full details and restrictions
[16] For EM with sensors please consult factory
[17] 4' available with DIM driver only. ≥6' available with all driver options.

Configuration Options

L9[1]	V9	T9	X9
Lit Horizontal 90° Corner	Lit Inverted 90° Corner	Lit "T" section	Lit "X" section

*See pages 12-13 for full details and restrictions

All options indicated with the green truck symbol are available with 4-week ship time. Mixed orders will defer to the longest lead time.



LW lens shown for reference

Construction:

Housing - Continuous, low copper 6063-T6 extruded aluminum profile with aluminum endcaps, available as Individual fixtures (up to 8') or Runs.

Flange (L6R1 or L6R2 Series)- 9/16" (14mm) wide flange runs full lengths of both sides and is part of the main extruded body. Specify continuous flange (L6R1) or flush (L6R2) end cap. L6R2 does not work in T-Bar ceiling.

Geartray - Low copper 6063-T6 extruded aluminum profile.

Shielding - Extruded, impact resistant acrylic snap in lens:
- LED Optimized White Lens (LW)
- Clear Lens with Microprism (MI)

"LMO" refers to the Selux proprietary LED optical system - Light modulation optics. These lenses are offered in M60 behind a Satine Lens for even illumination and comfortable lit appearance.
- "LMO" Symmetric Lens (NB)
- "LMO" Asymmetric 20° Wall Washer (A2)
- "LMO" Asymmetric 5° Wall Grazer (A5)
- "LMO" Batwing (BW)

Mounting(s) - Spackle-in (drywall), Slot grid, Decoustic, T-bar grid, Perimeter, Rotating Crossbar and Threaded Stud Mountings (see pages 3 through 6 for details).

Standard Luminaire lengths - All standard luminaires are supplied in nominal lengths to ensure full, even, illumination. Runs and Configurations are available in approximately 1/4" increments starting at the nominal 8' fixture length.
**Individual luminaires are not joinable in the field.

Exact length luminaires - Individual luminaires, Runs, and Configurations are available in exact lengths to meet your project needs. Please consult factory with you requirements.
**Lens luminance may soften at the very ends of the straight sections for exact length luminaires.

L60 Joiner(s) - Runs and Configurations are supplied in multiple housings that are joined together in the field using the supplied L60 Joiner System. This allows ease of installation and ensures a uniform appearance (see page 10 for detail).

Weight: 2.4 lb. per foot.

Electrical/Performance:

LED Light Engine - Brand-name mid-power LEDs create a high efficiency LED light engine able to provide a lumen maintenance of 95% at 25,000 hours and 90% at 60,000 hours at 25°C per TM-21 reports. Reported L70 greater than 60,000 hours.

Photometrics - Consult website or factory for IES Files. Independent photometric lumen measurement complies with IES LM-79-08 testing procedures. Due to the LED manufacturer's tolerances, the listed output has a ±5% tolerance. For outputs based on different optics or CCT, please see page 14 for details.

CCT - Available in 2700K, 3000K, 3500K and 4000K, tolerance within a 3-step MacAdam ellipse.

CRI - 90+ and 80+ CRI. Consult factory for lead times of 80 CRI.

All Drivers - High efficiency, constant current, soft start, Electronic Class 2 with a PFC>0.90. For more detailed information on the available drivers please see page 7.

Sensors - Selux offers a variety of integral sensor options. For details and specifications, please refer to page 11.

Emergency - There are multiple emergency options available - Emergency Circuit, Remote Micro Inverter, and Integral EM Battery Pack. All options compliant with UL 924 listed emergency luminaire. Please consult factory for use of sensors with emergency options. For more details on EC and EM options, see page 10.

Thermal Performance:

Ambient Operating Temperature - Luminaires suitable for maximum ambient temperature of 35°C (95°F) for all drivers.

Luminaires are suitable for minimum ambient temperatures of -40°C (-40°F) for DIM, DIL, DED, D01, and DL01 drivers; 0°C (32°F) for DC2 and DE1 drivers.

Luminaire Finish:

Powder Coat - All Selux luminaries are finished in high quality polyester powder coating in our Tiger Drylac certified facility and are tested in accordance with test specifications for coatings from ASTM and PCI.

All products undergo a five stage intensive pretreatment process where product is thoroughly cleaned, phosphated, and sealed. Selux powder coated products provide excellent salt and humidity resistance as well as ultra violet resistance for color retention.

Standard interior colors are White (WH), Semi-Matte Black (BL), and Silver (SV). Selux premium colors (SP) are available, please specify from your Selux color selection guide.

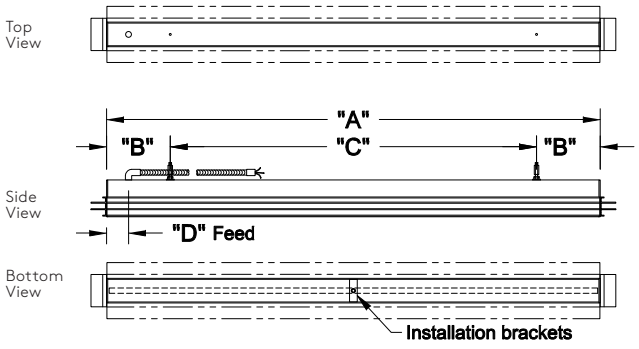
Warranty:

5 Year Limited LED Luminaire Warranty - Selux offers a 5 Year Limited Warranty to the original purchaser that the M60 series LED luminaire shall be free from defects in material and workmanship for up to five (5) years from date of shipment. This limited warranty covers the LED driver and LED light engine when installed according to Selux instructions and operated within the Ambient Temperature. For additional details and exclusions, see "Selux Terms and Condition of Sale."

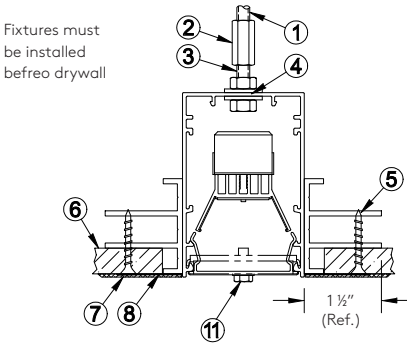
Certifications and Compliance:

NRTL - For Dry and Damp location
(I.E. cULus; cCSAus)
ARRA Compliant
RoHS Compliant
*EM option is non IC-rated

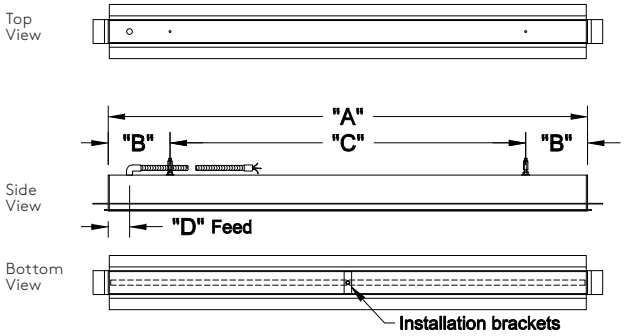
½" Spackle Flange Mounting (SF1)



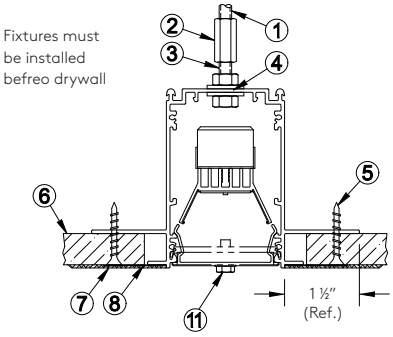
½" Spackle Flange Mounting (SF1)



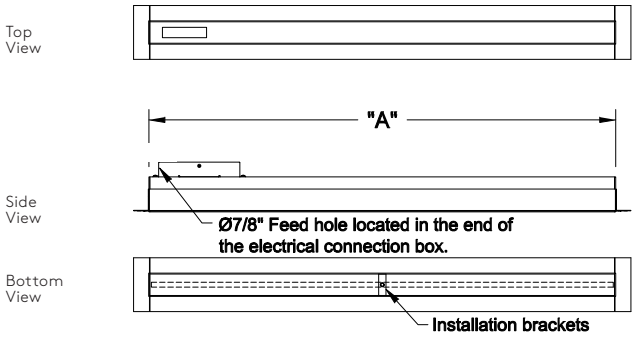
⅝" Spackle Flange Mounting (SF2)



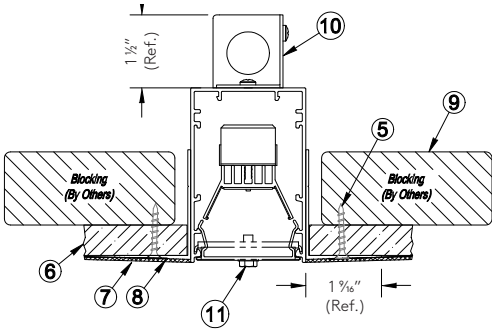
⅝" Spackle Flange Mounting (SF2)



After Drywall Flange Mounting (SF3)



After Drywall Flange Mounting (SF3)

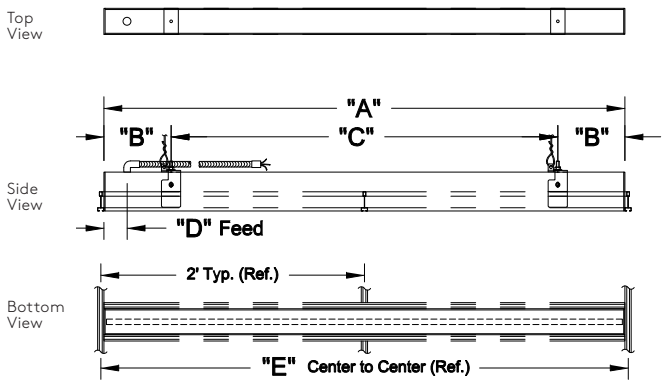


Spackle Flange Mounting (SF1, SF2 and SF3) - Dimensions								
Nominal Length	**"A" O.A.L. w/o Flange**		**"B" End Suspensions**		*** "C" (Ref.) Mid. Suspension**		**"D" Feed Location**	
	Feet/Inch	**MM**	**Feet/Inch**	**MM**	**Feet/Inch**	**MM**	**Feet/Inch**	**MM**
01 (1 ft.)	1' - ¼''	311	0' - 1 ⅝''	41	0' - 9''	229	0' - 4 ⅛''	105
02 (2 ft.)	2' - ¼''	616	0' -1 ⅝''	41	1' - 9''	533	0' - 4 ⅛''	105
03 (3 ft.)	3' - ¼''	921	0' -6 ⅛''	156	2' - 0''	609	0' - 2 ⅛''	54
04 (4 ft.)	4' - ¼''	1226	0' -6 ⅛''	156	3' - 0''	914	0' - 2 ⅛''	54
05 (5 ft.)	5' - ¼''	1530	0' -6 ⅛''	156	4' - 0''	1219	0' - 2 ⅛''	54
06 (6 ft.)	6' - ¼''	1835	0' -6 ⅛''	156	5' - 0''	1524	0' - 2 ⅛''	54
07 (7 ft.)	7' - ¼''	2140	0' -6 ⅛''	156	6' - 0''	1829	0' - 2 ⅛''	54
08 (8 ft.)	8' - ¼''	2445	0' -6 ⅛''	156	7' - 0''	2134	0' - 2 ⅛''	54

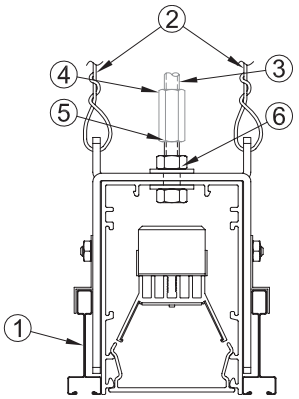
*Dimension(s) rounded to the nearest 1⁄16" with a ± 1⁄16" (1mm) tolerance.

1. ¼"-20 Threaded rod to struture (supplied and installed by others).
2. ¼"-20 Coupler hardware (supplied and installed by others).
3. 1" ¼"-20 Stud (by Selux).
4. Ø5⁄16" (Ø7mm) mounting hole.
5. Drywall/Drywall screw (Ref.)
6. Drywall/Drywall (Ref.)
7. ⅛" Plaster skimcoat (Ref.)
8. Drywall/Drywall tape (Ref.)
9. Blocking to secure fixture (by others)
10. Electrical connection box, removable side cover for electrical connection pre-installation, once installed the wiring is accessible from below the ceiling through the luminaire.
11. Luminaires ship with the brackets pre-installed.
    - The brackets cannot be removed until the fixture is completely installed and secured through the spackle flange.
    - Once the brackets are removed, the lens can be installed.

Slot Grid Mounting (SG)



9⁄16" Slot Grid Mounting (SG)
(Wire Suspension or ¼"-20 Stud)

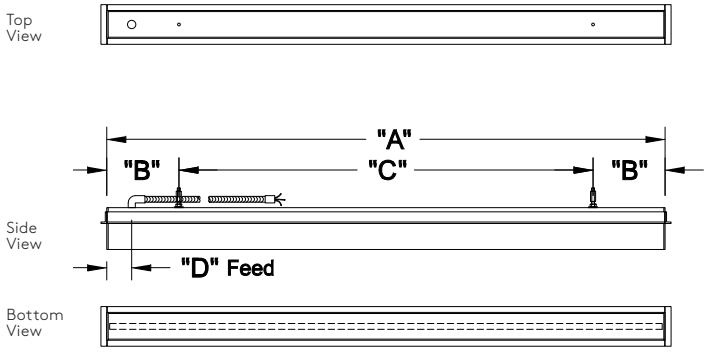


1. 9⁄16" Slot grid (shown as Ref.)
2. Support wire to structure (supplied and installed by others).
3. ¼"-20 Threaded rod to structure (supplied and installed by others).
4. ¼"-20 Coupler hardware (supplied and installed by others).
5. 1" ¼"-20 Stud (by Selux).
6. Ø5⁄16" (Ø7mm) mounting hole.

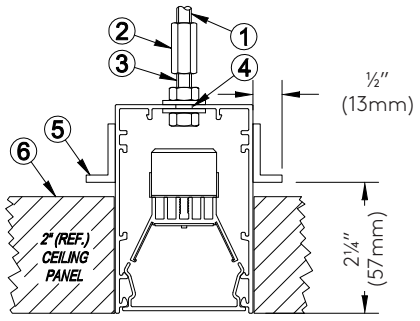
Slot Grid Mounting (SG) - Dimensions									
Nominal Length	**"A" Housing Length**		**"B" End Suspensions**		*** "C" (Ref.) Mid. Suspension**		**"D" Feed Location**		**"E" Grid Spacing**
	Feet/Inch	**MM**	**Feet/Inch**	**MM**	**Feet/Inch**	**MM**	**Feet/Inch**	**MM**	
02 (2 ft.)	1' - 11 5⁄16"	592	0' -1 5⁄8"	41	1' - 5 3⁄16"	437	0' - 1 1⁄8"	29	2' Center to Center
04 (4 ft.)	3' - 11 5⁄16"	1202	0' - 6 1⁄8"	156	2' - 11 3⁄16"	894	0' - 2 1⁄8"	54	4' Center to Center
05 (5 ft.)	4' - 11 5⁄16"	1507	0' - 6 1⁄8"	156	3' - 11 3⁄16"	1199	0' - 2 1⁄8"	54	5' Center to Center
06 (6 ft.)	5' - 11 5⁄16"	1811	0' - 6 1⁄8"	156	5' - 11 3⁄16"	1504	0' - 2 1⁄8"	54	6' Center to Center
08 (8 ft.)	7' - 11 5⁄16"	2421	0' - 6 1⁄8"	156	6' - 11 3⁄16"	2113	0' - 2 1⁄8"	54	8' Center to Center

*Dimension(s) rounded to the nearest 1⁄16" with a ± 1⁄16" (1mm) tolerance.

Decoustic Mounting (DC)



Decoustic Mounting (DC)
(Panels up to 2" thick)

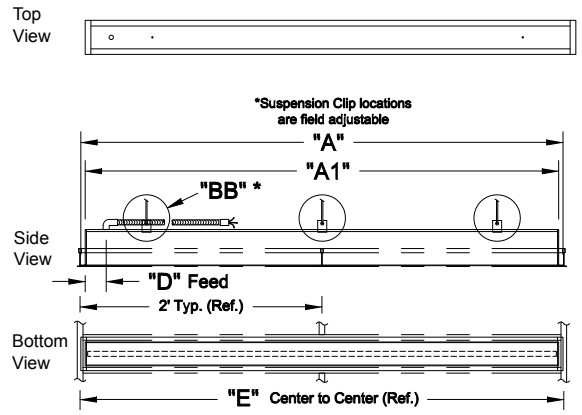


Decoustic Mounting (DC) - Dimensions								
Nominal Length	**"A" Housing Length**		**"B" End Suspensions**		*** "C" (Ref.) Mid. Suspension**		**"D" Feed Location**	
	Feet/Inch	**MM**	**Feet/Inch**	**MM**	**Feet/Inch**	**MM**	**Feet/Inch**	**MM**
01 (1 ft.)	1' - ¼"	311	1 5⁄8"	41	0' - 9"	229	0' - 4 1⁄8"	105
02 (2 ft.)	2' - ¼"	616	1 5⁄8"	41	1' - 9"	533	0' - 4 1⁄8"	105
03 (3 ft.)	3' - ¼"	921	6 1⁄8"	156	2' - 0"	609	0' - 2 1⁄8"	54
04 (4 ft.)	4' - ¼"	1226	6 1⁄8"	156	3' - 0"	914	0' - 2 1⁄8"	54
05 (5 ft.)	5' - ¼"	1530	6 1⁄8"	156	4' - 0"	1219	0' - 2 1⁄8"	54
06 (6 ft.)	6' - ¼"	1835	6 1⁄8"	156	5' - 0"	1524	0' - 2 1⁄8"	54
07 (7 ft.)	7' - ¼"	2140	6 1⁄8"	156	6' - 0"	1829	0' - 2 1⁄8"	54
08 (8 ft.)	8' - ¼"	2445	6 1⁄8"	156	7' - 0"	2134	0' - 2 1⁄8"	54

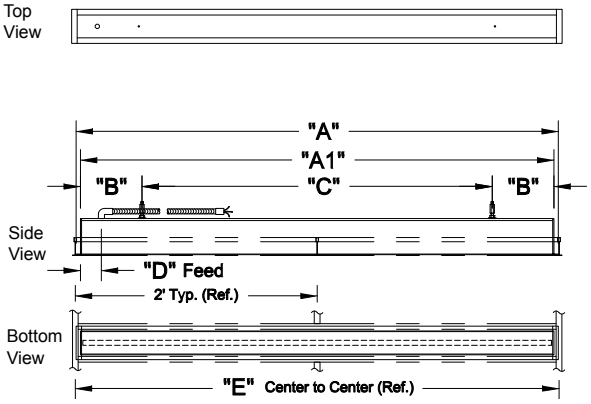
*Dimension(s) rounded to the nearest 1⁄16" with a ± 1⁄16" (1mm) tolerance.

1. ¼"-20 Threaded rod to structure (supplied and installed by others).
2. ¼"-20 Coupler hardware (supplied and installed by others).
3. 1" ¼"-20 Stud (by Selux).
4. Ø5⁄16" (Ø7mm) mounting hole.
5. ½" wide aluminum angle runs the entire length of fixture to block view into plenum area from below fixture.
6. Suitable for Decoustic® ceiling panel installations with panels up to 2" thick (supplied and installed by others). Other ceiling systems possible, please consult factory. Decoustic® is a registered trademark of Decoustics Ltd. Corporation.

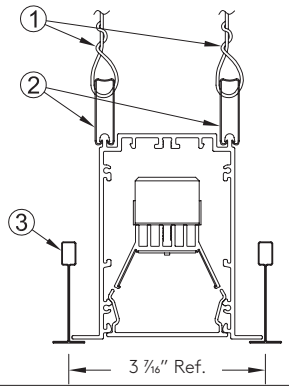
T-Bar Mounting (TB)



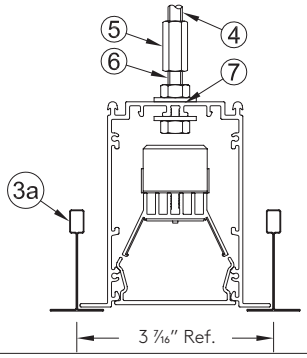
T-Bar with Stud Mounting (TBS)



T-Bar with Suspension Clips (TB)
(9⁄16" or 15⁄16" grid)



T-Bar with ¼"-20 Stud (TBS)
(9⁄16" or 15⁄16" grid)



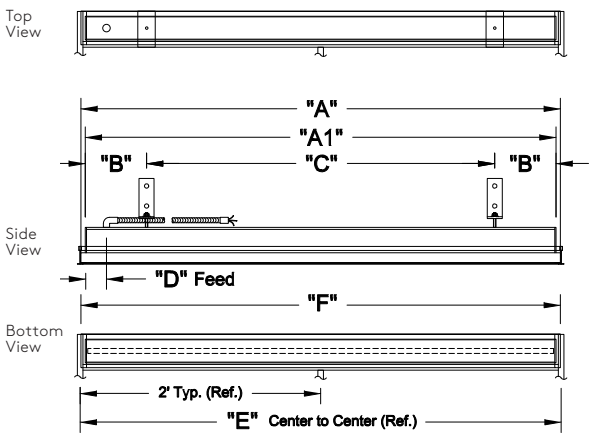
1. Support wire to structure (supplied and installed by others).
2. Spring steel suspension clips located approximately every 4 ft. (supplied by Selux).
3. 9⁄16" T-bar grid (shown as Ref.)
3a. 15⁄16" T-bar grid (shown as Ref.)
4. ¼"-20 Threaded rod to structure (supplied and installed by others).
5. ¼"-20 Coupler hardware (supplied and installed by others).
6. 1" ¼"-20 Stud (by Selux).
7. Ø5⁄16" (Ø7mm) mounting hole.

T-Bar (TB and TBS) and Perimeter Mount (PMT) - Dimensions														
Nominal Length	**"A" O.A.L. with Flange**		**"A1" O.A.L. without Flange**		**"B" End Suspensions**		**"BB" (TB mtg.) Suspension Clips**	**** "C" (Ref.) Mid. Suspension**		**"D" Feed Location**		**"E" Grid Spacing**	**"F" Wall Angle**	
	Feet/Inch	**MM**	**Feet/Inch**	**MM**	**Feet/Inch**	**MM**	**Quantity**	**Feet/Inch**	**MM**	**Feet/Inch**	**MM**		**Feet/Inch**	**MM**
***02 (2 ft.)**	1' - 11 13⁄16"	605	1' - 11"	583	0' - 1 5⁄8"	41	4x	1' - 4 3⁄4"	425	0' - 1 1⁄8"	29	2' Center to Center	1' - 10 3⁄4"	577
***04 (4 ft.)**	3' - 11 13⁄16"	1215	3' - 11"	1193	0' - 6 5⁄8"	156	6x	2' - 10 3⁄4"	882	0' - 2 1⁄8"	54	4' Center to Center	3' - 10 3⁄4"	1187
***05 (5 ft.)**	4' - 11 13⁄16"	1519	4' - 11"	1497	0' - 6 5⁄8"	156	6x	3' - 10 3⁄4"	1187	0' - 2 1⁄8"	54	5' Center to Center	4' - 10 3⁄4"	1491
***06 (6 ft.)**	5' - 11 13⁄16"	1825	5' - 11"	1803	0' - 6 5⁄8"	156	6x	4' - 10 3⁄4"	1492	0' - 2 1⁄8"	54	6' Center to Center	5' - 10 3⁄4"	1787
***08 (8 ft.)**	7' - 11 13⁄16"	2434	7' - 11"	2412	0' - 6 5⁄8"	156	8x	6' - 10 3⁄4"	2101	0' - 2 1⁄8"	54	8' Center to Center	7' - 10 3⁄4"	2406

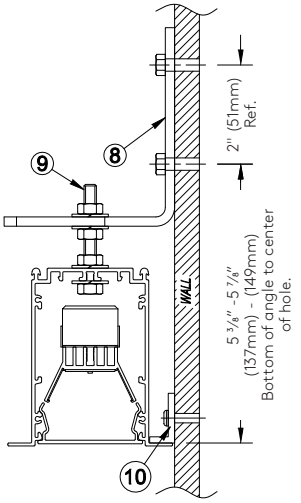
*For other lengths consult factory

**Dimension(s) rounded to the nearest 1⁄16" with a ± 1⁄16" (1mm) tolerance.

Perimeter Mounting T-Bar Length (PMT)

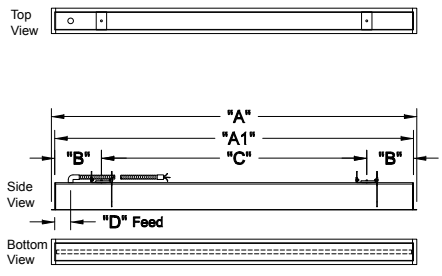


Perimeter Mount T-Bar Length (PMT)
(Recessed Wall Mounting)

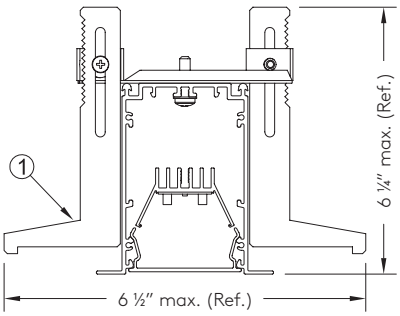


8. Steel Wall Bracket with provision for ¼"-20 fasteners (hardware to code by others).
9. 2" ¼"-20 Stud (by Selux).
10. ½" x 1" aluminum wall angle allows a gap between flange and wall to create shadow line allowing for uneveness of wall. Provision for #10 screws supplied approximately every 2 ft. (hardware to code by others).

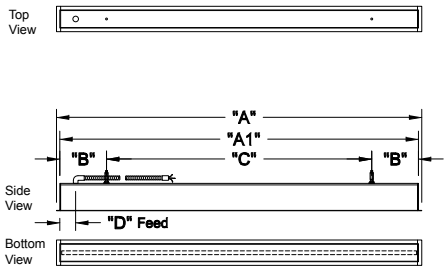
Rotating Crossbar Mounting (RC)



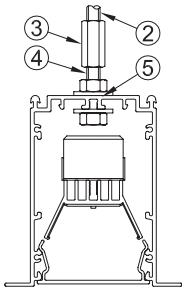
Rotating Crossbars (RC)
(¼" to 2" thick ceiling)



¼"-20 Threaded Stud Mounting (TS)



¼-20 Threaded Stud (TS)
(1" Threaded Stud)



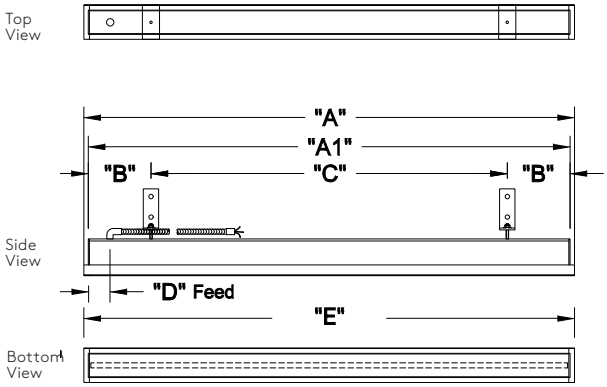
1. Rotating Crossbar intended for inaccessible ceilings, adjustable for ceiling thickness of ¼" to 2".
2. ¼"-20 Threaded rod to structure (supplied and installed by others).
3. ¼"-20 Coupler hardware (supplied and installed by others).
4. 1" ¼"-20 Stud (by Selux).
5. Ø5⁄16" (Ø7mm) mounting hole.

Rotating Crossbar (RC), Threaded Stud (TS), and Perimeter Mountings (PM) - Dimensions												
Nominal Length	"A" O.A.L. with Flange		"A1" O.A.L. without Flange		"B" End Suspensions		** "C" (Ref.) Mid. Suspension		"D" Feed Location		"E" Wall Angle	
	Feet/Inch	MM	Feet/Inch	MM	Feet/Inch	MM	Feet/Inch	MM	Feet/Inch	MM	Feet/Inch	MM
*01 (1 ft.)	1' - 1 1⁄8"	333	1' - ¼"	311	0' - 1 5⁄8"	41	0' - 9"	229	0' - 4 1⁄8"	105	1' - 0"	305
02 (2 ft.)	2' - 1 1⁄8"	638	2' - ¼"	616	0' - 1 5⁄8"	41	1' - 9"	533	0' - 4 1⁄8"	105	2' - 0"	610
03 (3 ft.)	3' - 1 1⁄8"	942	3' - ¼"	921	0' - 6 1⁄8"	156	2' - 0"	609	0' - 2 1⁄8"	54	3' - 0"	914
04 (4 ft.)	4' - 1 1⁄8"	1247	4' - ¼"	1226	0' - 6 1⁄8"	156	3' - 0"	914	0' - 2 1⁄8"	54	4' - 0"	1219
05 (5 ft.)	5' - 1 1⁄8"	1552	5' - ¼"	1530	0' - 6 1⁄8"	156	4' - 0"	1219	0' - 2 1⁄8"	54	5' - 0"	1524
06 (6 ft.)	6' - 1 1⁄8"	1857	6' - ¼"	1835	0' - 6 1⁄8"	156	5' - 0"	1524	0' - 2 1⁄8"	54	6' - 0"	1829
07 (7 ft.)	7' - 1 1⁄8"	2162	7' - ¼"	2140	0' - 6 1⁄8"	156	6' - 0"	1829	0' - 2 1⁄8"	54	7' - 0"	2134
08 (8 ft.)	8' - 1 1⁄8"	2466	8' - ¼"	2445	0' - 6 1⁄8"	156	7' - 0"	2134	0' - 2 1⁄8"	54	8' - 0"	2438

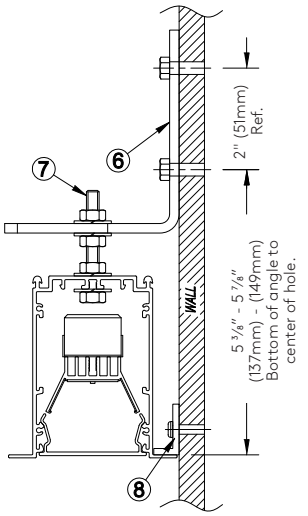
*RC mounting, consult factory for lengths under 2'

**Dimension(s) rounded to the nearest 1⁄16" with a ± 1⁄16" (1mm) tolerance.

Perimeter Mounting (PM)



Perimeter Mount (PM)
(Recessed Wall Mounting)



6. Steel Wall Bracket with provision for ¼"-20 fasteners (hardware to code by others).
7. 2" ¼"-20 Stud (by Selux).
8. ½" x 1" aluminum wall angle allows a gap between flange and wall to create shadow line allowing for uneveness of wall. Provision for #10 screws supplied approximately every 2 feet (hardware to code by others).

Drivers:

0-10V linear dimming (DIM)
Luminaires supplied with drivers offering the capability of either normal switched operation of 0-10V dimming for linear dimming curve. Fixtures ship wired for dimming. For on/off functionality, simply cap the dimming leads. Minimum dimming level preset at factory to 1%. (Due to size constraints, 1' luminaires are supplied with a driver from a different manufacturer than 2' and above luminaires. For details, please consult factory).

0-10V logarithmic eldoLED ECOdrive dimming (DIL)
Luminaires supplied with drivers offering the capability of either normal switched operation of 0-10V dimming for logarithmic dimming curve, Fixtures shipped wired for dimming. For on/off functionality, simply cap the dimming leades. Minimum dimming level preset at factory to 1%.

eldoLED ECOdrive DALI dimming (DED)
Luminaires supplied with ECOdrive DALI dimming driver with logarithmic dimming curve. Minimum dimming level preset at factory to 1%. For "dim to dark" (down to 0.1%), please consult factory.

eldoLED SOLOdrive 0-10V linear dimming (D01)
Luminaires supplied with SOLOdrive 0-10V dimming driver with linear dimming curve. Minimum dimming level preset at factory to 0.1% and "dim to dark".

eldoLED SOLOdrive 0-10V logarithmic dimming (DL01)
Luminaires supplied with SOLOdrive 0-10V dimming driver with logarithmic dimming curve. Minimum dimming level preset at factory to 0.1% and "dim to dark".

LUTRON 2-wire dimming (DC2)
Luminaires supplied with Hi-Lume 2-wire dimming driver (120V only) programmed for Constant Current Reduction (CCR). For Pulse Width Modulation (PWM) dimming, please consult factory. Minimum dimming level down to 1%.

LUTRON EcoSystem dimming (DE1/DC5)
Luminaires supplied with Hi-Lume EcoSystem (4 wire, digital link) dimming driver programmed for Constant Current Reduction (CCR). Minimum dimming level down to 1% (DE1) with SoftOn/FadeToBlack or 5% (DC5).

*For control recommendations, please contact driver manufacturer.

<table>
<tr><td colspan="16">Driver Quantity</td></tr>
<tr><td rowspan="2">Light Engine</td><td rowspan="2">Dimming Code</td><td colspan="14">Length</td></tr>
<tr><td>1ft</td><td>2ft</td><td>2ft SG/TB</td><td>3ft</td><td>4ft</td><td>4ft SG/TB</td><td>5ft</td><td>5ft SG/TB</td><td>6ft</td><td>6ft SG/TB</td><td>7ft</td><td>8ft</td><td>8ft SG/TB</td><td>9ft</td><td>10ft</td><td>11ft</td><td>12ft</td></tr>
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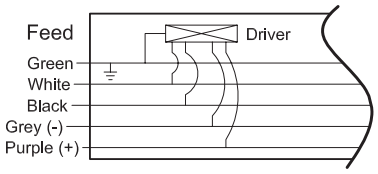
<tr><td rowspan="4">1C35</td><td>DIM/DIL</td><td>1</td><td colspan="7" rowspan="4">1</td><td rowspan="4">2</td><td rowspan="3">1</td><td rowspan="4">2</td><td rowspan="3">2</td><td rowspan="3">1</td><td rowspan="4">2</td><td colspan="2" rowspan="3">2</td><td rowspan="3">2</td></tr>
<tr><td>D01/DL01/DED</td><td rowspan="12">N/A</td></tr>
<tr><td>DE1/DC5</td></tr>
<tr><td>DC2</td><td>2</td><td>2</td><td colspan="2">3</td><td>3</td></tr>
<tr><td rowspan="4">1C40</td><td>DIM/DIL</td><td colspan="7" rowspan="3">1</td><td rowspan="3">2</td><td rowspan="3">1</td><td rowspan="3">2</td><td rowspan="2">2</td><td colspan="4" rowspan="3">2</td><td colspan="2" rowspan="3">3</td></tr>
<tr><td>D01/DL01/DED</td><td rowspan="2">1</td></tr>
<tr><td>DE1/DC5</td><td colspan="14">N/A</td></tr>
<tr><td>DC2</td></tr>
<tr><td rowspan="4">1C45</td><td>DIM/DIL</td><td colspan="6" rowspan="3">1</td><td>2</td><td rowspan="3">2</td><td rowspan="3">1</td><td colspan="2" rowspan="3">2</td><td colspan="2" rowspan="3">2</td><td>3</td><td rowspan="3">2</td><td colspan="2" rowspan="3">3</td></tr>
<tr><td>D01/DL01/DED</td><td>1</td><td>2</td></tr>
<tr><td>DE1/DC5</td><td colspan="14">N/A</td></tr>
<tr><td>DC2</td></tr>
</table>

*For inrush and control current, please refer to the driver manufacturers' spec sheets.

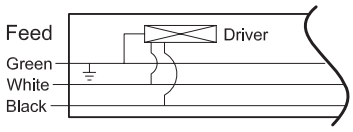
Wiring Diagrams

0-10V linear (DIM)
0-10V logarithmic eldoLED Ecodrive (DIL)
DALI logarithmic eldoLED ECOdrive (DED)
0-10V linear eldoLED SOLOdrive (D01)
0-10V logarithmic eldoLED SOLOdrive (DL01)

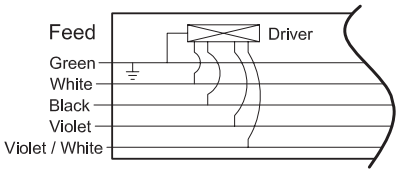


Standard Wiring supplied for all drivers.	Green = Ground White = Neutral Black = Hot
- The following wire(s) are in addition to the standard above -	
DIM, DIL, DED D01, DL01	Gray = (-) DALI or 0-10V Dimming Control Purple = (+) DALI or 0-10V Dimming Control
DC2	No additional wires
DE1, DC5	Violet = "E1" Digital Link Dimming Control Violet/White = "E2" Digital Link Dimming Control

Lutron 2-Wire (DC2)

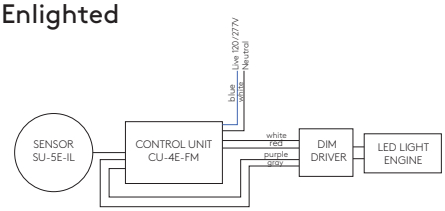


Lutron EcoSystem (DE1)
Lutron 5-Series (DC5)

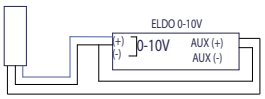


Sensor Wiring Diagrams

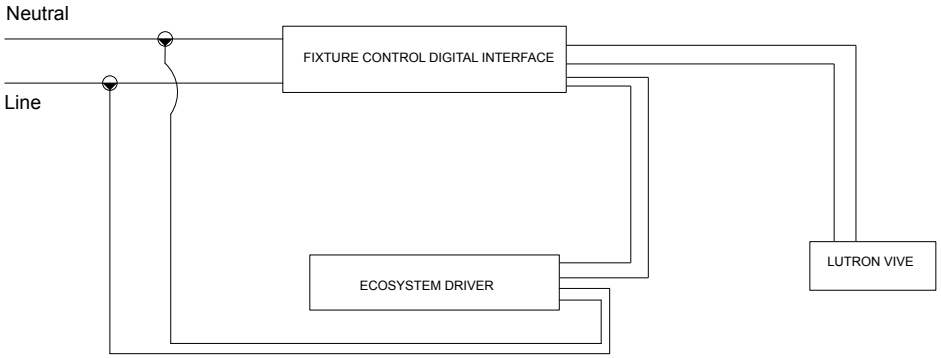
Enlighted



Sensor Switch



Lutron Vive



Driver power chart - use below values to determine the nominal watts per foot based on driver, light engine, and voltage.
* Driver losses increase the wattage for fixtures less than 4 foot.
** Values are nominal values determined based on multiple tested fixtures.

Driver Power Usage				
Driver	**Light Engine**	**Nominal W/ft**		
		120V	**277V**	**347V**
DIM, DIL, DED, D01, DL01	1C20	4.9	5.3	n/a
	1C25	6.1	6.5	
	1C30	7.3	7.7	
	1C35	8.7	8.9	
	1C40	9.9	10.1	
	1C45	11.1	11.3	
DC2, DE1, DCE, DC5, DC3	1C20	5.5	5.2	n/a
	1C25	6.7	6.3	
	1C30	8.0	7.6	
	1C35	9.3	8.8	
	1C40	10.6	10.0	
	1C45	11.6	11.3	
DIM @347V	1C20	n/a	n/a	5.4
	1C25			6.5
	1C30			7.7
	1C35			8.8
	1C40			10.0
	1C45			11.2
EM	all	6		n/a

Fuse (FS) - Fusing, luminaires supplied with a in-line fuse located on the hot wire for each feed. (supplied with an 8A slow burn fuse).

Damp Location (DL) - Luminaires are suitable for use in damp location(s). Examples of such locations include protected areas under canopies, marquees, roofed porches, and similar locations where the fixture(s) are protected from direct contact with rain, snow, or excessive moisture (such as ocean spray). Interior locations include areas subject to moderate degrees of moisture, such as basements and certain barns and cold storage buildings.

*For Damp Location with sensors, please consult factory.

Separate Switching (SS) - Luminaires available with separately switched 4' (nominal) sections starting at 7' and up. Luminaire is intended to be wired to the same panel/breaker (not intended for Emergency use).

* All separately switched (non-EM) circuits within an individual luminaire, linear run, or configuration must be connected to the same branch circuit on-site.

* To specify this option, the number of separately switched sections and locations of these sections must be provided at time of order.

*If the project requires different separate switching than outlined above please consult the factory.

*For Separate Switching with sensors, please consult factory.

Emergency Wiring (EC) - Luminaires with (EC) option are compliant to UL 924 listed emergency luminaire. EC luminaires are intended to be wired to separate panels/breakers for emergency use. See install instructions for proper wiring.

For 1' to 6' nominal luminaires, the entire fixture is wired for operation on emergency circuit.

For 7' and up nominal luminaires, the first 4' nominal length is wired for operation by a separate EM circuit by default to meet the required "Life Safety Code" (NFPA 101).

If a different configuration is needed, please consult factory.

Note: Wiring may vary slightly due to on-site conditions or local codes. Please follow all safety installation protocols contained within install instructions when installing luminaire.

Emergency Battery (EM) – Luminaires with emergency battery (EM) option are compliant to UL 924 listed emergency luminaire. The EM battery is located integral to fixture and is factory pre-wired. See install instructions for proper wiring.

In the event of an emergency, EM battery will illuminate a 4' section at 12W (constant) for 90 minutes at 25°C. Recharge time is 24 hours.

Direct fixtures are available for emergency battery (EM) use in 4' and ≥6. Due to size constraints, EM is not available in 5' fixtures.

For individual fixtures, emergency option will illuminate the first 4' section of fixture. For continuous runs, please consult factory to advise on 4' section intended for emergency use. For fixtures >12' or if a different configuration is needed, please consult factory.

Emergency test switch and plate is a non-illuminated 3" blank section located adjacent to the length of fixture wired for emergency.

*Emergency battery option is UNV for use with 120V or 277V and is not available for 347V.

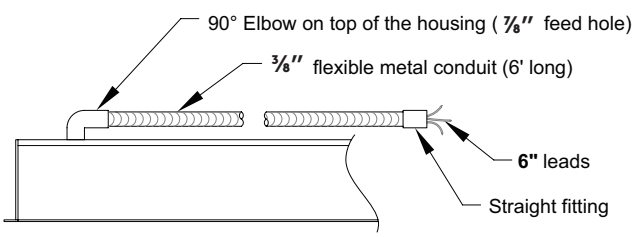
*Please note battery pack requires an unswitched hot.

*For EM with sensors, please consult factory.

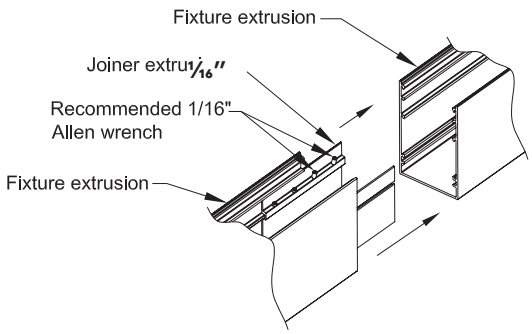
*If a different configuration is needed, please consult factory.

Note: Wiring may vary slightly due to on-site conditions or local codes. Please follow all safety installation protocols contained within install instructions when installing luminaire.

Flex Whip - standard for recessed fixtures



Joiner System - standard for Runs and Configurations



Sensor Ordering Chart		
Quantity	**Sensor**	**Settings***
x Number of Sensors	**E** Enlighted SU-5E-IL **S** Sensor Switch MSD EZ **V** Lutron Vive DFCSJ	**1** Daylight **2** Occupancy/Vacancy **3** Daylight/Occupancy/Vacancy * Settings not available with Enlighted

Enlighted SU-5E-IL (E)
Enlighted Micro Sensor SU-5E-IL (Independent Lighting) provided as standard with an Enlighted CU-4E-FM Fixture Mount Control Unit integral to fixture. If SU-5E-CL (Connected Lighting) or SU-5E-IoT (Internet of Things) is desired, please contact factory. Occupancy/vacancy, thermal, daylight sensing plus Tunable White, Room & Zone control, Internet of Things (IoT) data collection and reporting control. For full details, please see SU-5E-(IoT/CL/IL) spec sheet on the Enlighted website. Must be paired with a 0-10V driver with auxiliary (DIM driver selection). Commissioning by Enlighted.

*Sensor can control up to 5 drivers. Please refer to driver quantity chart on page 7. Multiple sensors may be required for longer lengths.

Sensor Switch MSD EZ (S)
Occupancy/vacancy and daylight harvesting. For full functionality and programming options, select settings option 3. If a different settings option is selected, other settings may be unavailable. For full details, please see MSD EZ spec sheets on the Sensor Switch website. Must be paired with DIM driver selection. Manual control of dimming not available with MSD EZ sensor.

*Sensor can control up to 30 drivers. Please refer to driver quantity chart on page 7. Multiple sensors may be required for longer lengths.

Lutron Vive DFCSJ (V)
The DFCSJ-OEM-OCC provides the capabilities of daylight harvesting and occupancy/vacancy sensing. When integrated with the DFC-OEM-DBI (Fixture Contril Digital Link Interface), the sensor is wirelessly compatible with the DE1 Lutron EcoSystem driver. Commissioning bt certified Lutron technician.

*Vive DFCSJ sensor can control up to a maximum of five (5) drivers per sensor. Please refer to driver chart on page 7. Multiple sensors may be required for longer lengths.

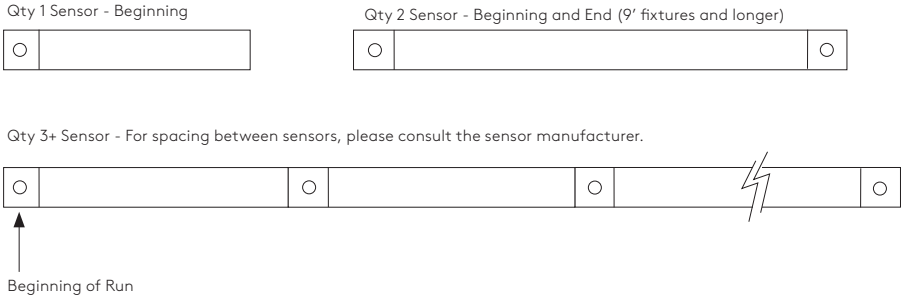
	Occupancy	**Vacancy**	**Daylight Harvesting**	**Driver Compatibility**
Enlighted SU-5E-IL (E)	√	√	√	DIM
Sensor Switch MSD EZ (S)	√	√	√	DIM
Lutron Vive DFCSJ (V)	√	√	√	DE1

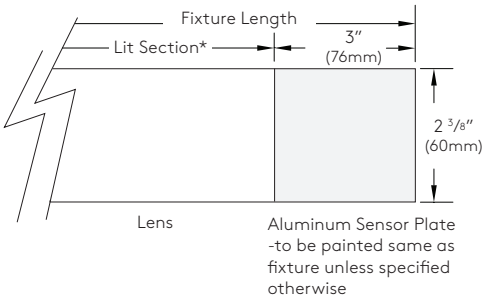
Please contact controls manufacturer for details prior to specifying.

Factory Presets - Sensors come from the sensor manufacturer with factory presets for each of the settings in above chart. Please see sensor manufacturers' spec sheets for details on presets and re-programming.

Commissioning - Commissioning of sensors and installation by others. Contact sensor manufacturer for details and costs associated with commissioning the system prior to specification of sensors.

Standard Sensor Placement - for other placement options, please consult factory. For functionality and limitations, please see sensor details above.





*Lit section will be the fixture length minus 3" for sensor plate.

Notes: 1. For spacing between sensors, please consult the sensor manufacturer.
2. Exact sensor placement and coverage will be defined by approved factory drawing.
3. Sections controlled by sensors may not be symmetrical - consult factory for layout.

Standard Recessed (L60) shapes/configurations:

Listed below are the minimum lengths and details for standard shapes. These standard shapes can be combined with each other and/or the standard luminaire lengths, ensuring full even illumination. If you have any questions, please consult the factory.

The minimum standard lengths for "L" shapes:
- L9 or V9 open shapes is 4' x 4' nominal (example: leg, 90, leg)
- L9 or V9 closed shapes is 6' x 6' nominal (example: 90, leg, 90)
(Exception is that the L9 and V9's can be joined directly to provide a 4' x 4' nominal shape)

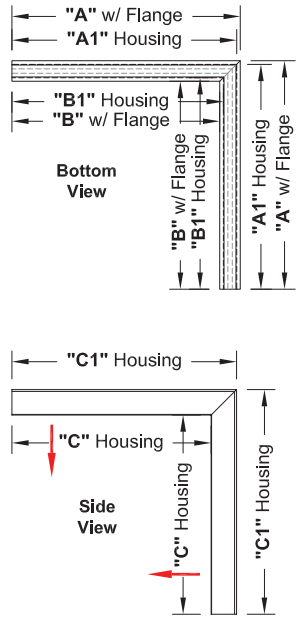
The minimum standard lengths for "T" and "X" shapes:
- T9 = 4' nominal on the short leg and 8' nominal on the long side
- X9 = 8' nominal for either direction

*For sensors in configurations, please consult factory.

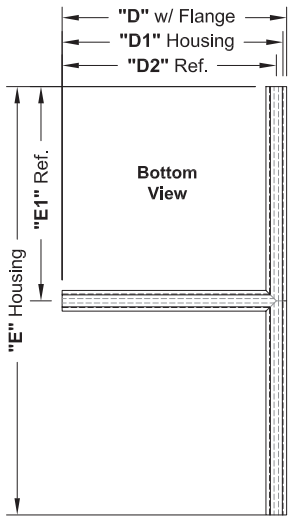
Project Specific Recessed (L60) shapes/configurations:

Selux is capable of supplying a wide range of project solutions including different shapes, angles, and sizes to meet the project requirements. Due to the complex nature of these project specific layout(s) we ask that you please consult the factory with the project requirements for review.

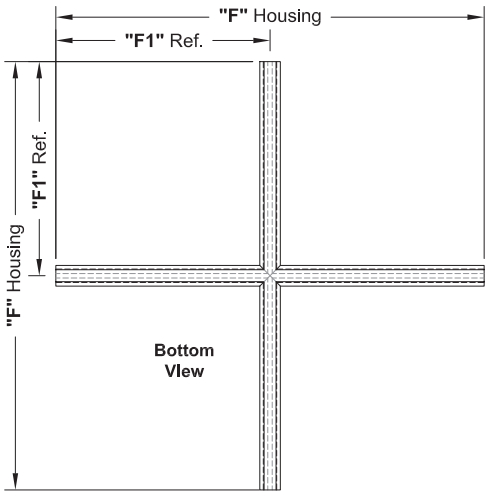
L9 - Lit Horizontal Corner



T9 - Lit "T" Section



X9 - Lit "X" Section



Recessed (L60) Lit Corner and Section - Dimensions								
	L9		V9		T9		X9	
	Feet/Inch	MM	Feet/Inch	MM	Feet/Inch	MM	Feet/Inch	MM
"A" Housing (Outside)	2' - 1 ¼"	642						
"A1" Housing (Inside)	1' - 10 15/16"	582						
"B" Housing (Outside)			1' - 11 ½"	597				
"B1" Housing (Inside)			2' - 3 1/16"	688				
"C" Housing (Inside)					2' - 1 ¼"	642		
* "C1" Ref.					2' - ⅛"	612		
"D" Housing					4' - 3/16"	1224		
* "D1" Ref.					2' - ⅛"	612		
"E" Housing							4' - 3/16"	1224
* "E1" Ref.							2' - ⅛"	612

*Dimension(s) rounded to the nearest 1/16" with a ± 1/16" (1mm) tolerance.

Standard Recessed (L6R1/2) shapes/configurations:

Listed below are the minimum lengths and details for standard shapes. These standard shapes can be combined with each other and/or the standard luminaire lengths, ensuring full even illumination. If you have any questions please consult the factory.

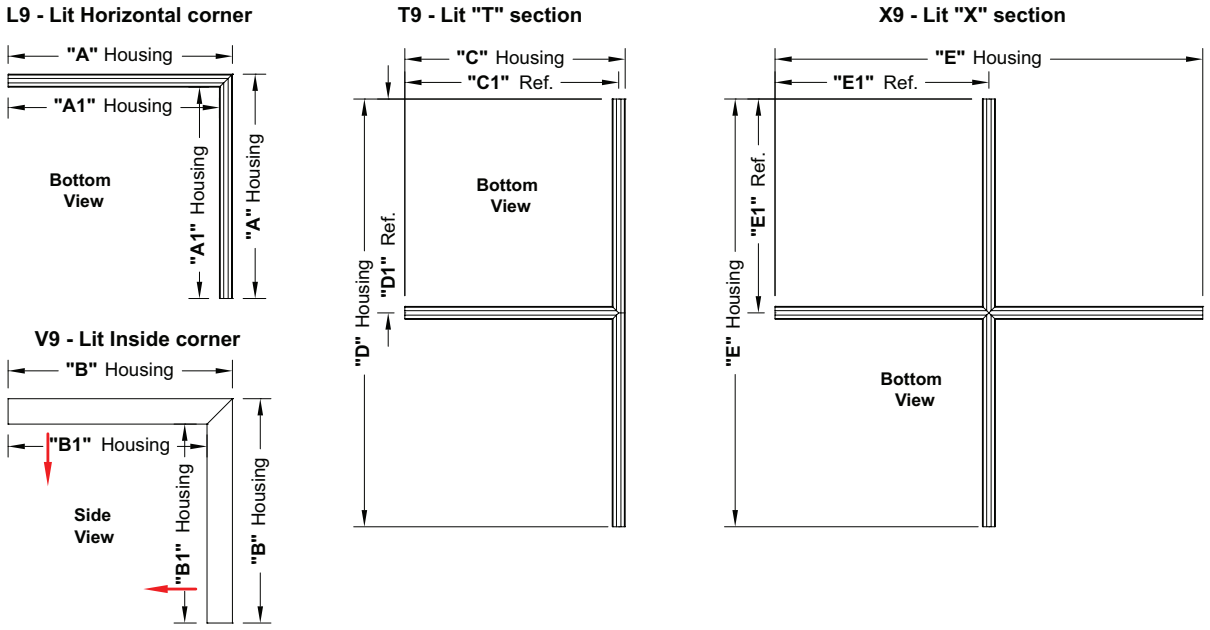
The minimum standard lengths for "L" shapes:
- L9 or V9 open shapes is 4' x 4' nominal (example, leg, 90, leg)
- L9 or V9 closed shapes is 6' x 6' nominal (example, 90, leg, 90)
(Exception is that the L9 and V9's can be joined directly to provide a 4' x 4' nominal shape)

*For sensors in configurations, please consult factory.

The minimum standard lengths for "T" and "X" shapes:
- T9 = 4' nominal on the short leg and 8' nominal on the long side
- X9 = 8' nominal for either direction

Project Specific Recessed (L6R1/2) shapes/configurations:

Selux is capable of supplying a wide range of project solutions including different shapes, angles, and sizes to meet the project requirements. Due to the complex nature of these project specific layout(s) we ask that you please consult the factory with the project requirements for review.



Recessed (L6R1/R2) Lit Corner and Section - Dimensions								
	L9		V9		T9		X9	
	Feet/Inch	MM	Feet/Inch	MM	Feet/Inch	MM	Feet/Inch	MM
"A" w/Flange (Outside)	2' - 1 3/4"	654						
"A1" Housing (Outside)	2' - 1 1/4"	642						
"B" w/Flange (Inside)	1' - 10 7/16"	570						
"B1" Housing (Inside)	1' - 10 15/16"	582						
"C" Housing (Inside)			2' - 3 1/16"	688				
"C1" Housing (Outside)			1' - 11 1/2"	597				
"D" w/Flange					2' - 1 3/4"	654		
"D1" Housing					2' - 1 1/4"	642		
* "D2" Ref.					2' - 1/8"	612		
"E" Housing					4' - 3/16"	1224		
* "E1" Ref.					2' - 1/8"	612		
"F" Housing							4' - 3/16"	1224
* "F1" Ref.							2' - 1/8"	612

*Dimension(s) rounded to the nearest 1/16" with a ± 1/16" (1mm) tolerance.

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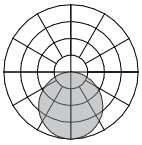
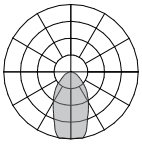
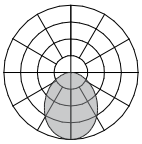
Photometry



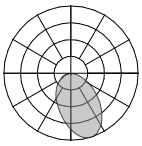
LW - LED Optimized White Lens				
Light Engine	Lumens per 4 foot	Lumens per foot	Input watts per foot	lm/W
1C35	2804	701	8.8	79



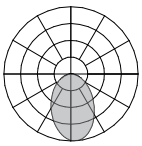
MI - Clear Lens with Microprism Inlay				
Light Engine	Lumens per 4 foot	Lumens per foot	Input watts per foot	lm/W
1C35	3251	813	8.8	92



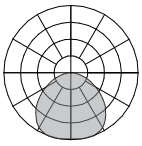
NB - LMO Symmetric				
Light Engine	Lumens per 4 foot	Lumens per foot	Input watts per foot	lm/W
1C35	3002	751	8.8	85



A2 - LMO Asymmetric 20° Wall Washer				
Light Engine	Lumens per 4 foot	Lumens per foot	Input watts per foot	lm/W
1C35	3032	758	8.8	86



A5 - LMO Asymmetric 5° Wall Grazer				
Light Engine	Lumens per 4 foot	Lumens per foot	Input watts per foot	lm/W
1C35	2807	702	8.8	79



BW - LMO Batwing				
Light Engine	Lumens per 4 foot	Lumens per foot	Input watts per foot	lm/W
1C35	3926	982	8.8	111

M60 Recessed	
CCT Multiplier	
4000K	1.05
3500K	1.00
3000K	0.96
2700K	0.92
CRI Multiplier	
90+ CRI	1.00
80+ CRI	1.19
Lens Multiplier	
LW	1.00
MI	1.02
NB	1.22
A2	1.26
A5	1.26
BW	1.00

CCT and CRI multipliers apply to the photometry, IES files, and per foot values listed on page 1 (light engine).

Lens multipliers supplied for per foot values listed on page 1 (light engine).

Date: _____ Customer: _____

Project: _____

Type: _____ Qty: _____

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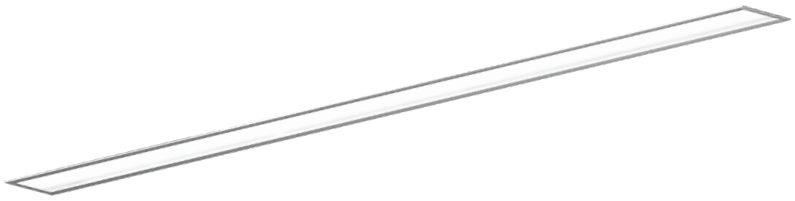
M60
LED Recessed



Order Code: _____ - _____ - _____ - _____ - _____ - _____ - _____ - _____ - _____ - _____ - _____ - _____ - _____ - _____

Series

L60 Multi-Mount Form	**L6R1** Continuous Flange (Flanged Endcaps)	**L6R2** Continuous Flange (Flangeless Endcaps)

Light Engine

1C45[1,2,3]	1C40[1,2,3]	1C35[1]	1C30[1,2]	1C25[1,2]	1C20[1,2]
80CRI-1018lm 90CRI-855lm 11.1W per foot	80CRI-954lm 90CRI-802lm 9.9W per foot	80CRI-834lm 90CRI-701lm 8.7W per foot	80CRI-746lm 90CRI-627lm 7.3W per foot	80CRI-594lm 90CRI-500lm 6.1W per foot	80CRI-494lm 90CRI-415lm 4.9W per foot

[1] Values calculated from a 4' fixture at 3500K, 90+ CRI using LW shielding and DIM driver. For additional information please see page 2.
[2] Available starting at 2' and up
[3] Not available with Lutron

CCT

927	930	935	940	827[4]	830[4]	835[4]	840[4]	RGBW
2700K 90+ CRI	3000K 90+ CRI	3500K 90+ CRI	4000K 90+ CRI	2700K 80+ CRI	3000K 80+ CRI	3500K 80+ CRI	4000K 80+ CRI	(consult factory)

[4] Consult factory for lead times.

Shielding

LW	MI	NB	A2	A5	BW
LED Optimized White Lens	Clear Lens with Microprism	LMO Symmetric with Satine Lens	LMO Asymmetric 20° Wall Washer with Satine Lens	LMO Asymmetric 5° Wall Grazer with Satine Lens	LMO Batwing with Satine Lens

Mounting L60 or Mounting L6R1 or L6R2

SF1	SF2	SF3	SG	DC
Spackle Flange (½" Drywall)	Spackle Flange (⅝" Drywall)	Spackle Flange (After Drywall)	Slot Grid (9/16") (Wire Suspension or ¼"-20 stud)	Decoustic Ceiling (up to 2" thick)

TB[5]	TBS[5]	PMT[5]	RC[6]	TS	PM
T-Bar Length with suspension clips	T-Bar Length with 1" ¼"-20 Stud	T-Bar Length Perimeter Mount	Rotating Crossbar (Ceilings ¼" to 2" thick)	1" ¼"-20 Stud	Perimeter Mount

[5] L6R1 only
[6] Consult factory for lengths under 2'

Nominal Fixture Length

01*	02[7]	03	04[7]	05[7]	06[7]	07	08[7]	XX
1 ft.	2 ft.	3 ft.	4 ft.	5 ft.	6 ft.	7 ft.	8 ft.	Runs (over 8') and Configurations, round up to the nearest foot and replace the "xx" with the # (i.e. 09=09' nominal)

**1' fixture only available with 1C35 light engine.*
Individual fixtures, Runs and Configurations are supplied in nominal lengths to ensure full, even, illumination. See pages 2 through 6 for additional details.

[7] Length intended to fit centered between the grid for SG, TB, TBS, PMT mountings

Finish

WH	BL	SV	SP
White	Semi-Matte Black	Silver	Specify Premium Color

** Custom colors are available, please consult factory*

Voltage

1	2	U	3[8]
120V	277V	120V through 277V 50/60hz capable	347V (consult factory)

[8] 347V not available with EM integral battery option

Driver

DIM[9]	DIL[9,10]	DED[9,10]	D01[9,10]	DL01[9,10]	DC2[9,10,11]	DE1[9,10]	DC5	DC3
0-10V 1% (Linear)	eldoLED 1% ECOdrive 0-10V (Logarithmic)	eldoLED 1% ECOdrive DALI (Logarithmic)	eldoLED 0.1% SOLOdrive 0-10V (Linear)	eldoLED 0.1% SOLOdrive 0-10V (Logarithmic)	Lutron 1% 2-Wire	Lutron 1% EcoSystem	Lutron 5% 5-Series (consult factory)	Lutron 1% 3-Wire (consult factory)

[9] See page 7 for full details
[10] Not available for 1' length
[11] 120V only

Fixture Options

DL	FS	SS[12]	CCEA
Damp Location Rated	In-line Fuse	Separate Switching	CCEA approved

[12] See page 10 for details

Sensor Options

xE[13,14]	xS1[13,14]	xS2[13,14]	xS3[13,14]	xSN	xV
Enlighted	Sensor Switch Daylight	Sensor Switch Occ/Vac/ Daylight	Sensor Switch Occ/Vac/ Daylight	nLight Enabled (consult factory)	Lutron Vive (consult factory)

Replace "x" with quantity

[13] Minimum fixture length 2'. See page 10 for full details and restrictions
[14] Requires DIM driver (0-10V)

Emergency Options

EC[15,16]	EMR	EM[15,16,17]
Emergency Circuit Wiring	Remote Micro Inverter (consult factory)	Integral EM Battery Pack (Non-IC rated)

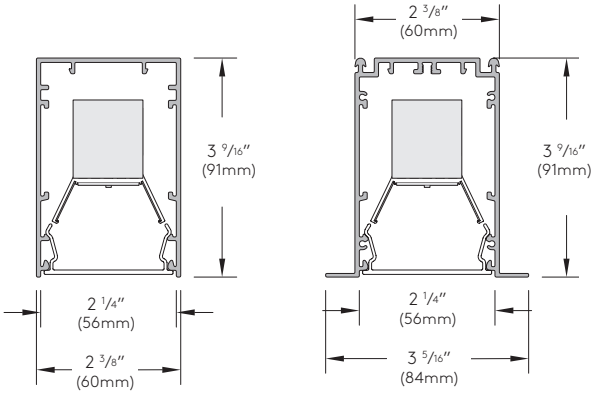
[15] See page 8 for full details and restrictions
[16] For EM with sensors please consult factory
[17] 4' available with DIM driver only. ≥6' available with all driver options.

Configuration Options

L9[1]	V9	T9	X9
Lit Horizontal 90° Corner	Lit Inverted 90° Corner	Lit "T" section	Lit "X" section

*See pages 12-13 for full details and restrictions

All options indicated with the green truck symbol are available with 4-week ship time. Mixed orders will defer to the longest lead time.



LW lens shown for reference

Construction:

Housing - Continuous, low copper 6063-T6 extruded aluminum profile with aluminum endcaps, available as Individual fixtures (up to 8') or Runs.

Flange (L6R1 or L6R2 Series)- 9/16" (14mm) wide flange runs full lengths of both sides and is part of the main extruded body. Specify continuous flange (L6R1) or flush (L6R2) end cap. L6R2 does not work in T-Bar ceiling.

Geartray - Low copper 6063-T6 extruded aluminum profile.

Shielding - Extruded, impact resistant acrylic snap in lens:
- LED Optimized White Lens (LW)
- Clear Lens with Microprism (MI)

"LMO" refers to the Selux proprietary LED optical system - Light modulation optics. These lenses are offered in M60 behind a Satine Lens for even illumination and comfortable lit appearance.
- "LMO" Symmetric Lens (NB)
- "LMO" Asymmetric 20° Wall Washer (A2)
- "LMO" Asymmetric 5° Wall Grazer (A5)
- "LMO" Batwing (BW)

Mounting(s) - Spackle-in (drywall), Slot grid, Decoustic, T-bar grid, Perimeter, Rotating Crossbar and Threaded Stud Mountings (see pages 3 through 6 for details).

Standard Luminaire lengths - All standard luminaires are supplied in nominal lengths to ensure full, even, illumination. Runs and Configurations are available in approximately 1/4" increments starting at the nominal 8' fixture length.
**Individual luminaires are not joinable in the field.

Exact length luminaires - Individual luminaires, Runs, and Configurations are available in exact lengths to meet your project needs. Please consult factory with you requirements.
**Lens luminance may soften at the very ends of the straight sections for exact length luminaires.

L60 Joiner(s) - Runs and Configurations are supplied in multiple housings that are joined together in the field using the supplied L60 Joiner System. This allows ease of installation and ensures a uniform appearance (see page 10 for detail).

Weight: 2.4 lb. per foot.

Electrical/Performance:

LED Light Engine - Brand-name mid-power LEDs create a high efficiency LED light engine able to provide a lumen maintenance of 95% at 25,000 hours and 90% at 60,000 hours at 25°C per TM-21 reports. Reported L70 greater than 60,000 hours.

Photometrics - Consult website or factory for IES Files. Independent photometric lumen measurement complies with IES LM-79-08 testing procedures. Due to the LED manufacturer's tolerances, the listed output has a ±5% tolerance. For outputs based on different optics or CCT, please see page 14 for details.

CCT - Available in 2700K, 3000K, 3500K and 4000K, tolerance within a 3-step MacAdam ellipse.

CRI - 90+ and 80+ CRI. Consult factory for lead times of 80 CRI.

All Drivers - High efficiency, constant current, soft start, Electronic Class 2 with a PFC>0.90. For more detailed information on the available drivers please see page 7.

Sensors - Selux offers a variety of integral sensor options. For details and specifications, please refer to page 11.

Emergency - There are multiple emergency options available - Emergency Circuit, Remote Micro Inverter, and Integral EM Battery Pack. All options compliant with UL 924 listed emergency luminaire. Please consult factory for use of sensors with emergency options. For more details on EC and EM options, see page 10.

Thermal Performance:

Ambient Operating Temperature - Luminaires suitable for maximum ambient temperature of 35°C (95°F) for all drivers.

Luminaires are suitable for minimum ambient temperatures of -40°C (-40°F) for DIM, DIL, DED, D01, and DL01 drivers; 0°C (32°F) for DC2 and DE1 drivers.

Luminaire Finish:

Powder Coat - All Selux luminaries are finished in high quality polyester powder coating in our Tiger Drylac certified facility and are tested in accordance with test specifications for coatings from ASTM and PCI.

All products undergo a five stage intensive pretreatment process where product is thoroughly cleaned, phosphated, and sealed. Selux powder coated products provide excellent salt and humidity resistance as well as ultra violet resistance for color retention.

Standard interior colors are White (WH), Semi-Matte Black (BL), and Silver (SV). Selux premium colors (SP) are available, please specify from your Selux color selection guide.

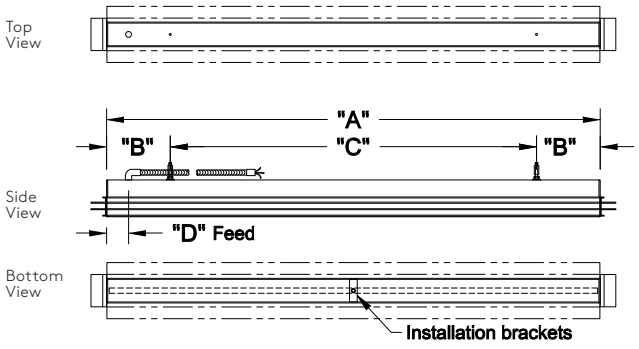
Warranty:

5 Year Limited LED Luminaire Warranty - Selux offers a 5 Year Limited Warranty to the original purchaser that the M60 series LED luminaire shall be free from defects in material and workmanship for up to five (5) years from date of shipment. This limited warranty covers the LED driver and LED light engine when installed according to Selux instructions and operated within the Ambient Temperature. For additional details and exclusions, see "Selux Terms and Condition of Sale."

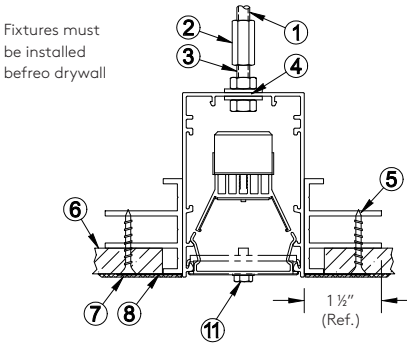
Certifications and Compliance:

NRTL - For Dry and Damp location
(I.E. cULus; cCSAus)
ARRA Compliant
RoHS Compliant
*EM option is non IC-rated

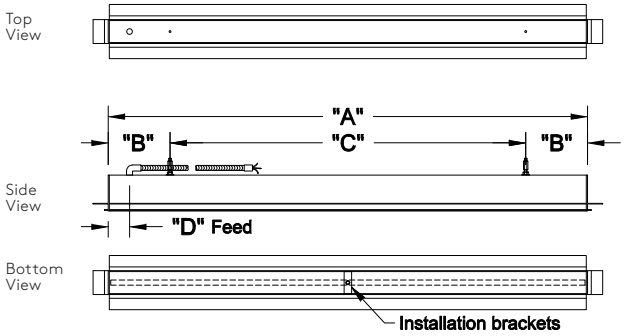
½" Spackle Flange Mounting (SF1)



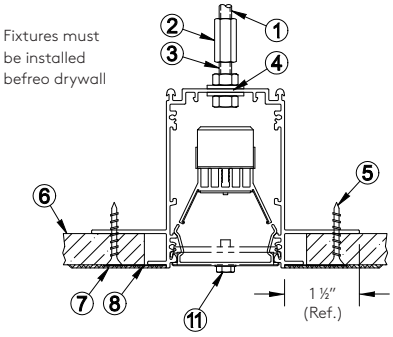
½" Spackle Flange Mounting (SF1)



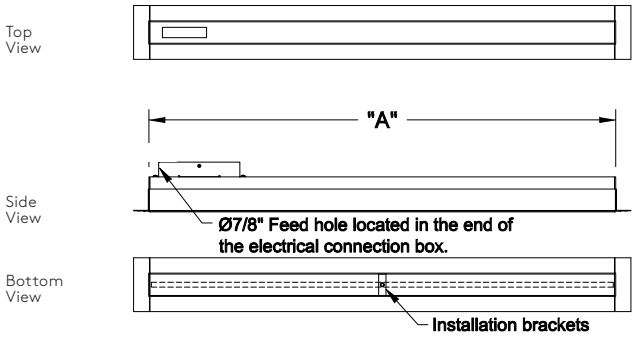
⅝" Spackle Flange Mounting (SF2)



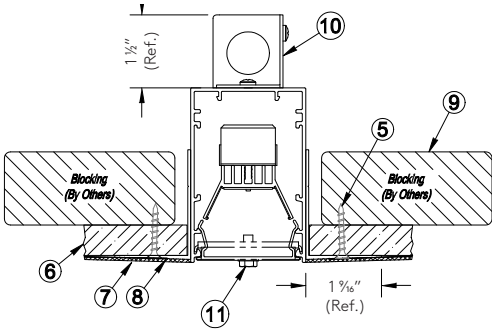
⅝" Spackle Flange Mounting (SF2)



After Drywall Flange Mounting (SF3)



After Drywall Flange Mounting (SF3)

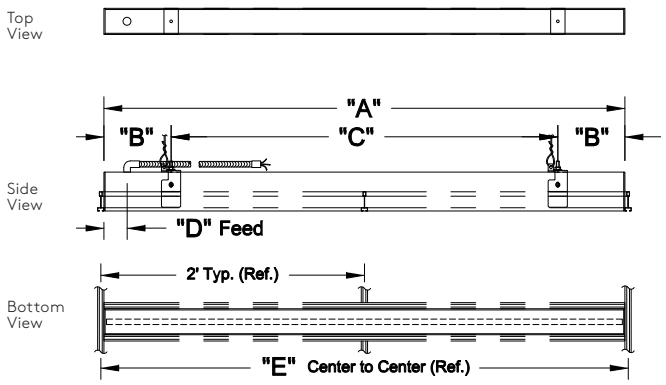


Spackle Flange Mounting (SF1, SF2 and SF3) - Dimensions								
Nominal Length	**"A" O.A.L. w/o Flange**		**"B" End Suspensions**		*** "C" (Ref.) Mid. Suspension**		**"D" Feed Location**	
	Feet/Inch	**MM**	**Feet/Inch**	**MM**	**Feet/Inch**	**MM**	**Feet/Inch**	**MM**
01 (1 ft.)	1' - ¼''	311	0' - 1 ⅝''	41	0' - 9''	229	0' - 4 ⅛''	105
02 (2 ft.)	2' - ¼''	616	0' -1 ⅝''	41	1' - 9''	533	0' - 4 ⅛''	105
03 (3 ft.)	3' - ¼''	921	0' -6 ⅛''	156	2' - 0''	609	0' - 2 ⅛''	54
04 (4 ft.)	4' - ¼''	1226	0' -6 ⅛''	156	3' - 0''	914	0' - 2 ⅛''	54
05 (5 ft.)	5' - ¼''	1530	0' -6 ⅛''	156	4' - 0''	1219	0' - 2 ⅛''	54
06 (6 ft.)	6' - ¼''	1835	0' -6 ⅛''	156	5' - 0''	1524	0' - 2 ⅛''	54
07 (7 ft.)	7' - ¼''	2140	0' -6 ⅛''	156	6' - 0''	1829	0' - 2 ⅛''	54
08 (8 ft.)	8' - ¼''	2445	0' -6 ⅛''	156	7' - 0''	2134	0' - 2 ⅛''	54

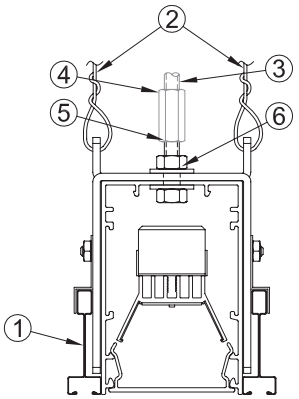
*Dimension(s) rounded to the nearest 1⁄16" with a ± 1⁄16" (1mm) tolerance.

1. ¼"-20 Threaded rod to struture (supplied and installed by others).
2. ¼"-20 Coupler hardware (supplied and installed by others).
3. 1" ¼"-20 Stud (by Selux).
4. Ø5⁄16" (Ø7mm) mounting hole.
5. Drywall/Drywall screw (Ref.)
6. Drywall/Drywall (Ref.)
7. ⅛" Plaster skimcoat (Ref.)
8. Drywall/Drywall tape (Ref.)
9. Blocking to secure fixture (by others)
10. Electrical connection box, removable side cover for electrical connection pre-installation, once installed the wiring is accessible from below the ceiling through the luminaire.
11. Luminaires ship with the brackets pre-installed.
    - The brackets cannot be removed until the fixture is completely installed and secured through the spackle flange.
    - Once the brackets are removed, the lens can be installed.

Slot Grid Mounting (SG)



9⁄16" Slot Grid Mounting (SG)
(Wire Suspension or ¼"-20 Stud)

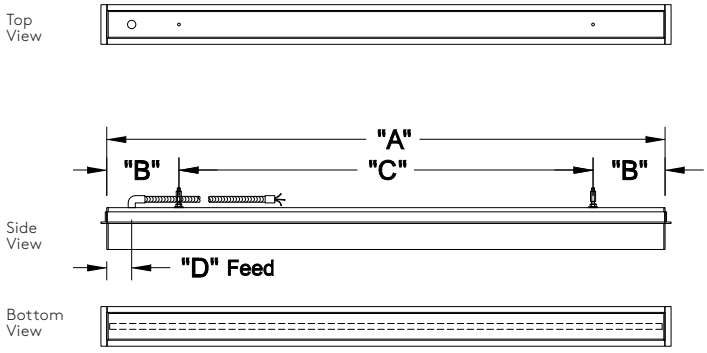


1. 9⁄16" Slot grid (shown as Ref.)
2. Support wire to structure (supplied and installed by others).
3. ¼"-20 Threaded rod to structure (supplied and installed by others).
4. ¼"-20 Coupler hardware (supplied and installed by others).
5. 1" ¼"-20 Stud (by Selux).
6. Ø5⁄16" (Ø7mm) mounting hole.

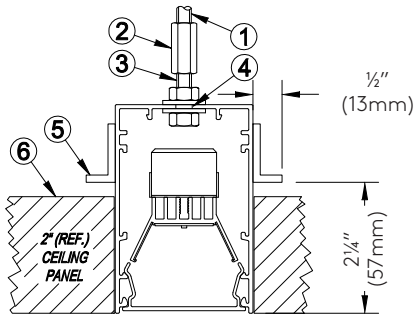
Slot Grid Mounting (SG) - Dimensions									
Nominal Length	**"A" Housing Length**		**"B" End Suspensions**		*** "C" (Ref.) Mid. Suspension**		**"D" Feed Location**		**"E" Grid Spacing**
	Feet/Inch	**MM**	**Feet/Inch**	**MM**	**Feet/Inch**	**MM**	**Feet/Inch**	**MM**	
02 (2 ft.)	1' - 11 5⁄16"	592	0' -1 5⁄8"	41	1' - 5 3⁄16"	437	0' - 1 1⁄8"	29	2' Center to Center
04 (4 ft.)	3' - 11 5⁄16"	1202	0' - 6 1⁄8"	156	2' - 11 3⁄16"	894	0' - 2 1⁄8"	54	4' Center to Center
05 (5 ft.)	4' - 11 5⁄16"	1507	0' - 6 1⁄8"	156	3' - 11 3⁄16"	1199	0' - 2 1⁄8"	54	5' Center to Center
06 (6 ft.)	5' - 11 5⁄16"	1811	0' - 6 1⁄8"	156	5' - 11 3⁄16"	1504	0' - 2 1⁄8"	54	6' Center to Center
08 (8 ft.)	7' - 11 5⁄16"	2421	0' - 6 1⁄8"	156	6' - 11 3⁄16"	2113	0' - 2 1⁄8"	54	8' Center to Center

*Dimension(s) rounded to the nearest 1⁄16" with a ± 1⁄16" (1mm) tolerance.

Decoustic Mounting (DC)



Decoustic Mounting (DC)
(Panels up to 2" thick)

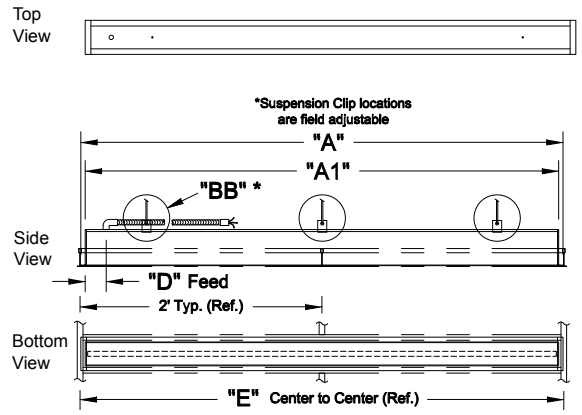


Decoustic Mounting (DC) - Dimensions								
Nominal Length	**"A" Housing Length**		**"B" End Suspensions**		*** "C" (Ref.) Mid. Suspension**		**"D" Feed Location**	
	Feet/Inch	**MM**	**Feet/Inch**	**MM**	**Feet/Inch**	**MM**	**Feet/Inch**	**MM**
01 (1 ft.)	1' - ¼"	311	1 5⁄8"	41	0' - 9"	229	0' - 4 1⁄8"	105
02 (2 ft.)	2' - ¼"	616	1 5⁄8"	41	1' - 9"	533	0' - 4 1⁄8"	105
03 (3 ft.)	3' - ¼"	921	6 1⁄8"	156	2' - 0"	609	0' - 2 1⁄8"	54
04 (4 ft.)	4' - ¼"	1226	6 1⁄8"	156	3' - 0"	914	0' - 2 1⁄8"	54
05 (5 ft.)	5' - ¼"	1530	6 1⁄8"	156	4' - 0"	1219	0' - 2 1⁄8"	54
06 (6 ft.)	6' - ¼"	1835	6 1⁄8"	156	5' - 0"	1524	0' - 2 1⁄8"	54
07 (7 ft.)	7' - ¼"	2140	6 1⁄8"	156	6' - 0"	1829	0' - 2 1⁄8"	54
08 (8 ft.)	8' - ¼"	2445	6 1⁄8"	156	7' - 0"	2134	0' - 2 1⁄8"	54

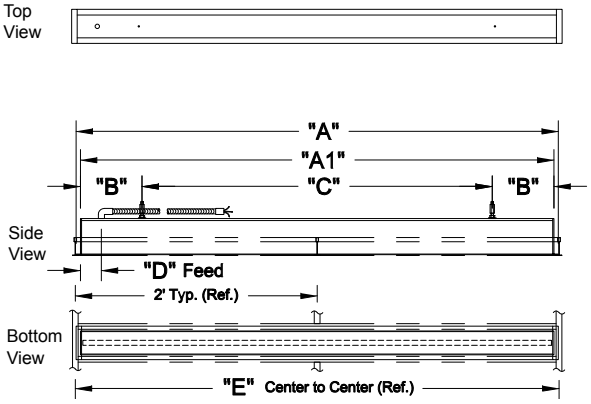
*Dimension(s) rounded to the nearest 1⁄16" with a ± 1⁄16" (1mm) tolerance.

1. ¼"-20 Threaded rod to structure (supplied and installed by others).
2. ¼"-20 Coupler hardware (supplied and installed by others).
3. 1" ¼"-20 Stud (by Selux).
4. Ø5⁄16" (Ø7mm) mounting hole.
5. ½" wide aluminum angle runs the entire length of fixture to block view into plenum area from below fixture.
6. Suitable for Decoustic® ceiling panel installations with panels up to 2" thick (supplied and installed by others). Other ceiling systems possible, please consult factory. Decoustic® is a registered trademark of Decoustics Ltd. Corporation.

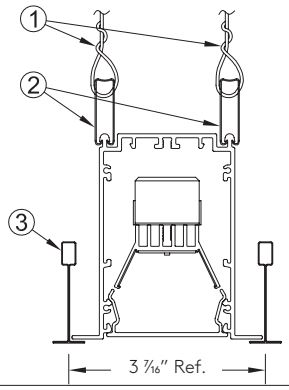
T-Bar Mounting (TB)



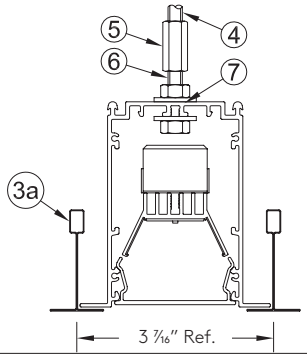
T-Bar with Stud Mounting (TBS)



T-Bar with Suspension Clips (TB)
(9⁄16" or 15⁄16" grid)



T-Bar with ¼"-20 Stud (TBS)
(9⁄16" or 15⁄16" grid)



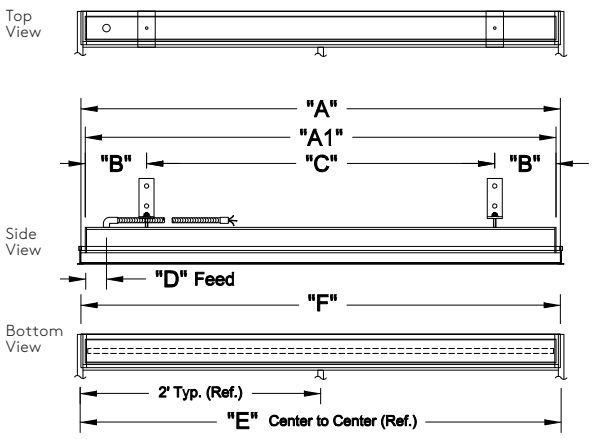
1. Support wire to structure (supplied and installed by others).
2. Spring steel suspension clips located approximately every 4 ft. (supplied by Selux).
3. 9⁄16" T-bar grid (shown as Ref.)
3a. 15⁄16" T-bar grid (shown as Ref.)
4. ¼"-20 Threaded rod to structure (supplied and installed by others).
5. ¼"-20 Coupler hardware (supplied and installed by others).
6. 1" ¼"-20 Stud (by Selux).
7. Ø5⁄16" (Ø7mm) mounting hole.

T-Bar (TB and TBS) and Perimeter Mount (PMT) - Dimensions														
Nominal Length	**"A" O.A.L. with Flange**		**"A1" O.A.L. without Flange**		**"B" End Suspensions**		**"BB" (TB mtg.) Suspension Clips**	**** "C" (Ref.) Mid. Suspension**		**"D" Feed Location**		**"E" Grid Spacing**	**"F" Wall Angle**	
	Feet/Inch	**MM**	**Feet/Inch**	**MM**	**Feet/Inch**	**MM**	**Quantity**	**Feet/Inch**	**MM**	**Feet/Inch**	**MM**		**Feet/Inch**	**MM**
***02 (2 ft.)**	1' - 11 13⁄16"	605	1' - 11"	583	0' - 1 5⁄8"	41	4x	1' - 4 3⁄4"	425	0' - 1 1⁄8"	29	2' Center to Center	1' - 10 3⁄4"	577
***04 (4 ft.)**	3' - 11 13⁄16"	1215	3' - 11"	1193	0' - 6 5⁄8"	156	6x	2' - 10 3⁄4"	882	0' - 2 1⁄8"	54	4' Center to Center	3' - 10 3⁄4"	1187
***05 (5 ft.)**	4' - 11 13⁄16"	1519	4' - 11"	1497	0' - 6 5⁄8"	156	6x	3' - 10 3⁄4"	1187	0' - 2 1⁄8"	54	5' Center to Center	4' - 10 3⁄4"	1491
***06 (6 ft.)**	5' - 11 13⁄16"	1825	5' - 11"	1803	0' - 6 5⁄8"	156	6x	4' - 10 3⁄4"	1492	0' - 2 1⁄8"	54	6' Center to Center	5' - 10 3⁄4"	1787
***08 (8 ft.)**	7' - 11 13⁄16"	2434	7' - 11"	2412	0' - 6 5⁄8"	156	8x	6' - 10 3⁄4"	2101	0' - 2 1⁄8"	54	8' Center to Center	7' - 10 3⁄4"	2406

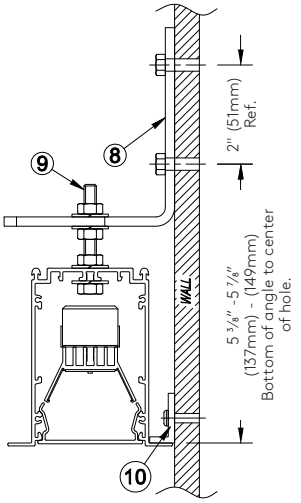
*For other lengths consult factory

**Dimension(s) rounded to the nearest 1⁄16" with a ± 1⁄16" (1mm) tolerance.

Perimeter Mounting T-Bar Length (PMT)

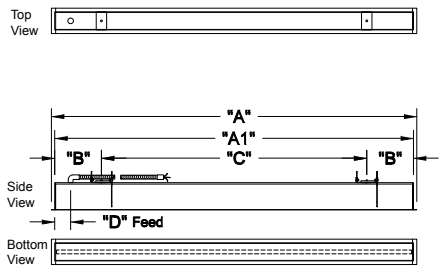


Perimeter Mount T-Bar Length (PMT)
(Recessed Wall Mounting)

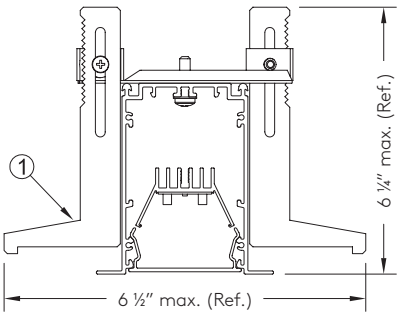


8. Steel Wall Bracket with provision for ¼"-20 fasteners (hardware to code by others).
9. 2" ¼"-20 Stud (by Selux).
10. ½" x 1" aluminum wall angle allows a gap between flange and wall to create shadow line allowing for uneveness of wall. Provision for #10 screws supplied approximately every 2 ft. (hardware to code by others).

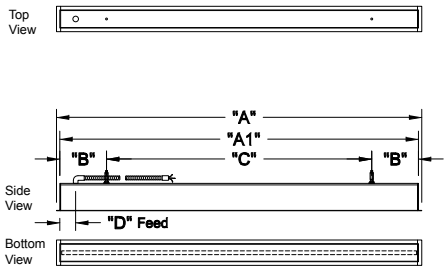
Rotating Crossbar Mounting (RC)



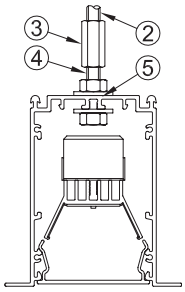
Rotating Crossbars (RC)
(¼" to 2" thick ceiling)



¼"-20 Threaded Stud Mounting (TS)



¼-20 Threaded Stud (TS)
(1" Threaded Stud)



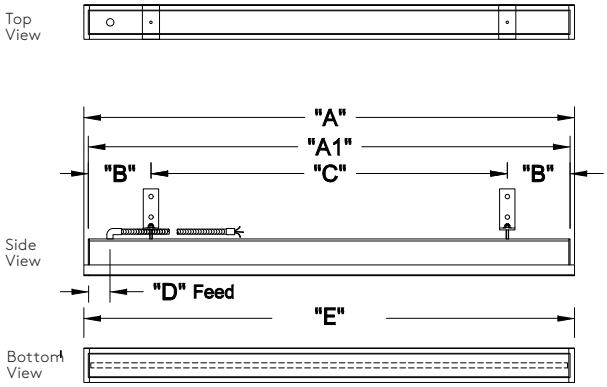
1. Rotating Crossbar intended for inaccessible ceilings, adjustable for ceiling thickness of ¼" to 2".
2. ¼"-20 Threaded rod to structure (supplied and installed by others).
3. ¼"-20 Coupler hardware (supplied and installed by others).
4. 1" ¼"-20 Stud (by Selux).
5. Ø5⁄16" (Ø7mm) mounting hole.

Rotating Crossbar (RC), Threaded Stud (TS), and Perimeter Mountings (PM) - Dimensions												
Nominal Length	"A" O.A.L. with Flange		"A1" O.A.L. without Flange		"B" End Suspensions		** "C" (Ref.) Mid. Suspension		"D" Feed Location		"E" Wall Angle	
	Feet/Inch	MM	Feet/Inch	MM	Feet/Inch	MM	Feet/Inch	MM	Feet/Inch	MM	Feet/Inch	MM
*01 (1 ft.)	1' - 1 1⁄8"	333	1' - ¼"	311	0' - 1 5⁄8"	41	0' - 9"	229	0' - 4 1⁄8"	105	1' - 0"	305
02 (2 ft.)	2' - 1 1⁄8"	638	2' - ¼"	616	0' - 1 5⁄8"	41	1' - 9"	533	0' - 4 1⁄8"	105	2' - 0"	610
03 (3 ft.)	3' - 1 1⁄8"	942	3' - ¼"	921	0' - 6 1⁄8"	156	2' - 0"	609	0' - 2 1⁄8"	54	3' - 0"	914
04 (4 ft.)	4' - 1 1⁄8"	1247	4' - ¼"	1226	0' - 6 1⁄8"	156	3' - 0"	914	0' - 2 1⁄8"	54	4' - 0"	1219
05 (5 ft.)	5' - 1 1⁄8"	1552	5' - ¼"	1530	0' - 6 1⁄8"	156	4' - 0"	1219	0' - 2 1⁄8"	54	5' - 0"	1524
06 (6 ft.)	6' - 1 1⁄8"	1857	6' - ¼"	1835	0' - 6 1⁄8"	156	5' - 0"	1524	0' - 2 1⁄8"	54	6' - 0"	1829
07 (7 ft.)	7' - 1 1⁄8"	2162	7' - ¼"	2140	0' - 6 1⁄8"	156	6' - 0"	1829	0' - 2 1⁄8"	54	7' - 0"	2134
08 (8 ft.)	8' - 1 1⁄8"	2466	8' - ¼"	2445	0' - 6 1⁄8"	156	7' - 0"	2134	0' - 2 1⁄8"	54	8' - 0"	2438

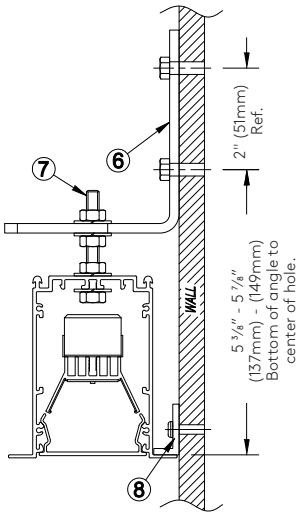
*RC mounting, consult factory for lengths under 2'

**Dimension(s) rounded to the nearest 1⁄16" with a ± 1⁄16" (1mm) tolerance.

Perimeter Mounting (PM)



Perimeter Mount (PM)
(Recessed Wall Mounting)



6. Steel Wall Bracket with provision for ¼"-20 fasteners (hardware to code by others).
7. 2" ¼"-20 Stud (by Selux).
8. ½" x 1" aluminum wall angle allows a gap between flange and wall to create shadow line allowing for uneveness of wall. Provision for #10 screws supplied approximately every 2 feet (hardware to code by others).

Drivers:

0-10V linear dimming (DIM)
Luminaires supplied with drivers offering the capability of either normal switched operation of 0-10V dimming for linear dimming curve. Fixtures ship wired for dimming. For on/off functionality, simply cap the dimming leads. Minimum dimming level preset at factory to 1%. (Due to size constraints, 1' luminaires are supplied with a driver from a different manufacturer than 2' and above luminaires. For details, please consult factory).

0-10V logarithmic eldoLED ECOdrive dimming (DIL)
Luminaires supplied with drivers offering the capability of either normal switched operation of 0-10V dimming for logarithmic dimming curve, Fixtures shipped wired for dimming. For on/off functionality, simply cap the dimming leades. Minimum dimming level preset at factory to 1%.

eldoLED ECOdrive DALI dimming (DED)
Luminaires supplied with ECOdrive DALI dimming driver with logarithmic dimming curve. Minimum dimming level preset at factory to 1%. For "dim to dark" (down to 0.1%), please consult factory.

eldoLED SOLOdrive 0-10V linear dimming (D01)
Luminaires supplied with SOLOdrive 0-10V dimming driver with linear dimming curve. Minimum dimming level preset at factory to 0.1% and "dim to dark".

eldoLED SOLOdrive 0-10V logarithmic dimming (DL01)
Luminaires supplied with SOLOdrive 0-10V dimming driver with logarithmic dimming curve. Minimum dimming level preset at factory to 0.1% and "dim to dark".

LUTRON 2-wire dimming (DC2)
Luminaires supplied with Hi-Lume 2-wire dimming driver (120V only) programmed for Constant Current Reduction (CCR). For Pulse Width Modulation (PWM) dimming, please consult factory. Minimum dimming level down to 1%.

LUTRON EcoSystem dimming (DE1/DC5)
Luminaires supplied with Hi-Lume EcoSystem (4 wire, digital link) dimming driver programmed for Constant Current Reduction (CCR). Minimum dimming level down to 1% (DE1) with SoftOn/FadeToBlack or 5% (DC5).

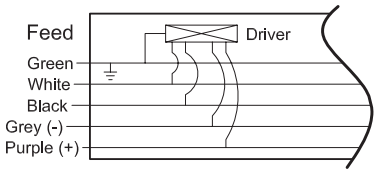
*For control recommendations, please contact driver manufacturer.

<table>
<tr><td colspan="16">Driver Quantity</td></tr>
<tr><td rowspan="2">Light Engine</td><td rowspan="2">Dimming Code</td><td colspan="14">Length</td></tr>
<tr><td>1ft</td><td>2ft</td><td>2ft SG/TB</td><td>3ft</td><td>4ft</td><td>4ft SG/TB</td><td>5ft</td><td>5ft SG/TB</td><td>6ft</td><td>6ft SG/TB</td><td>7ft</td><td>8ft</td><td>8ft SG/TB</td><td>9ft</td><td>10ft</td><td>11ft</td><td>12ft</td></tr>
<tr><td rowspan="4">1C20</td><td>DIM/DIL</td><td rowspan="13">N/A</td><td colspan="7" rowspan="4">1</td><td rowspan="4">2</td><td rowspan="4">1</td><td rowspan="4">2</td><td rowspan="4">1</td><td colspan="2" rowspan="4">2</td><td rowspan="4">2</td><td rowspan="4">1</td></tr>
<tr><td>D01/DL01/DED</td></tr>
<tr><td>DE1/DC5</td></tr>
<tr><td>DC2</td><td colspan="2">3</td><td>2</td></tr>
<tr><td rowspan="4">1C25</td><td>DIM/DIL</td><td colspan="7" rowspan="4">1</td><td rowspan="4">2</td><td rowspan="4">1</td><td rowspan="4">2</td><td rowspan="3">1</td><td colspan="2" rowspan="3">2</td><td rowspan="3">1</td></tr>
<tr><td>D01/DL01/DED</td></tr>
<tr><td>DE1/DC5</td></tr>
<tr><td>DC2</td><td colspan="2">2</td><td colspan="2">3</td><td>2</td></tr>
<tr><td rowspan="4">1C30</td><td>DIM/DIL</td><td colspan="7" rowspan="4">1</td><td rowspan="4">2</td><td rowspan="3">1</td><td rowspan="4">2</td><td rowspan="4">1</td><td rowspan="4">2</td><td colspan="2" rowspan="3">2</td><td rowspan="3">2</td></tr>
<tr><td>D01/DL01/DED</td></tr>
<tr><td>DE1/DC5</td></tr>
<tr><td>DC2</td><td>2</td><td colspan="2">2</td><td colspan="2">3</td><td>3</td></tr>
<tr><td rowspan="4">1C35</td><td>DIM/DIL</td><td>1</td><td colspan="7" rowspan="4">1</td><td rowspan="4">2</td><td rowspan="3">1</td><td rowspan="4">2</td><td rowspan="3">2</td><td rowspan="3">1</td><td rowspan="4">2</td><td colspan="2" rowspan="3">2</td><td rowspan="3">2</td></tr>
<tr><td>D01/DL01/DED</td><td rowspan="12">N/A</td></tr>
<tr><td>DE1/DC5</td></tr>
<tr><td>DC2</td><td>2</td><td>2</td><td colspan="2">3</td><td>3</td></tr>
<tr><td rowspan="4">1C40</td><td>DIM/DIL</td><td colspan="7" rowspan="3">1</td><td rowspan="3">2</td><td rowspan="3">1</td><td rowspan="3">2</td><td rowspan="2">2</td><td colspan="4" rowspan="3">2</td><td colspan="2" rowspan="3">3</td></tr>
<tr><td>D01/DL01/DED</td><td rowspan="2">1</td></tr>
<tr><td>DE1/DC5</td><td colspan="14">N/A</td></tr>
<tr><td>DC2</td></tr>
<tr><td rowspan="4">1C45</td><td>DIM/DIL</td><td colspan="6" rowspan="3">1</td><td>2</td><td rowspan="3">2</td><td rowspan="3">1</td><td colspan="2" rowspan="3">2</td><td colspan="2" rowspan="3">2</td><td>3</td><td rowspan="3">2</td><td colspan="2" rowspan="3">3</td></tr>
<tr><td>D01/DL01/DED</td><td>1</td><td>2</td></tr>
<tr><td>DE1/DC5</td><td colspan="14">N/A</td></tr>
<tr><td>DC2</td></tr>
</table>

*For inrush and control current, please refer to the driver manufacturers' spec sheets.

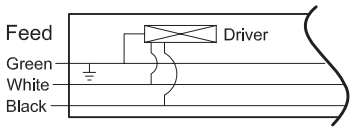
Wiring Diagrams

0-10V linear (DIM)
0-10V logarithmic eldoLED Ecodrive (DIL)
DALI logarithmic eldoLED ECOdrive (DED)
0-10V linear eldoLED SOLOdrive (D01)
0-10V logarithmic eldoLED SOLOdrive (DL01)

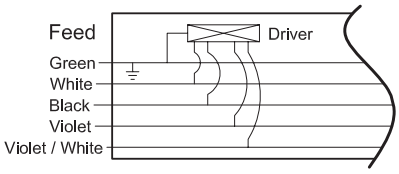


Standard Wiring supplied for all drivers.	Green = Ground White = Neutral Black = Hot
- The following wire(s) are in addition to the standard above -	
DIM, DIL, DED D01, DL01	Gray = (-) DALI or 0-10V Dimming Control Purple = (+) DALI or 0-10V Dimming Control
DC2	No additional wires
DE1, DC5	Violet = "E1" Digital Link Dimming Control Violet/White = "E2" Digital Link Dimming Control

Lutron 2-Wire (DC2)

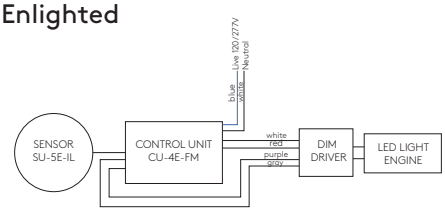


Lutron EcoSystem (DE1)
Lutron 5-Series (DC5)

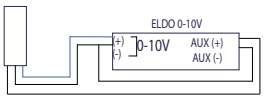


Sensor Wiring Diagrams

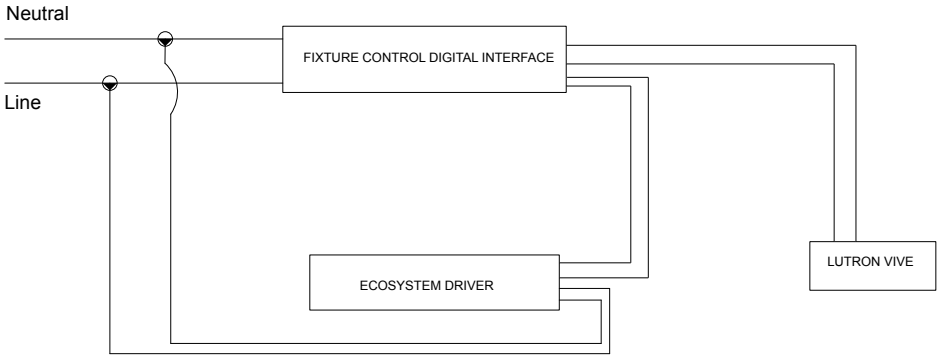
Enlighted



Sensor Switch



Lutron Vive



Driver power chart - use below values to determine the nominal watts per foot based on driver, light engine, and voltage.
* Driver losses increase the wattage for fixtures less than 4 foot.
** Values are nominal values determined based on multiple tested fixtures.

Driver Power Usage				
Driver	**Light Engine**	**Nominal W/ft**		
		120V	**277V**	**347V**
DIM, DIL, DED, D01, DL01	1C20	4.9	5.3	n/a
	1C25	6.1	6.5	
	1C30	7.3	7.7	
	1C35	8.7	8.9	
	1C40	9.9	10.1	
	1C45	11.1	11.3	
DC2, DE1, DCE, DC5, DC3	1C20	5.5	5.2	n/a
	1C25	6.7	6.3	
	1C30	8.0	7.6	
	1C35	9.3	8.8	
	1C40	10.6	10.0	
	1C45	11.6	11.3	
DIM @347V	1C20	n/a	n/a	5.4
	1C25			6.5
	1C30			7.7
	1C35			8.8
	1C40			10.0
	1C45			11.2
EM	all	6		n/a

Fuse (FS) - Fusing, luminaires supplied with a in-line fuse located on the hot wire for each feed. (supplied with an 8A slow burn fuse).

Damp Location (DL) - Luminaires are suitable for use in damp location(s). Examples of such locations include protected areas under canopies, marquees, roofed porches, and similar locations where the fixture(s) are protected from direct contact with rain, snow, or excessive moisture (such as ocean spray). Interior locations include areas subject to moderate degrees of moisture, such as basements and certain barns and cold storage buildings.

*For Damp Location with sensors, please consult factory.

Separate Switching (SS) - Luminaires available with separately switched 4' (nominal) sections starting at 7' and up. Luminaire is intended to be wired to the same panel/breaker (not intended for Emergency use).

* All separately switched (non-EM) circuits within an individual luminaire, linear run, or configuration must be connected to the same branch circuit on-site.

* To specify this option, the number of separately switched sections and locations of these sections must be provided at time of order.

*If the project requires different separate switching than outlined above please consult the factory.

*For Separate Switching with sensors, please consult factory.

Emergency Wiring (EC) - Luminaires with (EC) option are compliant to UL 924 listed emergency luminaire. EC luminaires are intended to be wired to separate panels/breakers for emergency use. See install instructions for proper wiring.

For 1' to 6' nominal luminaires, the entire fixture is wired for operation on emergency circuit.

For 7' and up nominal luminaires, the first 4' nominal length is wired for operation by a separate EM circuit by default to meet the required "Life Safety Code" (NFPA 101).

If a different configuration is needed, please consult factory.

Note: Wiring may vary slightly due to on-site conditions or local codes. Please follow all safety installation protocols contained within install instructions when installing luminaire.

Emergency Battery (EM) – Luminaires with emergency battery (EM) option are compliant to UL 924 listed emergency luminaire. The EM battery is located integral to fixture and is factory pre-wired. See install instructions for proper wiring.

In the event of an emergency, EM battery will illuminate a 4' section at 12W (constant) for 90 minutes at 25°C. Recharge time is 24 hours.

Direct fixtures are available for emergency battery (EM) use in 4' and ≥6. Due to size constraints, EM is not available in 5' fixtures.

For individual fixtures, emergency option will illuminate the first 4' section of fixture. For continuous runs, please consult factory to advise on 4' section intended for emergency use. For fixtures >12' or if a different configuration is needed, please consult factory.

Emergency test switch and plate is a non-illuminated 3" blank section located adjacent to the length of fixture wired for emergency.

*Emergency battery option is UNV for use with 120V or 277V and is not available for 347V.

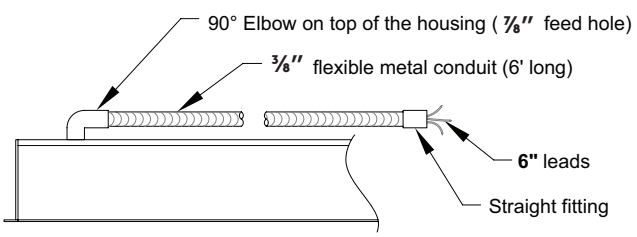
*Please note battery pack requires an unswitched hot.

*For EM with sensors, please consult factory.

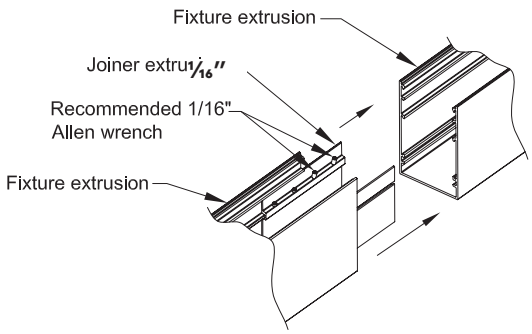
*If a different configuration is needed, please consult factory.

Note: Wiring may vary slightly due to on-site conditions or local codes. Please follow all safety installation protocols contained within install instructions when installing luminaire.

Flex Whip - standard for recessed fixtures



Joiner System - standard for Runs and Configurations



Sensor Ordering Chart		
Quantity	**Sensor**	**Settings***
x Number of Sensors	**E** Enlighted SU-5E-IL **S** Sensor Switch MSD EZ **V** Lutron Vive DFCSJ	**1** Daylight **2** Occupancy/Vacancy **3** Daylight/Occupancy/Vacancy * Settings not available with Enlighted

Enlighted SU-5E-IL (E)
Enlighted Micro Sensor SU-5E-IL (Independent Lighting) provided as standard with an Enlighted CU-4E-FM Fixture Mount Control Unit integral to fixture. If SU-5E-CL (Connected Lighting) or SU-5E-IoT (Internet of Things) is desired, please contact factory. Occupancy/vacancy, thermal, daylight sensing plus Tunable White, Room & Zone control, Internet of Things (IoT) data collection and reporting control. For full details, please see SU-5E-(IoT/CL/IL) spec sheet on the Enlighted website. Must be paired with a 0-10V driver with auxiliary (DIM driver selection). Commissioning by Enlighted.

*Sensor can control up to 5 drivers. Please refer to driver quantity chart on page 7. Multiple sensors may be required for longer lengths.

Sensor Switch MSD EZ (S)
Occupancy/vacancy and daylight harvesting. For full functionality and programming options, select settings option 3. If a different settings option is selected, other settings may be unavailable. For full details, please see MSD EZ spec sheets on the Sensor Switch website. Must be paired with DIM driver selection. Manual control of dimming not available with MSD EZ sensor.

*Sensor can control up to 30 drivers. Please refer to driver quantity chart on page 7. Multiple sensors may be required for longer lengths.

Lutron Vive DFCSJ (V)
The DFCSJ-OEM-OCC provides the capabilities of daylight harvesting and occupancy/vacancy sensing. When integrated with the DFC-OEM-DBI (Fixture Contril Digital Link Interface), the sensor is wirelessly compatible with the DE1 Lutron EcoSystem driver. Commissioning bt certified Lutron technician.

*Vive DFCSJ sensor can control up to a maximum of five (5) drivers per sensor. Please refer to driver chart on page 7. Multiple sensors may be required for longer lengths.

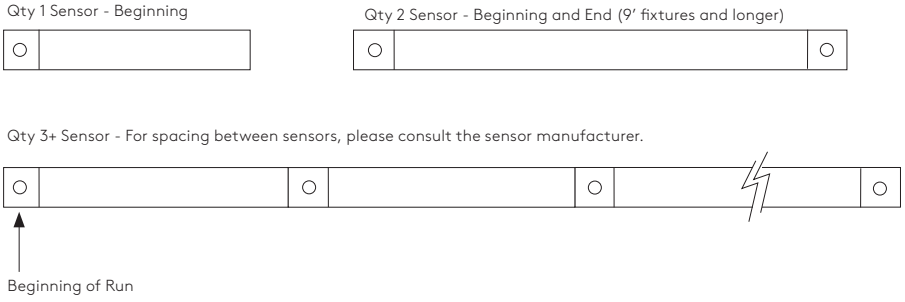
	Occupancy	**Vacancy**	**Daylight Harvesting**	**Driver Compatibility**
Enlighted SU-5E-IL (E)	√	√	√	DIM
Sensor Switch MSD EZ (S)	√	√	√	DIM
Lutron Vive DFCSJ (V)	√	√	√	DE1

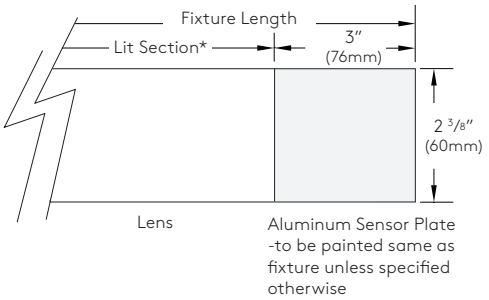
Please contact controls manufacturer for details prior to specifying.

Factory Presets - Sensors come from the sensor manufacturer with factory presets for each of the settings in above chart. Please see sensor manufacturers' spec sheets for details on presets and re-programming.

Commissioning - Commissioning of sensors and installation by others. Contact sensor manufacturer for details and costs associated with commissioning the system prior to specification of sensors.

Standard Sensor Placement - for other placement options, please consult factory. For functionality and limitations, please see sensor details above.





*Lit section will be the fixture length minus 3" for sensor plate.

Notes: 1. For spacing between sensors, please consult the sensor manufacturer.
2. Exact sensor placement and coverage will be defined by approved factory drawing.
3. Sections controlled by sensors may not be symmetrical - consult factory for layout.

Standard Recessed (L60) shapes/configurations:

Listed below are the minimum lengths and details for standard shapes. These standard shapes can be combined with each other and/or the standard luminaire lengths, ensuring full even illumination. If you have any questions, please consult the factory.

The minimum standard lengths for "L" shapes:
- L9 or V9 open shapes is 4' x 4' nominal (example: leg, 90, leg)
- L9 or V9 closed shapes is 6' x 6' nominal (example: 90, leg, 90)
(Exception is that the L9 and V9's can be joined directly to provide a 4' x 4' nominal shape)

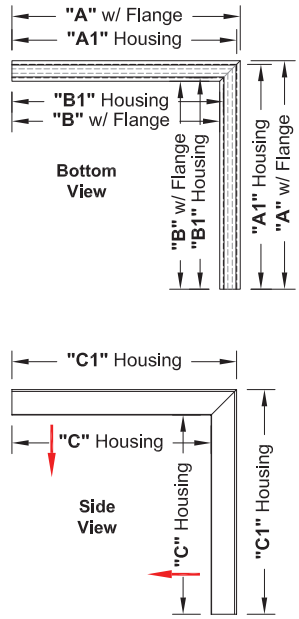
The minimum standard lengths for "T" and "X" shapes:
- T9 = 4' nominal on the short leg and 8' nominal on the long side
- X9 = 8' nominal for either direction

*For sensors in configurations, please consult factory.

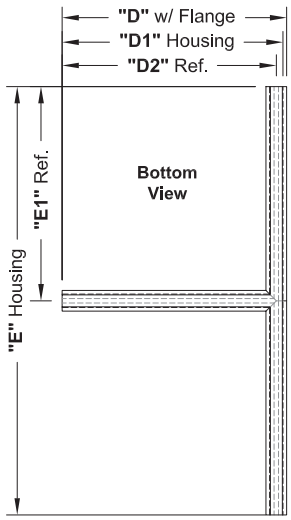
Project Specific Recessed (L60) shapes/configurations:

Selux is capable of supplying a wide range of project solutions including different shapes, angles, and sizes to meet the project requirements. Due to the complex nature of these project specific layout(s) we ask that you please consult the factory with the project requirements for review.

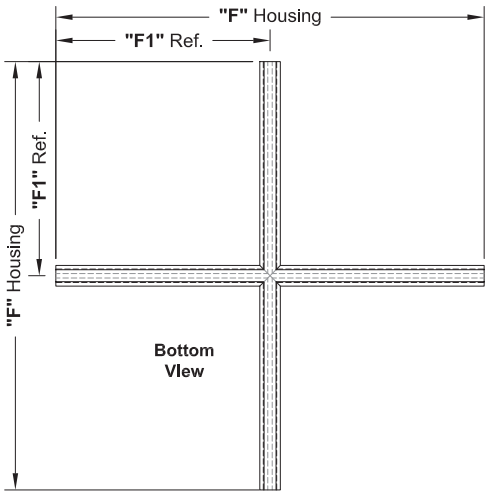
L9 - Lit Horizontal Corner



T9 - Lit "T" Section



X9 - Lit "X" Section



Recessed (L60) Lit Corner and Section - Dimensions								
	L9		V9		T9		X9	
	Feet/Inch	MM	Feet/Inch	MM	Feet/Inch	MM	Feet/Inch	MM
"A" Housing (Outside)	2' - 1 ¼"	642						
"A1" Housing (Inside)	1' - 10 15/16"	582						
"B" Housing (Outside)			1' - 11 ½"	597				
"B1" Housing (Inside)			2' - 3 1/16"	688				
"C" Housing (Inside)					2' - 1 ¼"	642		
* "C1" Ref.					2' - ⅛"	612		
"D" Housing					4' - 3/16"	1224		
* "D1" Ref.					2' - ⅛"	612		
"E" Housing							4' - 3/16"	1224
* "E1" Ref.							2' - ⅛"	612

*Dimension(s) rounded to the nearest 1/16" with a ± 1/16" (1mm) tolerance.

Standard Recessed (L6R1/2) shapes/configurations:

Listed below are the minimum lengths and details for standard shapes. These standard shapes can be combined with each other and/or the standard luminaire lengths, ensuring full even illumination. If you have any questions please consult the factory.

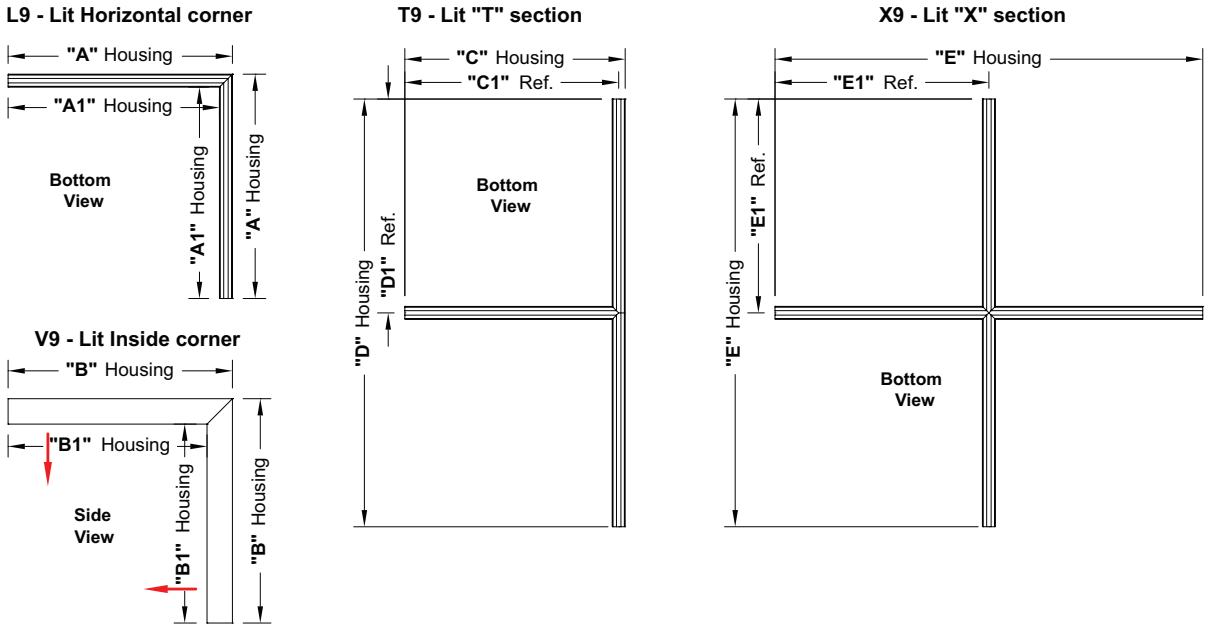
The minimum standard lengths for "L" shapes:
- L9 or V9 open shapes is 4' x 4' nominal (example, leg, 90, leg)
- L9 or V9 closed shapes is 6' x 6' nominal (example, 90, leg, 90)
(Exception is that the L9 and V9's can be joined directly to provide a 4' x 4' nominal shape)

*For sensors in configurations, please consult factory.

The minimum standard lengths for "T" and "X" shapes:
- T9 = 4' nominal on the short leg and 8' nominal on the long side
- X9 = 8' nominal for either direction

Project Specific Recessed (L6R1/2) shapes/configurations:

Selux is capable of supplying a wide range of project solutions including different shapes, angles, and sizes to meet the project requirements. Due to the complex nature of these project specific layout(s) we ask that you please consult the factory with the project requirements for review.



Recessed (L6R1/R2) Lit Corner and Section - Dimensions								
	L9		V9		T9		X9	
	Feet/Inch	MM	Feet/Inch	MM	Feet/Inch	MM	Feet/Inch	MM
"A" w/Flange (Outside)	2' - 1 3/4"	654						
"A1" Housing (Outside)	2' - 1 1/4"	642						
"B" w/Flange (Inside)	1' - 10 7/16"	570						
"B1" Housing (Inside)	1' - 10 15/16"	582						
"C" Housing (Inside)			2' - 3 1/16"	688				
"C1" Housing (Outside)			1' - 11 1/2"	597				
"D" w/Flange					2' - 1 3/4"	654		
"D1" Housing					2' - 1 1/4"	642		
* "D2" Ref.					2' - 1/8"	612		
"E" Housing					4' - 3/16"	1224		
* "E1" Ref.					2' - 1/8"	612		
"F" Housing							4' - 3/16"	1224
* "F1" Ref.							2' - 1/8"	612

*Dimension(s) rounded to the nearest 1/16" with a ± 1/16" (1mm) tolerance.

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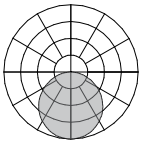
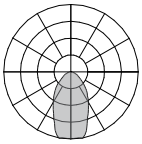
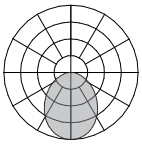
Photometry



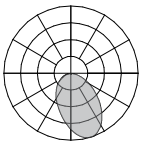
LW - LED Optimized White Lens				
Light Engine	Lumens per 4 foot	Lumens per foot	Input watts per foot	lm/W
1C35	2804	701	8.8	79



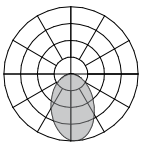
MI - Clear Lens with Microprism Inlay				
Light Engine	Lumens per 4 foot	Lumens per foot	Input watts per foot	lm/W
1C35	3251	813	8.8	92



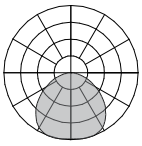
NB - LMO Symmetric				
Light Engine	Lumens per 4 foot	Lumens per foot	Input watts per foot	lm/W
1C35	3002	751	8.8	85



A2 - LMO Asymmetric 20° Wall Washer				
Light Engine	Lumens per 4 foot	Lumens per foot	Input watts per foot	lm/W
1C35	3032	758	8.8	86



A5 - LMO Asymmetric 5° Wall Grazer				
Light Engine	Lumens per 4 foot	Lumens per foot	Input watts per foot	lm/W
1C35	2807	702	8.8	79



BW - LMO Batwing				
Light Engine	Lumens per 4 foot	Lumens per foot	Input watts per foot	lm/W
1C35	3926	982	8.8	111

M60 Recessed	
CCT Multiplier	
4000K	1.05
3500K	1.00
3000K	0.96
2700K	0.92
CRI Multiplier	
90+ CRI	1.00
80+ CRI	1.19
Lens Multiplier	
LW	1.00
MI	1.02
NB	1.22
A2	1.26
A5	1.26
BW	1.00

CCT and CRI multipliers apply to the photometry, IES files, and per foot values listed on page 1 (light engine).

Lens multipliers supplied for per foot values listed on page 1 (light engine).

Date: _____ Customer: _____

Project: _____

Type: _____ Qty: _____

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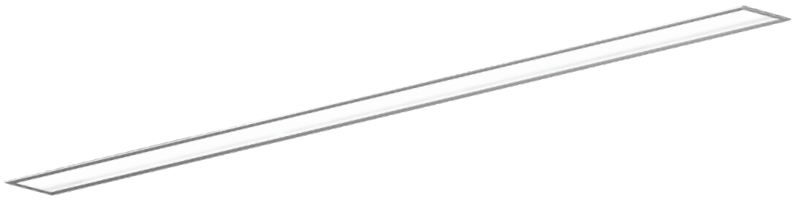
M60
LED Recessed



Order Code: _____ - _____ - _____ - _____ - _____ - _____ - _____ - _____ - _____ - _____ - _____ - _____ - _____ - _____

Series

L60 Multi-Mount Form	**L6R1** Continuous Flange (Flanged Endcaps)	**L6R2** Continuous Flange (Flangeless Endcaps)

Light Engine

1C45[1,2,3]	1C40[1,2,3]	1C35[1]	1C30[1,2]	1C25[1,2]	1C20[1,2]
80CRI-1018lm 90CRI-855lm 11.1W per foot	80CRI-954lm 90CRI-802lm 9.9W per foot	80CRI-834lm 90CRI-701lm 8.7W per foot	80CRI-746lm 90CRI-627lm 7.3W per foot	80CRI-594lm 90CRI-500lm 6.1W per foot	80CRI-494lm 90CRI-415lm 4.9W per foot

[1] Values calculated from a 4' fixture at 3500K, 90+ CRI using LW shielding and DIM driver. For additional information please see page 2.
[2] Available starting at 2' and up
[3] Not available with Lutron

CCT

927	930	935	940	827[4]	830[4]	835[4]	840[4]	RGBW
2700K 90+ CRI	3000K 90+ CRI	3500K 90+ CRI	4000K 90+ CRI	2700K 80+ CRI	3000K 80+ CRI	3500K 80+ CRI	4000K 80+ CRI	(consult factory)

[4] Consult factory for lead times.

Shielding

LW	MI	NB	A2	A5	BW
LED Optimized White Lens	Clear Lens with Microprism	LMO Symmetric with Satine Lens	LMO Asymmetric 20° Wall Washer with Satine Lens	LMO Asymmetric 5° Wall Grazer with Satine Lens	LMO Batwing with Satine Lens

Mounting L60 or Mounting L6R1 or L6R2

SF1	SF2	SF3	SG	DC
Spackle Flange (½" Drywall)	Spackle Flange (⅝" Drywall)	Spackle Flange (After Drywall)	Slot Grid (9/16") (Wire Suspension or ¼"-20 stud)	Decoustic Ceiling (up to 2" thick)

TB[5]	TBS[5]	PMT[5]	RC[6]	TS	PM
T-Bar Length with suspension clips	T-Bar Length with 1" ¼"-20 Stud	T-Bar Length Perimeter Mount	Rotating Crossbar (Ceilings ¼" to 2" thick)	1" ¼"-20 Stud	Perimeter Mount

[5] L6R1 only
[6] Consult factory for lengths under 2'

Nominal Fixture Length

01*	02[7]	03	04[7]	05[7]	06[7]	07	08[7]	XX
1 ft.	2 ft.	3 ft.	4 ft.	5 ft.	6 ft.	7 ft.	8 ft.	Runs (over 8') and Configurations, round up to the nearest foot and replace the "xx" with the # (i.e. 09=09' nominal)

**1' fixture only available with 1C35 light engine.*
Individual fixtures, Runs and Configurations are supplied in nominal lengths to ensure full, even, illumination. See pages 2 through 6 for additional details.

[7] Length intended to fit centered between the grid for SG, TB, TBS, PMT mountings

Finish

WH	BL	SV	SP
White	Semi-Matte Black	Silver	Specify Premium Color

** Custom colors are available, please consult factory*

Voltage

1	2	U	3[8]
120V	277V	120V through 277V 50/60hz capable	347V (consult factory)

[8] 347V not available with EM integral battery option

Driver

DIM[9]	DIL[9,10]	DED[9,10]	D01[9,10]	DL01[9,10]	DC2[9,10,11]	DE1[9,10]	DC5	DC3
0-10V 1% (Linear)	eldoLED 1% ECOdrive 0-10V (Logarithmic)	eldoLED 1% ECOdrive DALI (Logarithmic)	eldoLED 0.1% SOLOdrive 0-10V (Linear)	eldoLED 0.1% SOLOdrive 0-10V (Logarithmic)	Lutron 1% 2-Wire	Lutron 1% EcoSystem	Lutron 5% 5-Series (consult factory)	Lutron 1% 3-Wire (consult factory)

[9] See page 7 for full details
[10] Not available for 1' length
[11] 120V only

Fixture Options

DL	FS	SS[12]	CCEA
Damp Location Rated	In-line Fuse	Separate Switching	CCEA approved

[12] See page 10 for details

Sensor Options

xE[13,14]	xS1[13,14]	xS2[13,14]	xS3[13,14]	xSN	xV
Enlighted	Sensor Switch Daylight	Sensor Switch Occ/Vac/ Daylight	Sensor Switch Occ/Vac/ Daylight	nLight Enabled (consult factory)	Lutron Vive (consult factory)

Replace "x" with quantity

[13] Minimum fixture length 2'. See page 10 for full details and restrictions
[14] Requires DIM driver (0-10V)

Emergency Options

EC[15,16]	EMR	EM[15,16,17]
Emergency Circuit Wiring	Remote Micro Inverter (consult factory)	Integral EM Battery Pack (Non-IC rated)

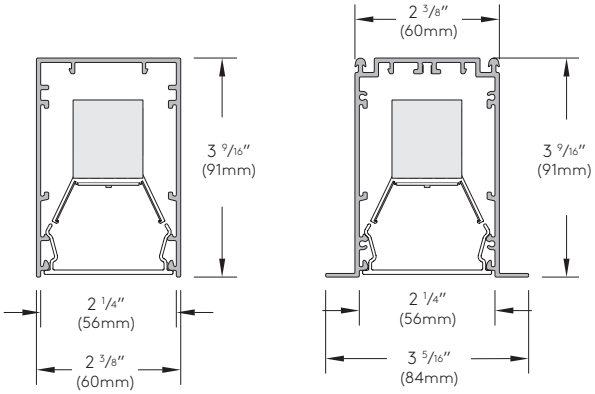
[15] See page 8 for full details and restrictions
[16] For EM with sensors please consult factory
[17] 4' available with DIM driver only. ≥6' available with all driver options.

Configuration Options

L9[1]	V9	T9	X9
Lit Horizontal 90° Corner	Lit Inverted 90° Corner	Lit "T" section	Lit "X" section

*See pages 12-13 for full details and restrictions

All options indicated with the green truck symbol are available with 4-week ship time. Mixed orders will defer to the longest lead time.



LW lens shown for reference

Construction:

Housing - Continuous, low copper 6063-T6 extruded aluminum profile with aluminum endcaps, available as Individual fixtures (up to 8') or Runs.

Flange (L6R1 or L6R2 Series)- 9/16" (14mm) wide flange runs full lengths of both sides and is part of the main extruded body. Specify continuous flange (L6R1) or flush (L6R2) end cap. L6R2 does not work in T-Bar ceiling.

Geartray - Low copper 6063-T6 extruded aluminum profile.

Shielding - Extruded, impact resistant acrylic snap in lens:
- LED Optimized White Lens (LW)
- Clear Lens with Microprism (MI)

"LMO" refers to the Selux proprietary LED optical system - Light modulation optics. These lenses are offered in M60 behind a Satine Lens for even illumination and comfortable lit appearance.
- "LMO" Symmetric Lens (NB)
- "LMO" Asymmetric 20° Wall Washer (A2)
- "LMO" Asymmetric 5° Wall Grazer (A5)
- "LMO" Batwing (BW)

Mounting(s) - Spackle-in (drywall), Slot grid, Decoustic, T-bar grid, Perimeter, Rotating Crossbar and Threaded Stud Mountings (see pages 3 through 6 for details).

Standard Luminaire lengths - All standard luminaires are supplied in nominal lengths to ensure full, even, illumination. Runs and Configurations are available in approximately 1/4" increments starting at the nominal 8' fixture length.
**Individual luminaires are not joinable in the field.

Exact length luminaires - Individual luminaires, Runs, and Configurations are available in exact lengths to meet your project needs. Please consult factory with you requirements.
**Lens luminance may soften at the very ends of the straight sections for exact length luminaires.

L60 Joiner(s) - Runs and Configurations are supplied in multiple housings that are joined together in the field using the supplied L60 Joiner System. This allows ease of installation and ensures a uniform appearance (see page 10 for detail).

Weight: 2.4 lb. per foot.

Electrical/Performance:

LED Light Engine - Brand-name mid-power LEDs create a high efficiency LED light engine able to provide a lumen maintenance of 95% at 25,000 hours and 90% at 60,000 hours at 25°C per TM-21 reports. Reported L70 greater than 60,000 hours.

Photometrics - Consult website or factory for IES Files. Independent photometric lumen measurement complies with IES LM-79-08 testing procedures. Due to the LED manufacturer's tolerances, the listed output has a ±5% tolerance. For outputs based on different optics or CCT, please see page 14 for details.

CCT - Available in 2700K, 3000K, 3500K and 4000K, tolerance within a 3-step MacAdam ellipse.

CRI - 90+ and 80+ CRI. Consult factory for lead times of 80 CRI.

All Drivers - High efficiency, constant current, soft start, Electronic Class 2 with a PFC>0.90. For more detailed information on the available drivers please see page 7.

Sensors - Selux offers a variety of integral sensor options. For details and specifications, please refer to page 11.

Emergency - There are multiple emergency options available - Emergency Circuit, Remote Micro Inverter, and Integral EM Battery Pack. All options compliant with UL 924 listed emergency luminaire. Please consult factory for use of sensors with emergency options. For more details on EC and EM options, see page 10.

Thermal Performance:

Ambient Operating Temperature - Luminaires suitable for maximum ambient temperature of 35°C (95°F) for all drivers.

Luminaires are suitable for minimum ambient temperatures of -40°C (-40°F) for DIM, DIL, DED, D01, and DL01 drivers; 0°C (32°F) for DC2 and DE1 drivers.

Luminaire Finish:

Powder Coat - All Selux luminaries are finished in high quality polyester powder coating in our Tiger Drylac certified facility and are tested in accordance with test specifications for coatings from ASTM and PCI.

All products undergo a five stage intensive pretreatment process where product is thoroughly cleaned, phosphated, and sealed. Selux powder coated products provide excellent salt and humidity resistance as well as ultra violet resistance for color retention.

Standard interior colors are White (WH), Semi-Matte Black (BL), and Silver (SV). Selux premium colors (SP) are available, please specify from your Selux color selection guide.

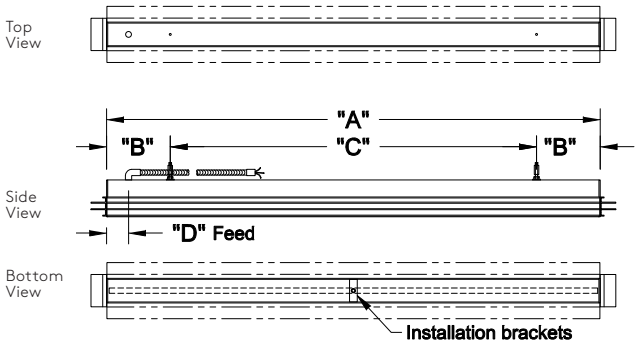
Warranty:

5 Year Limited LED Luminaire Warranty - Selux offers a 5 Year Limited Warranty to the original purchaser that the M60 series LED luminaire shall be free from defects in material and workmanship for up to five (5) years from date of shipment. This limited warranty covers the LED driver and LED light engine when installed according to Selux instructions and operated within the Ambient Temperature. For additional details and exclusions, see "Selux Terms and Condition of Sale."

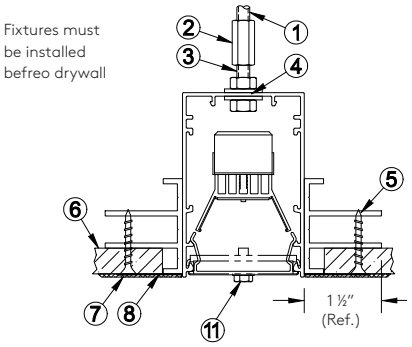
Certifications and Compliance:

NRTL - For Dry and Damp location
(I.E. cULus; cCSAus)
ARRA Compliant
RoHS Compliant
*EM option is non IC-rated

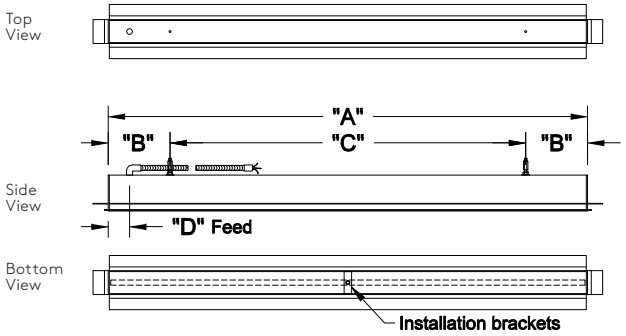
½" Spackle Flange Mounting (SF1)



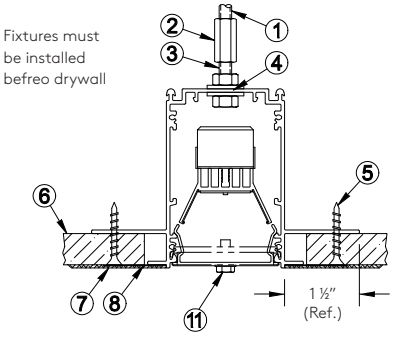
½" Spackle Flange Mounting (SF1)



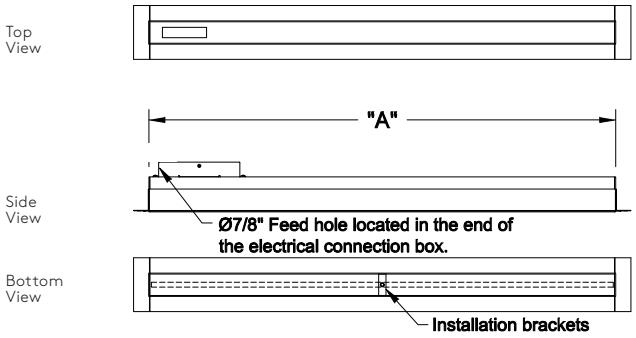
⅝" Spackle Flange Mounting (SF2)



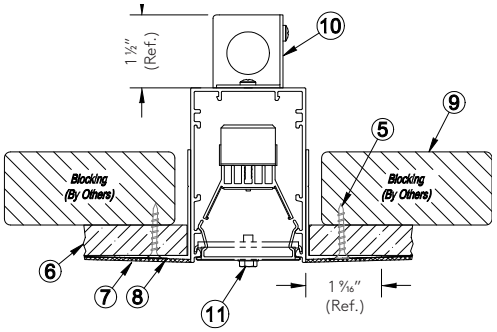
⅝" Spackle Flange Mounting (SF2)



After Drywall Flange Mounting (SF3)



After Drywall Flange Mounting (SF3)

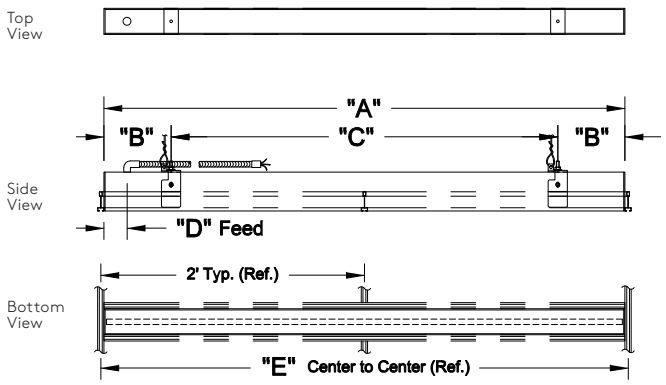


Spackle Flange Mounting (SF1, SF2 and SF3) - Dimensions								
Nominal Length	**"A" O.A.L. w/o Flange**		**"B" End Suspensions**		*** "C" (Ref.) Mid. Suspension**		**"D" Feed Location**	
	Feet/Inch	**MM**	**Feet/Inch**	**MM**	**Feet/Inch**	**MM**	**Feet/Inch**	**MM**
01 (1 ft.)	1' - ¼''	311	0' - 1 ⅝''	41	0' - 9''	229	0' - 4 ⅛''	105
02 (2 ft.)	2' - ¼''	616	0' -1 ⅝''	41	1' - 9''	533	0' - 4 ⅛''	105
03 (3 ft.)	3' - ¼''	921	0' -6 ⅛''	156	2' - 0''	609	0' - 2 ⅛''	54
04 (4 ft.)	4' - ¼''	1226	0' -6 ⅛''	156	3' - 0''	914	0' - 2 ⅛''	54
05 (5 ft.)	5' - ¼''	1530	0' -6 ⅛''	156	4' - 0''	1219	0' - 2 ⅛''	54
06 (6 ft.)	6' - ¼''	1835	0' -6 ⅛''	156	5' - 0''	1524	0' - 2 ⅛''	54
07 (7 ft.)	7' - ¼''	2140	0' -6 ⅛''	156	6' - 0''	1829	0' - 2 ⅛''	54
08 (8 ft.)	8' - ¼''	2445	0' -6 ⅛''	156	7' - 0''	2134	0' - 2 ⅛''	54

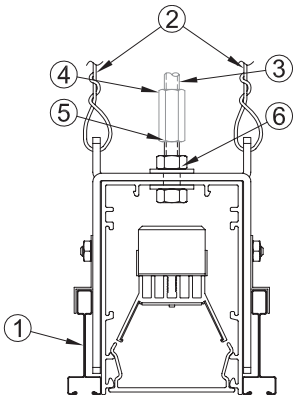
*Dimension(s) rounded to the nearest 1⁄16" with a ± 1⁄16" (1mm) tolerance.

1. ¼"-20 Threaded rod to struture (supplied and installed by others).
2. ¼"-20 Coupler hardware (supplied and installed by others).
3. 1" ¼"-20 Stud (by Selux).
4. Ø5⁄16" (Ø7mm) mounting hole.
5. Drywall/Drywall screw (Ref.)
6. Drywall/Drywall (Ref.)
7. ⅛" Plaster skimcoat (Ref.)
8. Drywall/Drywall tape (Ref.)
9. Blocking to secure fixture (by others)
10. Electrical connection box, removable side cover for electrical connection pre-installation, once installed the wiring is accessible from below the ceiling through the luminaire.
11. Luminaires ship with the brackets pre-installed.
    - The brackets cannot be removed until the fixture is completely installed and secured through the spackle flange.
    - Once the brackets are removed, the lens can be installed.

Slot Grid Mounting (SG)



9⁄16" Slot Grid Mounting (SG)
(Wire Suspension or ¼"-20 Stud)

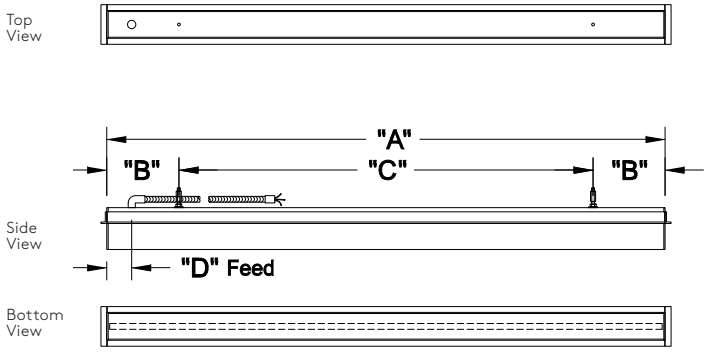


1. 9⁄16" Slot grid (shown as Ref.)
2. Support wire to structure (supplied and installed by others).
3. ¼"-20 Threaded rod to structure (supplied and installed by others).
4. ¼"-20 Coupler hardware (supplied and installed by others).
5. 1" ¼"-20 Stud (by Selux).
6. Ø5⁄16" (Ø7mm) mounting hole.

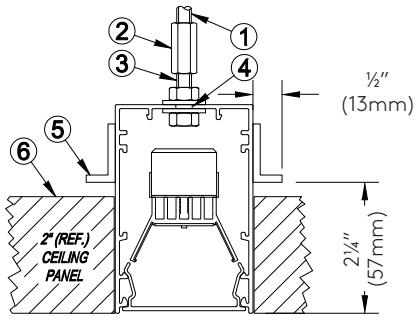
Slot Grid Mounting (SG) - Dimensions									
Nominal Length	**"A" Housing Length**		**"B" End Suspensions**		*** "C" (Ref.) Mid. Suspension**		**"D" Feed Location**		**"E" Grid Spacing**
	Feet/Inch	**MM**	**Feet/Inch**	**MM**	**Feet/Inch**	**MM**	**Feet/Inch**	**MM**	
02 (2 ft.)	1' - 11 5⁄16"	592	0' -1 5⁄8"	41	1' - 5 3⁄16"	437	0' - 1 1⁄8"	29	2' Center to Center
04 (4 ft.)	3' - 11 5⁄16"	1202	0' - 6 1⁄8"	156	2' - 11 3⁄16"	894	0' - 2 1⁄8"	54	4' Center to Center
05 (5 ft.)	4' - 11 5⁄16"	1507	0' - 6 1⁄8"	156	3' - 11 3⁄16"	1199	0' - 2 1⁄8"	54	5' Center to Center
06 (6 ft.)	5' - 11 5⁄16"	1811	0' - 6 1⁄8"	156	5' - 11 3⁄16"	1504	0' - 2 1⁄8"	54	6' Center to Center
08 (8 ft.)	7' - 11 5⁄16"	2421	0' - 6 1⁄8"	156	6' - 11 3⁄16"	2113	0' - 2 1⁄8"	54	8' Center to Center

*Dimension(s) rounded to the nearest 1⁄16" with a ± 1⁄16" (1mm) tolerance.

Decoustic Mounting (DC)



Decoustic Mounting (DC)
(Panels up to 2" thick)

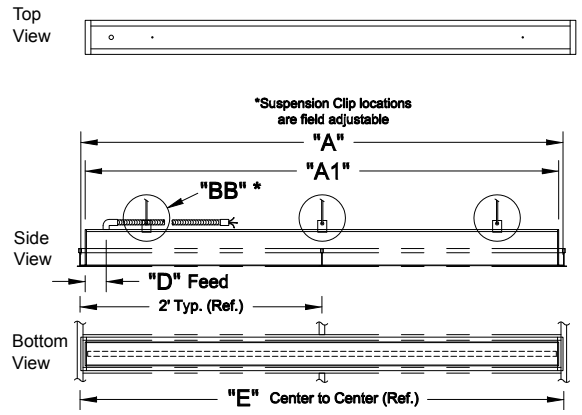


Decoustic Mounting (DC) - Dimensions								
Nominal Length	**"A" Housing Length**		**"B" End Suspensions**		*** "C" (Ref.) Mid. Suspension**		**"D" Feed Location**	
	Feet/Inch	**MM**	**Feet/Inch**	**MM**	**Feet/Inch**	**MM**	**Feet/Inch**	**MM**
01 (1 ft.)	1' - ¼"	311	1 5⁄8"	41	0' - 9"	229	0' - 4 1⁄8"	105
02 (2 ft.)	2' - ¼"	616	1 5⁄8"	41	1' - 9"	533	0' - 4 1⁄8"	105
03 (3 ft.)	3' - ¼"	921	6 1⁄8"	156	2' - 0"	609	0' - 2 1⁄8"	54
04 (4 ft.)	4' - ¼"	1226	6 1⁄8"	156	3' - 0"	914	0' - 2 1⁄8"	54
05 (5 ft.)	5' - ¼"	1530	6 1⁄8"	156	4' - 0"	1219	0' - 2 1⁄8"	54
06 (6 ft.)	6' - ¼"	1835	6 1⁄8"	156	5' - 0"	1524	0' - 2 1⁄8"	54
07 (7 ft.)	7' - ¼"	2140	6 1⁄8"	156	6' - 0"	1829	0' - 2 1⁄8"	54
08 (8 ft.)	8' - ¼"	2445	6 1⁄8"	156	7' - 0"	2134	0' - 2 1⁄8"	54

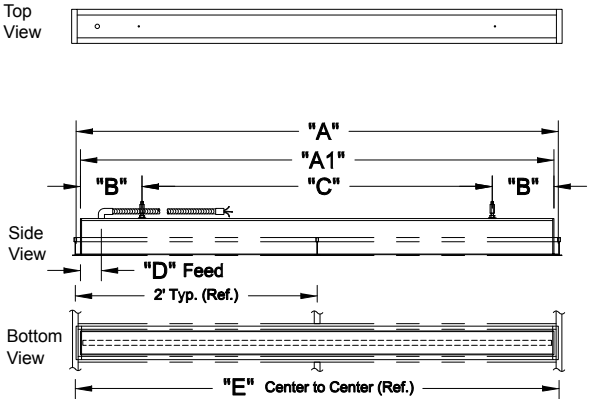
*Dimension(s) rounded to the nearest 1⁄16" with a ± 1⁄16" (1mm) tolerance.

1. ¼"-20 Threaded rod to structure (supplied and installed by others).
2. ¼"-20 Coupler hardware (supplied and installed by others).
3. 1" ¼"-20 Stud (by Selux).
4. Ø5⁄16" (Ø7mm) mounting hole.
5. ½" wide aluminum angle runs the entire length of fixture to block view into plenum area from below fixture.
6. Suitable for Decoustic® ceiling panel installations with panels up to 2" thick (supplied and installed by others). Other ceiling systems possible, please consult factory. Decoustic® is a registered trademark of Decoustics Ltd. Corporation.

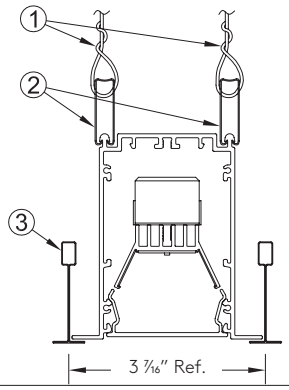
T-Bar Mounting (TB)



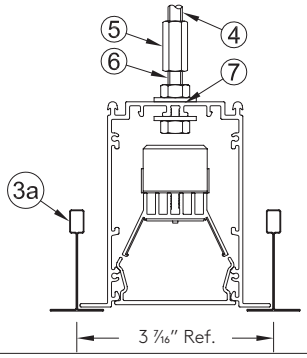
T-Bar with Stud Mounting (TBS)



T-Bar with Suspension Clips (TB)
(9⁄16" or 15⁄16" grid)



T-Bar with ¼"-20 Stud (TBS)
(9⁄16" or 15⁄16" grid)



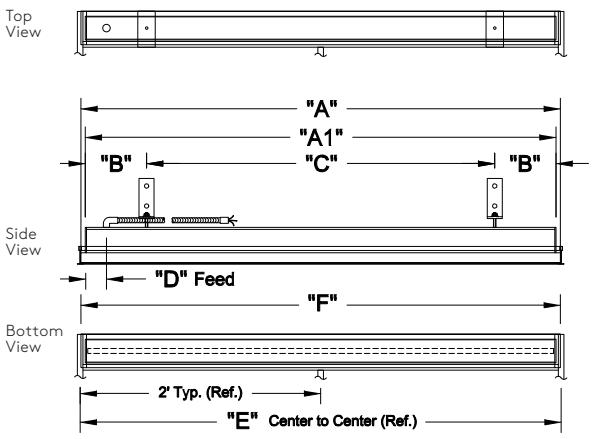
1. Support wire to structure (supplied and installed by others).
2. Spring steel suspension clips located approximately every 4 ft. (supplied by Selux).
3. 9⁄16" T-bar grid (shown as Ref.)
3a. 15⁄16" T-bar grid (shown as Ref.)
4. ¼"-20 Threaded rod to structure (supplied and installed by others).
5. ¼"-20 Coupler hardware (supplied and installed by others).
6. 1" ¼"-20 Stud (by Selux).
7. Ø5⁄16" (Ø7mm) mounting hole.

T-Bar (TB and TBS) and Perimeter Mount (PMT) - Dimensions														
Nominal Length	**"A" O.A.L. with Flange**		**"A1" O.A.L. without Flange**		**"B" End Suspensions**		**"BB" (TB mtg.) Suspension Clips**	**** "C" (Ref.) Mid. Suspension**		**"D" Feed Location**		**"E" Grid Spacing**	**"F" Wall Angle**	
	Feet/Inch	**MM**	**Feet/Inch**	**MM**	**Feet/Inch**	**MM**	**Quantity**	**Feet/Inch**	**MM**	**Feet/Inch**	**MM**		**Feet/Inch**	**MM**
***02 (2 ft.)**	1' - 11 13⁄16"	605	1' - 11"	583	0' - 1 5⁄8"	41	4x	1' - 4 3⁄4"	425	0' - 1 1⁄8"	29	2' Center to Center	1' - 10 3⁄4"	577
***04 (4 ft.)**	3' - 11 13⁄16"	1215	3' - 11"	1193	0' - 6 5⁄8"	156	6x	2' - 10 3⁄4"	882	0' - 2 1⁄8"	54	4' Center to Center	3' - 10 3⁄4"	1187
***05 (5 ft.)**	4' - 11 13⁄16"	1519	4' - 11"	1497	0' - 6 5⁄8"	156	6x	3' - 10 3⁄4"	1187	0' - 2 1⁄8"	54	5' Center to Center	4' - 10 3⁄4"	1491
***06 (6 ft.)**	5' - 11 13⁄16"	1825	5' - 11"	1803	0' - 6 5⁄8"	156	6x	4' - 10 3⁄4"	1492	0' - 2 1⁄8"	54	6' Center to Center	5' - 10 3⁄4"	1787
***08 (8 ft.)**	7' - 11 13⁄16"	2434	7' - 11"	2412	0' - 6 5⁄8"	156	8x	6' - 10 3⁄4"	2101	0' - 2 1⁄8"	54	8' Center to Center	7' - 10 3⁄4"	2406

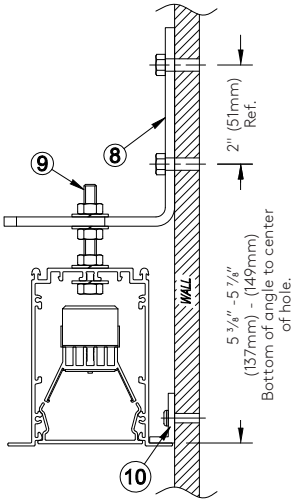
*For other lengths consult factory

**Dimension(s) rounded to the nearest 1⁄16" with a ± 1⁄16" (1mm) tolerance.

Perimeter Mounting T-Bar Length (PMT)

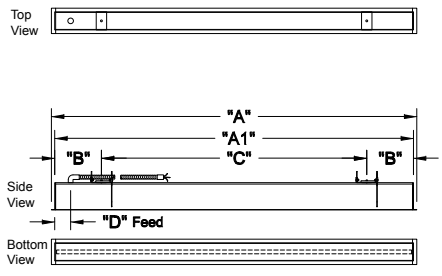


Perimeter Mount T-Bar Length (PMT)
(Recessed Wall Mounting)

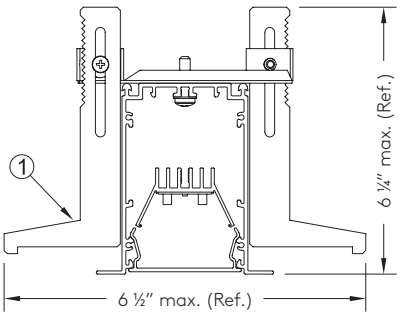


8. Steel Wall Bracket with provision for ¼"-20 fasteners (hardware to code by others).
9. 2" ¼"-20 Stud (by Selux).
10. ½" x 1" aluminum wall angle allows a gap between flange and wall to create shadow line allowing for uneveness of wall. Provision for #10 screws supplied approximately every 2 ft. (hardware to code by others).

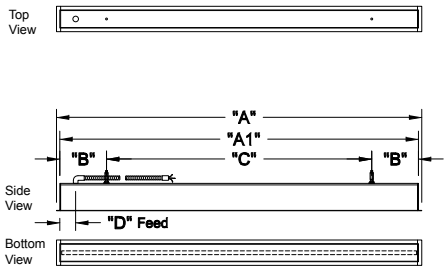
Rotating Crossbar Mounting (RC)



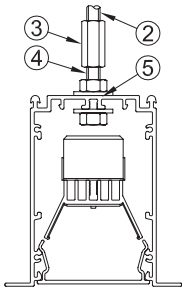
Rotating Crossbars (RC)
(¼" to 2" thick ceiling)



¼"-20 Threaded Stud Mounting (TS)



¼-20 Threaded Stud (TS)
(1" Threaded Stud)



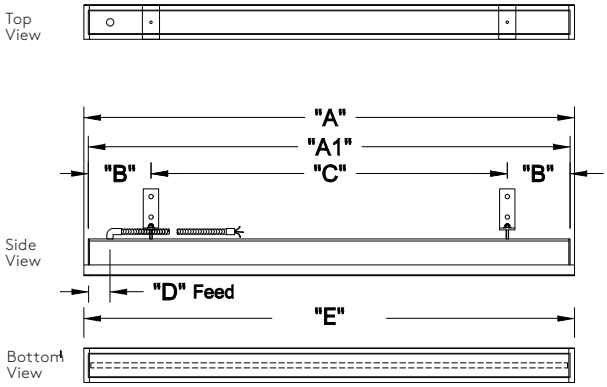
1. Rotating Crossbar intended for inaccessible ceilings, adjustable for ceiling thickness of ¼" to 2".
2. ¼"-20 Threaded rod to structure (supplied and installed by others).
3. ¼"-20 Coupler hardware (supplied and installed by others).
4. 1" ¼"-20 Stud (by Selux).
5. Ø5⁄16" (Ø7mm) mounting hole.

Rotating Crossbar (RC), Threaded Stud (TS), and Perimeter Mountings (PM) - Dimensions												
Nominal Length	"A" O.A.L. with Flange		"A1" O.A.L. without Flange		"B" End Suspensions		** "C" (Ref.) Mid. Suspension		"D" Feed Location		"E" Wall Angle	
	Feet/Inch	MM	Feet/Inch	MM	Feet/Inch	MM	Feet/Inch	MM	Feet/Inch	MM	Feet/Inch	MM
*01 (1 ft.)	1' - 1 1⁄8"	333	1' - ¼"	311	0' - 1 5⁄8"	41	0' - 9"	229	0' - 4 1⁄8"	105	1' - 0"	305
02 (2 ft.)	2' - 1 1⁄8"	638	2' - ¼"	616	0' - 1 5⁄8"	41	1' - 9"	533	0' - 4 1⁄8"	105	2' - 0"	610
03 (3 ft.)	3' - 1 1⁄8"	942	3' - ¼"	921	0' - 6 1⁄8"	156	2' - 0"	609	0' - 2 1⁄8"	54	3' - 0"	914
04 (4 ft.)	4' - 1 1⁄8"	1247	4' - ¼"	1226	0' - 6 1⁄8"	156	3' - 0"	914	0' - 2 1⁄8"	54	4' - 0"	1219
05 (5 ft.)	5' - 1 1⁄8"	1552	5' - ¼"	1530	0' - 6 1⁄8"	156	4' - 0"	1219	0' - 2 1⁄8"	54	5' - 0"	1524
06 (6 ft.)	6' - 1 1⁄8"	1857	6' - ¼"	1835	0' - 6 1⁄8"	156	5' - 0"	1524	0' - 2 1⁄8"	54	6' - 0"	1829
07 (7 ft.)	7' - 1 1⁄8"	2162	7' - ¼"	2140	0' - 6 1⁄8"	156	6' - 0"	1829	0' - 2 1⁄8"	54	7' - 0"	2134
08 (8 ft.)	8' - 1 1⁄8"	2466	8' - ¼"	2445	0' - 6 1⁄8"	156	7' - 0"	2134	0' - 2 1⁄8"	54	8' - 0"	2438

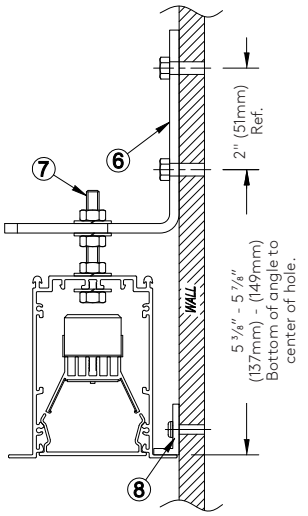
*RC mounting, consult factory for lengths under 2'

**Dimension(s) rounded to the nearest 1⁄16" with a ± 1⁄16" (1mm) tolerance.

Perimeter Mounting (PM)



Perimeter Mount (PM)
(Recessed Wall Mounting)



6. Steel Wall Bracket with provision for ¼"-20 fasteners (hardware to code by others).
7. 2" ¼"-20 Stud (by Selux).
8. ½" x 1" aluminum wall angle allows a gap between flange and wall to create shadow line allowing for uneveness of wall. Provision for #10 screws supplied approximately every 2 feet (hardware to code by others).

Drivers:

0-10V linear dimming (DIM)
Luminaires supplied with drivers offering the capability of either normal switched operation of 0-10V dimming for linear dimming curve. Fixtures ship wired for dimming. For on/off functionality, simply cap the dimming leads. Minimum dimming level preset at factory to 1%. (Due to size constraints, 1' luminaires are supplied with a driver from a different manufacturer than 2' and above luminaires. For details, please consult factory).

0-10V logarithmic eldoLED ECOdrive dimming (DIL)
Luminaires supplied with drivers offering the capability of either normal switched operation of 0-10V dimming for logarithmic dimming curve, Fixtures shipped wired for dimming. For on/off functionality, simply cap the dimming leades. Minimum dimming level preset at factory to 1%.

eldoLED ECOdrive DALI dimming (DED)
Luminaires supplied with ECOdrive DALI dimming driver with logarithmic dimming curve. Minimum dimming level preset at factory to 1%. For "dim to dark" (down to 0.1%), please consult factory.

eldoLED SOLOdrive 0-10V linear dimming (D01)
Luminaires supplied with SOLOdrive 0-10V dimming driver with linear dimming curve. Minimum dimming level preset at factory to 0.1% and "dim to dark".

eldoLED SOLOdrive 0-10V logarithmic dimming (DL01)
Luminaires supplied with SOLOdrive 0-10V dimming driver with logarithmic dimming curve. Minimum dimming level preset at factory to 0.1% and "dim to dark".

LUTRON 2-wire dimming (DC2)
Luminaires supplied with Hi-Lume 2-wire dimming driver (120V only) programmed for Constant Current Reduction (CCR). For Pulse Width Modulation (PWM) dimming, please consult factory. Minimum dimming level down to 1%.

LUTRON EcoSystem dimming (DE1/DC5)
Luminaires supplied with Hi-Lume EcoSystem (4 wire, digital link) dimming driver programmed for Constant Current Reduction (CCR). Minimum dimming level down to 1% (DE1) with SoftOn/FadeToBlack or 5% (DC5).

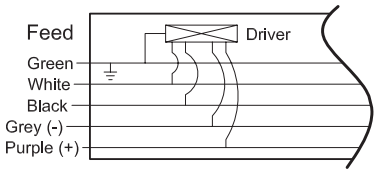
*For control recommendations, please contact driver manufacturer.

<table>
<tr><td colspan="16">Driver Quantity</td></tr>
<tr><td rowspan="2">Light Engine</td><td rowspan="2">Dimming Code</td><td colspan="14">Length</td></tr>
<tr><td>1ft</td><td>2ft</td><td>2ft SG/TB</td><td>3ft</td><td>4ft</td><td>4ft SG/TB</td><td>5ft</td><td>5ft SG/TB</td><td>6ft</td><td>6ft SG/TB</td><td>7ft</td><td>8ft</td><td>8ft SG/TB</td><td>9ft</td><td>10ft</td><td>11ft</td><td>12ft</td></tr>
<tr><td rowspan="4">1C20</td><td>DIM/DIL</td><td rowspan="13">N/A</td><td colspan="7" rowspan="4">1</td><td rowspan="4">2</td><td rowspan="4">1</td><td rowspan="4">2</td><td rowspan="4">1</td><td colspan="2" rowspan="4">2</td><td rowspan="4">2</td><td rowspan="4">1</td></tr>
<tr><td>D01/DL01/DED</td></tr>
<tr><td>DE1/DC5</td></tr>
<tr><td>DC2</td><td colspan="2">3</td><td>2</td></tr>
<tr><td rowspan="4">1C25</td><td>DIM/DIL</td><td colspan="7" rowspan="4">1</td><td rowspan="4">2</td><td rowspan="4">1</td><td rowspan="4">2</td><td rowspan="3">1</td><td colspan="2" rowspan="3">2</td><td rowspan="3">1</td></tr>
<tr><td>D01/DL01/DED</td></tr>
<tr><td>DE1/DC5</td></tr>
<tr><td>DC2</td><td colspan="2">2</td><td colspan="2">3</td><td>2</td></tr>
<tr><td rowspan="4">1C30</td><td>DIM/DIL</td><td colspan="7" rowspan="4">1</td><td rowspan="4">2</td><td rowspan="3">1</td><td rowspan="4">2</td><td rowspan="4">1</td><td rowspan="4">2</td><td colspan="2" rowspan="3">2</td><td rowspan="3">2</td></tr>
<tr><td>D01/DL01/DED</td></tr>
<tr><td>DE1/DC5</td></tr>
<tr><td>DC2</td><td>2</td><td colspan="2">2</td><td colspan="2">3</td><td>3</td></tr>
<tr><td rowspan="4">1C35</td><td>DIM/DIL</td><td>1</td><td colspan="7" rowspan="4">1</td><td rowspan="4">2</td><td rowspan="3">1</td><td rowspan="4">2</td><td rowspan="3">2</td><td rowspan="3">1</td><td rowspan="4">2</td><td colspan="2" rowspan="3">2</td><td rowspan="3">2</td></tr>
<tr><td>D01/DL01/DED</td><td rowspan="12">N/A</td></tr>
<tr><td>DE1/DC5</td></tr>
<tr><td>DC2</td><td>2</td><td>2</td><td colspan="2">3</td><td>3</td></tr>
<tr><td rowspan="4">1C40</td><td>DIM/DIL</td><td colspan="7" rowspan="3">1</td><td rowspan="3">2</td><td rowspan="3">1</td><td rowspan="3">2</td><td rowspan="2">2</td><td colspan="4" rowspan="3">2</td><td colspan="2" rowspan="3">3</td></tr>
<tr><td>D01/DL01/DED</td><td rowspan="2">1</td></tr>
<tr><td>DE1/DC5</td><td colspan="14">N/A</td></tr>
<tr><td>DC2</td></tr>
<tr><td rowspan="4">1C45</td><td>DIM/DIL</td><td colspan="6" rowspan="3">1</td><td>2</td><td rowspan="3">2</td><td rowspan="3">1</td><td colspan="2" rowspan="3">2</td><td colspan="2" rowspan="3">2</td><td>3</td><td rowspan="3">2</td><td colspan="2" rowspan="3">3</td></tr>
<tr><td>D01/DL01/DED</td><td>1</td><td>2</td></tr>
<tr><td>DE1/DC5</td><td colspan="14">N/A</td></tr>
<tr><td>DC2</td></tr>
</table>

*For inrush and control current, please refer to the driver manufacturers' spec sheets.

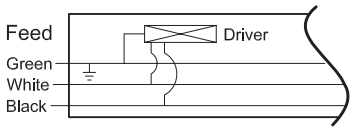
Wiring Diagrams

0-10V linear (DIM)
0-10V logarithmic eldoLED Ecodrive (DIL)
DALI logarithmic eldoLED ECOdrive (DED)
0-10V linear eldoLED SOLOdrive (D01)
0-10V logarithmic eldoLED SOLOdrive (DL01)

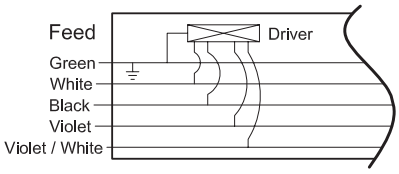


Standard Wiring supplied for all drivers.	Green = Ground White = Neutral Black = Hot
- The following wire(s) are in addition to the standard above -	
DIM, DIL, DED D01, DL01	Gray = (-) DALI or 0-10V Dimming Control Purple = (+) DALI or 0-10V Dimming Control
DC2	No additional wires
DE1, DC5	Violet = "E1" Digital Link Dimming Control Violet/White = "E2" Digital Link Dimming Control

Lutron 2-Wire (DC2)

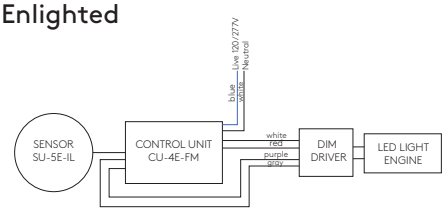


Lutron EcoSystem (DE1)
Lutron 5-Series (DC5)

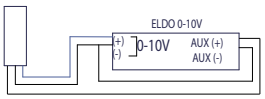


Sensor Wiring Diagrams

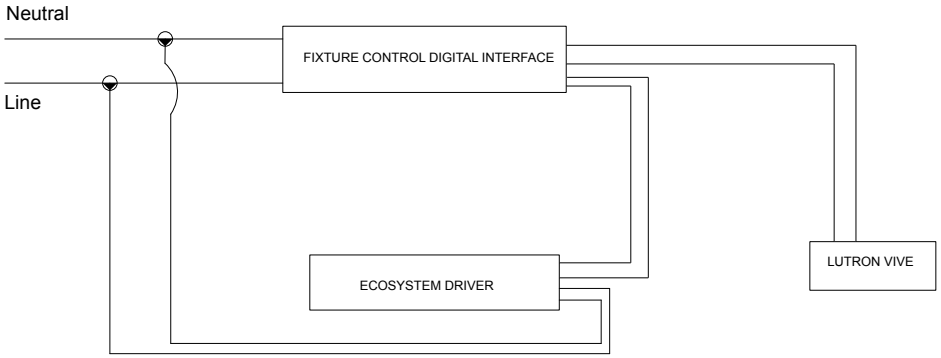
Enlighted



Sensor Switch



Lutron Vive



Driver power chart - use below values to determine the nominal watts per foot based on driver, light engine, and voltage.
* Driver losses increase the wattage for fixtures less than 4 foot.
** Values are nominal values determined based on multiple tested fixtures.

Driver Power Usage				
Driver	**Light Engine**	**Nominal W/ft**		
		120V	**277V**	**347V**
DIM, DIL, DED, D01, DL01	1C20	4.9	5.3	n/a
	1C25	6.1	6.5	
	1C30	7.3	7.7	
	1C35	8.7	8.9	
	1C40	9.9	10.1	
	1C45	11.1	11.3	
DC2, DE1, DCE, DC5, DC3	1C20	5.5	5.2	n/a
	1C25	6.7	6.3	
	1C30	8.0	7.6	
	1C35	9.3	8.8	
	1C40	10.6	10.0	
	1C45	11.6	11.3	
DIM @347V	1C20	n/a	n/a	5.4
	1C25			6.5
	1C30			7.7
	1C35			8.8
	1C40			10.0
	1C45			11.2
EM	all	6		n/a

Fuse (FS) - Fusing, luminaires supplied with a in-line fuse located on the hot wire for each feed. (supplied with an 8A slow burn fuse).

Damp Location (DL) - Luminaires are suitable for use in damp location(s). Examples of such locations include protected areas under canopies, marquees, roofed porches, and similar locations where the fixture(s) are protected from direct contact with rain, snow, or excessive moisture (such as ocean spray). Interior locations include areas subject to moderate degrees of moisture, such as basements and certain barns and cold storage buildings.

*For Damp Location with sensors, please consult factory.

Separate Switching (SS) - Luminaires available with separately switched 4' (nominal) sections starting at 7' and up. Luminaire is intended to be wired to the same panel/breaker (not intended for Emergency use).

* All separately switched (non-EM) circuits within an individual luminaire, linear run, or configuration must be connected to the same branch circuit on-site.

* To specify this option, the number of separately switched sections and locations of these sections must be provided at time of order.

*If the project requires different separate switching than outlined above please consult the factory.

*For Separate Switching with sensors, please consult factory.

Emergency Wiring (EC) - Luminaires with (EC) option are compliant to UL 924 listed emergency luminaire. EC luminaires are intended to be wired to separate panels/breakers for emergency use. See install instructions for proper wiring.

For 1' to 6' nominal luminaires, the entire fixture is wired for operation on emergency circuit.

For 7' and up nominal luminaires, the first 4' nominal length is wired for operation by a separate EM circuit by default to meet the required "Life Safety Code" (NFPA 101).

If a different configuration is needed, please consult factory.

Note: Wiring may vary slightly due to on-site conditions or local codes. Please follow all safety installation protocols contained within install instructions when installing luminaire.

Emergency Battery (EM) – Luminaires with emergency battery (EM) option are compliant to UL 924 listed emergency luminaire. The EM battery is located integral to fixture and is factory pre-wired. See install instructions for proper wiring.

In the event of an emergency, EM battery will illuminate a 4' section at 12W (constant) for 90 minutes at 25°C. Recharge time is 24 hours.

Direct fixtures are available for emergency battery (EM) use in 4' and ≥6. Due to size constraints, EM is not available in 5' fixtures.

For individual fixtures, emergency option will illuminate the first 4' section of fixture. For continuous runs, please consult factory to advise on 4' section intended for emergency use. For fixtures >12' or if a different configuration is needed, please consult factory.

Emergency test switch and plate is a non-illuminated 3" blank section located adjacent to the length of fixture wired for emergency.

*Emergency battery option is UNV for use with 120V or 277V and is not available for 347V.

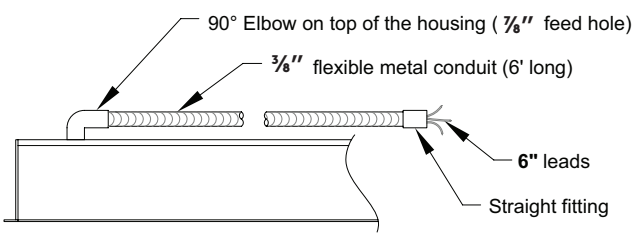
*Please note battery pack requires an unswitched hot.

*For EM with sensors, please consult factory.

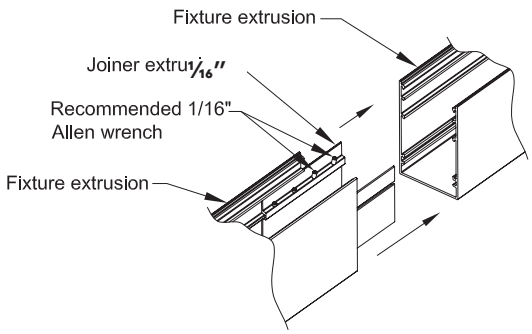
*If a different configuration is needed, please consult factory.

Note: Wiring may vary slightly due to on-site conditions or local codes. Please follow all safety installation protocols contained within install instructions when installing luminaire.

Flex Whip - standard for recessed fixtures



Joiner System - standard for Runs and Configurations



Sensor Ordering Chart		
Quantity	**Sensor**	**Settings***
x Number of Sensors	**E** Enlighted SU-5E-IL **S** Sensor Switch MSD EZ **V** Lutron Vive DFCSJ	**1** Daylight **2** Occupancy/Vacancy **3** Daylight/Occupancy/Vacancy * Settings not available with Enlighted

Enlighted SU-5E-IL (E)
Enlighted Micro Sensor SU-5E-IL (Independent Lighting) provided as standard with an Enlighted CU-4E-FM Fixture Mount Control Unit integral to fixture. If SU-5E-CL (Connected Lighting) or SU-5E-IoT (Internet of Things) is desired, please contact factory. Occupancy/vacancy, thermal, daylight sensing plus Tunable White, Room & Zone control, Internet of Things (IoT) data collection and reporting control. For full details, please see SU-5E-(IoT/CL/IL) spec sheet on the Enlighted website. Must be paired with a 0-10V driver with auxiliary (DIM driver selection). Commissioning by Enlighted.

*Sensor can control up to 5 drivers. Please refer to driver quantity chart on page 7. Multiple sensors may be required for longer lengths.

Sensor Switch MSD EZ (S)
Occupancy/vacancy and daylight harvesting. For full functionality and programming options, select settings option 3. If a different settings option is selected, other settings may be unavailable. For full details, please see MSD EZ spec sheets on the Sensor Switch website. Must be paired with DIM driver selection. Manual control of dimming not available with MSD EZ sensor.

*Sensor can control up to 30 drivers. Please refer to driver quantity chart on page 7. Multiple sensors may be required for longer lengths.

Lutron Vive DFCSJ (V)
The DFCSJ-OEM-OCC provides the capabilities of daylight harvesting and occupancy/vacancy sensing. When integrated with the DFC-OEM-DBI (Fixture Contril Digital Link Interface), the sensor is wirelessly compatible with the DE1 Lutron EcoSystem driver. Commissioning bt certified Lutron technician.

*Vive DFCSJ sensor can control up to a maximum of five (5) drivers per sensor. Please refer to driver chart on page 7. Multiple sensors may be required for longer lengths.

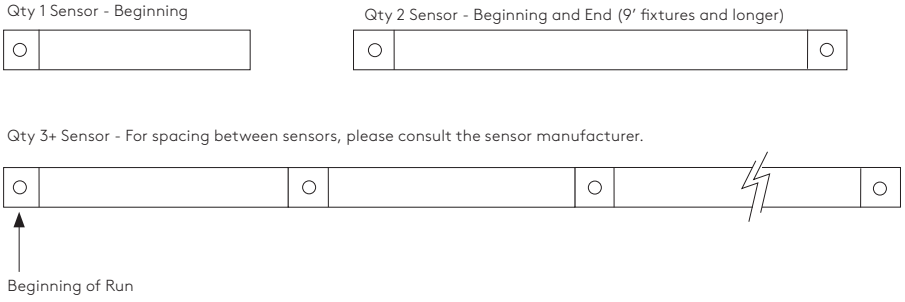
	Occupancy	**Vacancy**	**Daylight Harvesting**	**Driver Compatibility**
Enlighted SU-5E-IL (E)	√	√	√	DIM
Sensor Switch MSD EZ (S)	√	√	√	DIM
Lutron Vive DFCSJ (V)	√	√	√	DE1

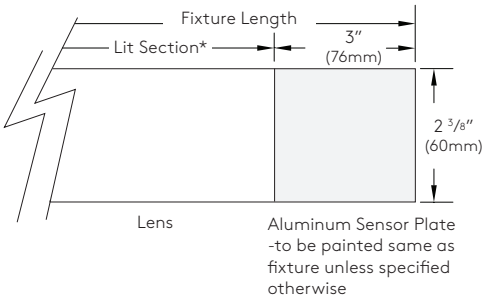
Please contact controls manufacturer for details prior to specifying.

Factory Presets - Sensors come from the sensor manufacturer with factory presets for each of the settings in above chart. Please see sensor manufacturers' spec sheets for details on presets and re-programming.

Commissioning - Commissioning of sensors and installation by others. Contact sensor manufacturer for details and costs associated with commissioning the system prior to specification of sensors.

Standard Sensor Placement - for other placement options, please consult factory. For functionality and limitations, please see sensor details above.





*Lit section will be the fixture length minus 3" for sensor plate.

Notes: 1. For spacing between sensors, please consult the sensor manufacturer.
2. Exact sensor placement and coverage will be defined by approved factory drawing.
3. Sections controlled by sensors may not be symmetrical - consult factory for layout.

Standard Recessed (L60) shapes/configurations:

Listed below are the minimum lengths and details for standard shapes. These standard shapes can be combined with each other and/or the standard luminaire lengths, ensuring full even illumination. If you have any questions, please consult the factory.

The minimum standard lengths for "L" shapes:
- L9 or V9 open shapes is 4' x 4' nominal (example: leg, 90, leg)
- L9 or V9 closed shapes is 6' x 6' nominal (example: 90, leg, 90)
(Exception is that the L9 and V9's can be joined directly to provide a 4' x 4' nominal shape)

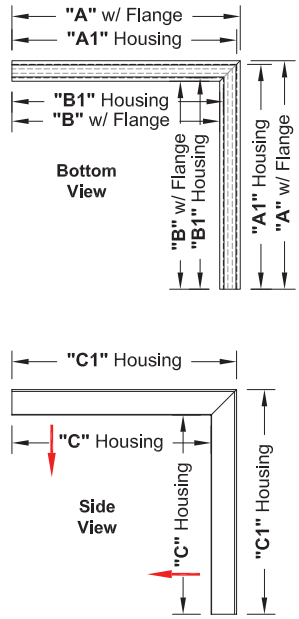
The minimum standard lengths for "T" and "X" shapes:
- T9 = 4' nominal on the short leg and 8' nominal on the long side
- X9 = 8' nominal for either direction

*For sensors in configurations, please consult factory.

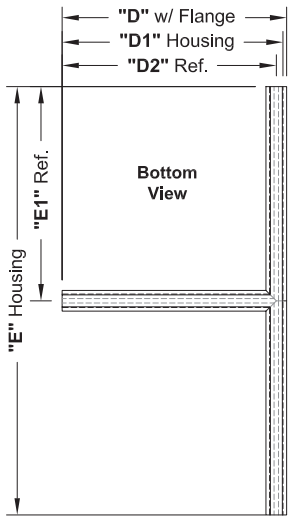
Project Specific Recessed (L60) shapes/configurations:

Selux is capable of supplying a wide range of project solutions including different shapes, angles, and sizes to meet the project requirements. Due to the complex nature of these project specific layout(s) we ask that you please consult the factory with the project requirements for review.

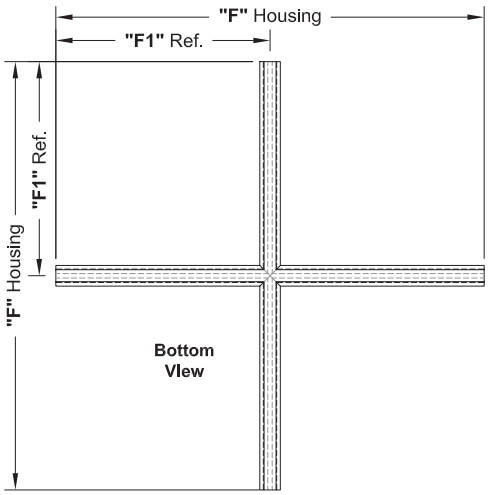
L9 - Lit Horizontal Corner



T9 - Lit "T" Section



X9 - Lit "X" Section



Recessed (L60) Lit Corner and Section - Dimensions								
	L9		V9		T9		X9	
	Feet/Inch	MM	Feet/Inch	MM	Feet/Inch	MM	Feet/Inch	MM
"A" Housing (Outside)	2' - 1 ¼"	642						
"A1" Housing (Inside)	1' - 10 15/16"	582						
"B" Housing (Outside)			1' - 11 ½"	597				
"B1" Housing (Inside)			2' - 3 1/16"	688				
"C" Housing (Inside)					2' - 1 ¼"	642		
* "C1" Ref.					2' - ⅛"	612		
"D" Housing					4' - 3/16"	1224		
* "D1" Ref.					2' - ⅛"	612		
"E" Housing							4' - 3/16"	1224
* "E1" Ref.							2' - ⅛"	612

*Dimension(s) rounded to the nearest 1/16" with a ± 1/16" (1mm) tolerance.

Standard Recessed (L6R1/2) shapes/configurations:

Listed below are the minimum lengths and details for standard shapes. These standard shapes can be combined with each other and/or the standard luminaire lengths, ensuring full even illumination. If you have any questions please consult the factory.

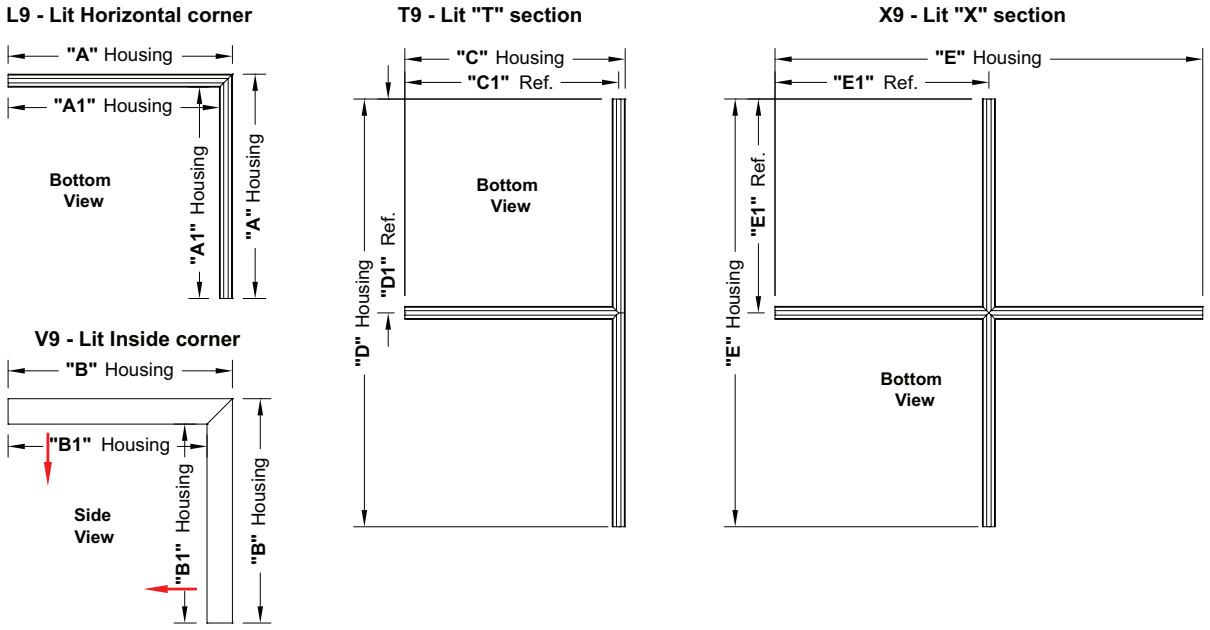
The minimum standard lengths for "L" shapes:
- L9 or V9 open shapes is 4' x 4' nominal (example, leg, 90, leg)
- L9 or V9 closed shapes is 6' x 6' nominal (example, 90, leg, 90)
(Exception is that the L9 and V9's can be joined directly to provide a 4' x 4' nominal shape)

*For sensors in configurations, please consult factory.

The minimum standard lengths for "T" and "X" shapes:
- T9 = 4' nominal on the short leg and 8' nominal on the long side
- X9 = 8' nominal for either direction

Project Specific Recessed (L6R1/2) shapes/configurations:

Selux is capable of supplying a wide range of project solutions including different shapes, angles, and sizes to meet the project requirements. Due to the complex nature of these project specific layout(s) we ask that you please consult the factory with the project requirements for review.



Recessed (L6R1/R2) Lit Corner and Section - Dimensions								
	L9		V9		T9		X9	
	Feet/Inch	MM	Feet/Inch	MM	Feet/Inch	MM	Feet/Inch	MM
"A" w/Flange (Outside)	2' - 1 3/4"	654						
"A1" Housing (Outside)	2' - 1 1/4"	642						
"B" w/Flange (Inside)	1' - 10 7/16"	570						
"B1" Housing (Inside)	1' - 10 15/16"	582						
"C" Housing (Inside)			2' - 3 1/16"	688				
"C1" Housing (Outside)			1' - 11 1/2"	597				
"D" w/Flange					2' - 1 3/4"	654		
"D1" Housing					2' - 1 1/4"	642		
* "D2" Ref.					2' - 1/8"	612		
"E" Housing					4' - 3/16"	1224		
* "E1" Ref.					2' - 1/8"	612		
"F" Housing							4' - 3/16"	1224
* "F1" Ref.							2' - 1/8"	612

*Dimension(s) rounded to the nearest 1/16" with a ± 1/16" (1mm) tolerance.

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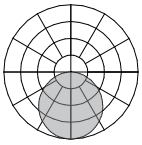
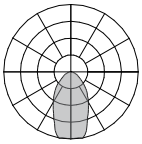
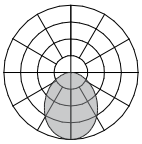
Photometry



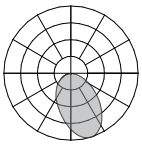
LW - LED Optimized White Lens				
Light Engine	Lumens per 4 foot	Lumens per foot	Input watts per foot	lm/W
1C35	2804	701	8.8	79



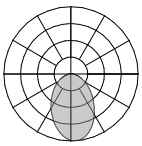
MI - Clear Lens with Microprism Inlay				
Light Engine	Lumens per 4 foot	Lumens per foot	Input watts per foot	lm/W
1C35	3251	813	8.8	92



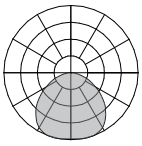
NB - LMO Symmetric				
Light Engine	Lumens per 4 foot	Lumens per foot	Input watts per foot	lm/W
1C35	3002	751	8.8	85



A2 - LMO Asymmetric 20° Wall Washer				
Light Engine	Lumens per 4 foot	Lumens per foot	Input watts per foot	lm/W
1C35	3032	758	8.8	86



A5 - LMO Asymmetric 5° Wall Grazer				
Light Engine	Lumens per 4 foot	Lumens per foot	Input watts per foot	lm/W
1C35	2807	702	8.8	79



BW - LMO Batwing				
Light Engine	Lumens per 4 foot	Lumens per foot	Input watts per foot	lm/W
1C35	3926	982	8.8	111

M60 Recessed	
CCT Multiplier	
4000K	1.05
3500K	1.00
3000K	0.96
2700K	0.92
CRI Multiplier	
90+ CRI	1.00
80+ CRI	1.19
Lens Multiplier	
LW	1.00
MI	1.02
NB	1.22
A2	1.26
A5	1.26
BW	1.00

CCT and CRI multipliers apply to the photometry, IES files, and per foot values listed on page 1 (light engine).

Lens multipliers supplied for per foot values listed on page 1 (light engine).

prescolite

DATE: LOCATION:

TYPE: PROJECT:

CATALOG #:

LTR-4RD

LITEISTRY 4" ROUND DOWNLIGHT

LITEISTRY

FEATURES

- 4" architectural LED downlight delivering 600 – 4000 lm
- Five beam distributions from 0.3 to 1.2 Spacing Criteria
- Quiet reflector appearance with superior 50° optical cutoff
- 2700K – 5000K, 80+ and 90+ CRI options
- Available for New Construction (non-IC), IC and Chicago Plenum applications
- Variety of dimming protocol options including 0–10V, DALI, DMX, Lutron Forward Phase and EcoSystem
- NX Distributed Intelligence™ wired and wireless controls capability available

WET LOCATION · C SA US · ENERGY STAR · BUY AMERICAN SOLUTIONS See Certification Specifications

RELATED PRODUCTS

- LTR-4RD-RFH Retrofit
- LTR-4RD SpectraSync
- LTR-4RDPH PowerHUBB
- 3" LITEISTRY Family
- 4" LITEISTRY Family
- 6" LITEISTRY Family

CONTROL TECHNOLOGY

NX DISTRIBUTED™ INTELLIGENCE

SPECIFICATIONS

CONSTRUCTION

- Standard Non-IC. Chicago Plenum and IC options
- Painted black durable steel platform with pre-installed bar hangers
- Pre-wired junction box with snap-on covers for easy access
- Snap-in connection from driver compartment allows easy installation
- Light Engine connections use plenum rated (CMP) cable

OPTICS

- Visually pleasing 50° cutoff to source and source image
- The light distribution is free of distracting bright spots or pixelation and the perimeter has a smooth transition
- Optical grade silicone lens integral to light engine
- High purity spun aluminum reflector, self-flanged
- Flush Mount flange option with mud-in ring available
- Large selection of anodized finishes and colors
- Painted cones and flange options available

ELECTRICAL

- Chip-on-board LED with 2 SDCM
- Multiple CCTs, 80+ or 90+ CRI
- Long LED life: L90 at >55,000 hours (TM-21)
- Universal voltage 120V–277V driver, 347V optional
- UL Class 2, inherent short circuit and overload protection, RoHS compliant
- Flicker free 0-10V dimming with 1% or <1% performance
- DALI, DMX, and Lutron Forward Phase and EcoSystem options
- Integral and remote emergency controller and battery pack options available
- NX or Lutron Vive control options available
- Refer to additional spec sheets for information on SpectraSync™ Tunable White or Dim-to-Warm or PowerHUBB™ PoE enabled solutions

INSTALLATION

- Accommodates ceiling thickness up to 2"
- Universal adjustable mounting brackets also accept 0.5" EMT conduit or 1.5" or 0.75" lathing channel (by others) or Prescolite accessory bar hangers (B24 or B6)
- Light Engine/Driver fully serviceable from above or below the ceiling

CERTIFICATIONS

- cCSAus certified to UL 1598
- Suitable for wet locations, covered ceiling. EM/ EMR: Suitable for damp locations.
- EM/EMR: Certified under UL 924 standard for emergency lighting and power equipment
- Approved for 8 (4 in/4 out) No. 12AWG conductors rated for 90°C through wiring
- ENERGY STAR® certified models available (See list and additional information on page 7)
- This product qualifies as a "designated country construction material" per FAR 52.225-11 Buy American-Construction. Materials under Trade Agreements effective 6/6/2020. See Buy American Solutions.

WARRANTY

- 5 year warranty
- See HLI Standard Warranty for additional information

KEY DATA	
Lumen Range	600-4000
Wattage Range	8-52
Efficacy Range (LPW)	90-99*
Reported Life (Hours)	L90 / >55,000
Input Current (mA)	65-433 (120V)

*Based on Specular, 35K, 80 CRI

HUBBELL Lighting

prescolite

LTR-4RD

LITEISTRY 4" ROUND DOWNLIGHT

DATE: LOCATION:

TYPE: PROJECT:

CATALOG #:

ORDERING GUIDE

Example: LTR–4RD–H–SL10L–DM1–LTR–4RD–T–SL35K8MD–S

CATALOG #

HOUSING

LTR-4RD-H –

Aperture/Shape/Function		Lumen Package		Lumen Output	
LTR-4RD-H	4" Round Downlight New Construction Housing	**SL**	Standard Lumen	**06L**	600
				10L	1000
				15L	1500
		ML	Medium Lumen	**20L**	2000
				25L	2500
				30L	3000
		HL	High Lumen	**35L**	3500
				40L	4000

– –

Driver Options		Control Options		Voltage		Housing Options	
DM1	0-10V Dimming to 1%	**NXE**	NX Enabled, Dual SmartPorts [3]	*Standard 120-277V*		**CP**	Chicago Plenum [7, 9]
DM01	0-10V Dimming to < 1%	**NXWE**	NX Wireless Enabled [3]	**34**	347V [6]	**IC**	IC rated [8, 9]
DMX	DMX with RDM dimming to < 0.1% [2]	**NXWD**	NX Wireless Enabled, Dual SmartPorts [3]			**EM**	Emergency Battery Pack with integral test switch and indicator light [9]
DALI	DALI Dimming to 1%	**LV**	Lutron Vive Enabled, 0-10V (requires 0-10V driver)			**EMR**	Emergency Battery Pack with remote test switch and indicator light [9]
2DM	Lutron Hi-Lume 2-wire Dimming to 1% (120V Forward Phase only) [2]	**LVE**	Lutron Vive Enabled, EcoSystem, (requires EDM)			**DTS**	Device Transfer Switch with Dimming Bypass [9, 11]
EDM	Lutron Hi-Lume EcoSystem Dimming to 1% [2]					**GTD**	Generator Transfer Device [9]
						F	Fuse

TRIM

LTR-4RD-T –

Aperture/Shape/Function		Lumen Package		CCT		CRI		Distribution	
LTR-4RD-T	4" Round Downlight Light Engine/Trim Assembly	**SL**	Standard Lumen	**27K**	2700K	**8**	80+CRI	**VNR**	Very Narrow (0.3 SC/20°) [13]
		ML	Medium Lumen	**30K**	3000K	**9**	90+CRI	**NR**	Narrow (0.4 SC/29°)
		HL	High Lumen	**35K**	3500K			**MD**	Medium (0.7 SC/44°)
				40K	4000K			**WD**	Wide (0.9 SC/61°)
				50K	5000K [1]			**XW**	Extra Wide (1.2 SC/78°)

TRIM CONTINUED

–

Reflector Finish		Reflector Color		Flange Color Options		Lower Trim Options		Reflector Options	
Finish not applicable with painted reflectors (WC or BC)		*Standard Clear*		*Standard matches reflector color*		**EM**	Pre-punched reflector for EM integral test switch and indicator	**AM**	Antimicrobial Coating [5]
S	Specular	**CG**	Champagne Gold	**WT**	White Flange [4]	**FM**	Flush Mount Mud-in Ring [10]		
SS	Semi-Specular	**BL**	Black	**BT**	Black Flange [4]	**WF**	Wide Flange		
MFC	American Matte™	**LW**	Light Wheat						
VS	Softglow®	**PW**	Pewter						
VSS	SoftSheen™	**WC**	Painted White Cone and Flange						
		BC	Painted Black Cone and Flange						

Accessories	
☐ **B24**	Set of two (2) 24" bar hangers for T-bar ceilings
☐ **B6**	Set of two bar hangers for ceiling joist up to 24" centers
☐ **FMR4-R**	Flush Mount Mud-In Ring Accessory, 4" Round
☐ **LiteGear**	LiteGear® Inverter, 125VA-250VA
☐ **LPS Series**	LightPower Micro-Inverter, 20VA-55VA
☐ **MOR4-R-WH**	Metal Oversized Ring, 4" Round, White (8.25" outside diameter)
☐ **MOR4-R-BL**	Metal Oversized Ring, 4" Round, Black (8.25" outside diameter)
☐ **LTR-SCA4-__**	Sloped Ceiling Adapter, 4", White [12]

Notes:

1 5000K available in 80+ CRI only.
2 2DM, EDM, DMX available in 10L-35L.
3 NX requires DM1 driver option.
4 WT not needed for WC, BT not needed for BC.
5 AM available with WC or Specular Clear (S or SWT). Consult factory for other colors.
6 347V requires DM1 driver option; not available in 06L or with Controls F, DTS, GTD, EM, EMR.
7 CP available up to 20L; not available with DMX, Controls, or EMR options.
8 IC available up to 20L; not available with Controls options.
9 Housing options (except Fuse) not available in combination.
10 Flush Mount Flange (FM) requires FMR accessory (sold separately).
11 DTS available with DM1, DM01, DALI, or EDM; not available with LVE.
12 Specify slope angle 5°-35° in 5° increments. Not available with EM, WF, or FM options.
13 VNR available up to 30L.

701 Millennium Blvd • Greenville, SC 29607 / Tel 864.678.1000 / Website www.prescolite.com

HUBBELL Lighting

prescolite

LTR-4RD

LITEISTRY 4" ROUND DOWNLIGHT

DATE: LOCATION:

TYPE: PROJECT:

CATALOG #:

CONTROLS

NX Distributed Intelligence™ Lighting Controls:

Supports applications in a variety of deployment options- wired, wireless, hybrid. Integrates with and enables a wide array of luminaires including those with SpectraSync™ Color Tuning Technology.

NX DISTRIBUTED™ INTELLIGENCE

NX INTEGRATED CONTROLS REFERENCE								
NX Option	Sensor	Networkable	Scheduling	Occupancy	Daylight Harvesting	0–10V Dimming	On/off Control	Bluetooth® App Programming
NX Networked – Wired								
NXE	N/A	Yes	Yes	No	No	Yes	Yes	Requires NXBTC/R[1]
NX Networked – Wireless								
NXWE[2]	N/A	Yes	Yes	No	No	Yes	Yes	No[3]
NX Networked – Wired/Wireless								
NXWD	N/A	Yes	Yes	No	No	Yes	Yes	Requires NXBTC/R[1,3]

1 NXBTC/R needs to be plugged into an available NX SmartPort™ on the fixture network

2 Programming via App requires factory assistance

3 To program NXWE option, need to consult factory. If connected to an area controller, programming can be done from that

NX Design & Application Guide

NX Brochure

HUBBELL Lighting

prescolite

LTR-4RD

LITEISTRY 4" ROUND DOWNLIGHT

DATE: LOCATION:

TYPE: PROJECT:

CATALOG #:

PERFORMANCE DATA TABLE

Performance data provided below is for 3500K, 80 CRI with Specular Clear reflector finish/color

Lumen Package	Nominal Lumens	Distribution	"Delivered Lumens"	Watts	LPW
06L	600	Very Narrow	691	7.6	91
		Narrow	785	7.8	101
		Medium	726	7.8	93
		Wide	664	7.8	85
		Extra Wide	644	7.8	83
10L	1000	Very Narrow	1132	11.8	96
		Narrow	1255	12.0	105
		Medium	1160	12.0	97
		Wide	1062	12.0	89
		Extra Wide	1030	12.0	86
15L	1500	Very Narrow	1623	17.2	94
		Narrow	1795	18.6	97
		Medium	1660	18.6	89
		Wide	1519	18.6	82
		Extra Wide	1474	18.6	79
20L	2000	Very Narrow	2032	22.4	91
		Narrow	2238	22.5	99
		Medium	2152	22.5	96
		Wide	2059	22.5	92
		Extra Wide	2028	22.5	90
25L	2500	Very Narrow	2447	28.6	86
		Narrow	2985	27.8	107
		Medium	2760	27.8	99
		Wide	2526	27.8	91
		Extra Wide	2451	27.8	88
30L	3000	Very Narrow	2855	35.9	80
		Narrow	3583	34.6	104
		Medium	3313	34.6	96
		Wide	3032	34.6	88
		Extra Wide	2941	34.6	85
35L	3500	Narrow	4280	42.9	100
		Medium	3957	42.9	92
		Wide	3622	42.9	84
		Extra Wide	3514	42.9	82
40L	4000	Narrow	4885	51.5	95
		Medium	4517	51.5	88
		Wide	4134	51.5	80
		Extra Wide	4011	51.5	78

HUBBELL Lighting

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LTR-4RD

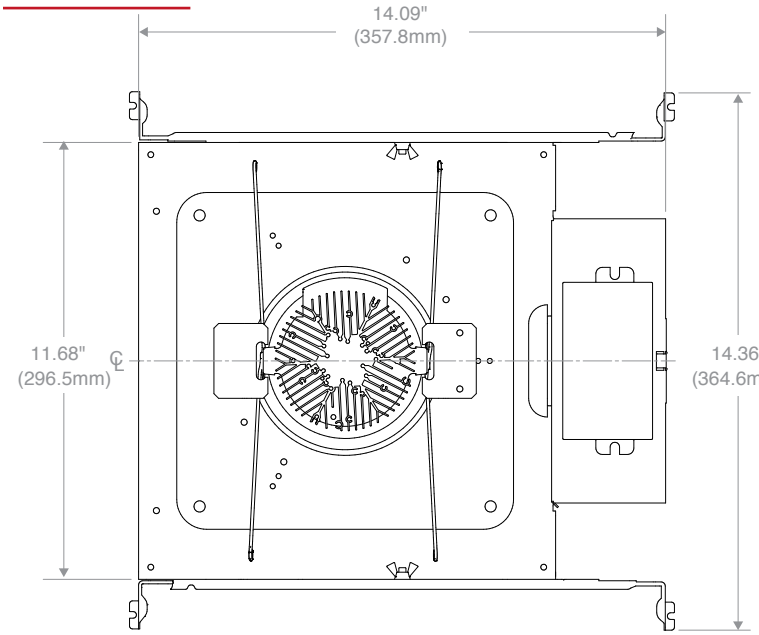
LITEISTRY 4" ROUND DOWNLIGHT

DATE: LOCATION:

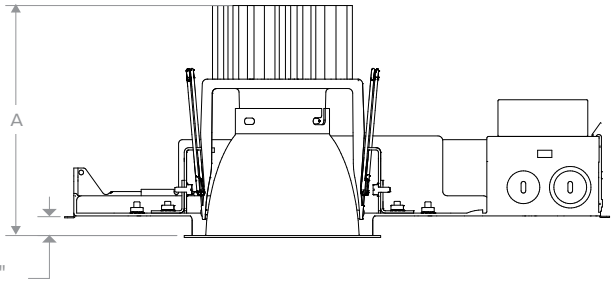
TYPE: PROJECT:

CATALOG #:

DIMENSIONS



Top View

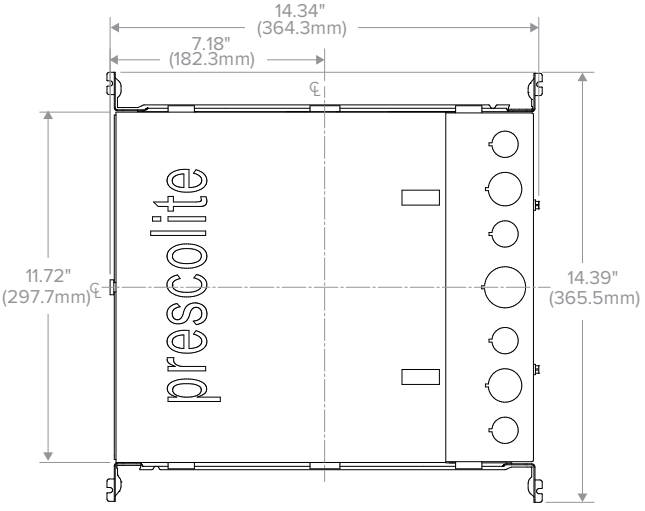


Dimensional Data		
Aperture		4.00" (101.6mm)
Flange:	Standard	5.25" (133.4mm)
	Flush Mount	4.50" (114.3mm)
Ceiling Cutout:	Standard	5.00" (127.0mm)
	Flush Mount	5.12" (130.0mm)
Ceiling Thickness:	Standard or w/ SCA 5-20° slope	0.50" to 2.00" (12.7mm to 50.8mm)
	With SCA 25-35° slope	0.50" to 1.75" (12.7mm to 44.6mm)

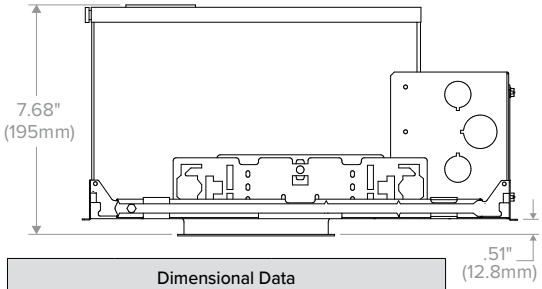
Lumen Package	"A"
06L-15L	4.97" (126.2mm)
20L-30L	6.15" (156.2mm)
35L-40L	7.33" (186.2mm)

SCA Sloped Ceiling Adapter accessory available, see LTR-SCA specification sheet and installation instructions for dimensional data and other details.

LTR-4RD-H New Construction



Top View



Dimensional Data		
Aperture		4.00" (101.6mm)
Flange:	Standard	5.25" (133.4mm)
	Flush Mount	4.50" (114.3mm)
Ceiling Cutout:	Standard	5.00" (127.0mm)
	Flush Mount	5.12" (130.0mm)
Ceiling Thickness:	Standard or w/ SCA 5-20° slope	0.50" to 2.00" (12.7mm to 50.8mm)
	With SCA 25-35° slope	0.50" to 1.75" (12.7mm to 44.6mm)

SCA Sloped Ceiling Adapter accessory available, see LTR-SCA specification sheet and installation instructions for dimensional data and other details.

LTR-4RD-H IC/CP

HUBBELL Lighting

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LTR-4RD

LITEISTRY 4" ROUND DOWNLIGHT

DATE: LOCATION:

TYPE: PROJECT:

CATALOG #:

PHOTOMETRY

LTR-4RD-H-ML20L-DM1 / LTR-4RD-T-ML35K8VNR-S

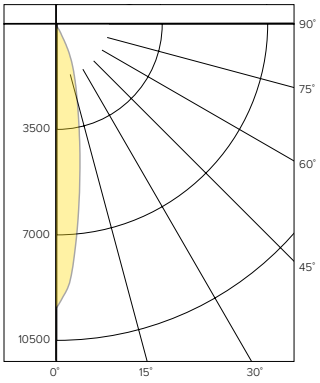
LUMINAIRE DATA

Test No.	**20.01331**
Description	**2000 lm, Very Narrow, 3500K, 80 CRI**
Delivered Lumens	**2032**
Watts	**22.4W**
Efficacy	**91**
Mounting	**Recessed**
Spacing Criterion	**0.3**
Beam Angle (FWHM)	**20**

ZONAL LUMEN SUMMARY

Zone	Lumens	% Luminaire
0-40	2011	99.0
0-60	2032	100.0
0-90	2032	100.0
0-180	2032	100.0

POLAR GRAPH



CANDELA DISTRIBUTION

Degree	Candela
0	9388
5	7360
15	2780
25	1073
35	198
45	20
55	0
65	0
75	0
85	0
90	0

LUMINANCE DATA*

Vertical Angle	Average
45°	3489
55°	0
65°	0
75°	0
85°	0

*Candela/Square Meter

LTR-4RD-H-ML20L-DM1 / LTR-4RD-T-ML35K8NR-S

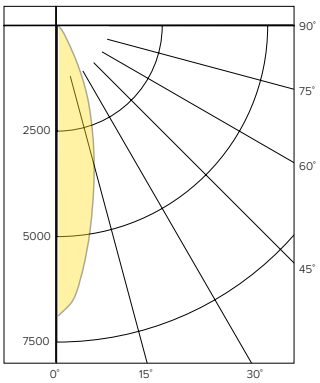
LUMINAIRE DATA

Test No.	**19.00532**
Description	**2000 lm, Narrow, 3500K, 80 CRI**
Delivered Lumens	**2238**
Watts	**22.5W**
Efficacy	**99.3**
Mounting	**Recessed**
Spacing Criterion	**0.4**
Beam Angle (FWHM)	**29**

ZONAL LUMEN SUMMARY

Zone	Lumens	% Luminaire
0-40	2208	98.6
0-60	2237	99.9
0-90	2238	100.0
0-180	2238	100.0

POLAR GRAPH



CANDELA DISTRIBUTION

Degree	Candela
0	6877
5	6035
15	3284
25	1313
35	260
45	26
55	3
65	1
75	0
85	0
90	0

LUMINANCE DATA*

Vertical Angle	Average
45°	4535
55°	645
65°	292
75°	0
85°	0

*Candela/Square Meter

LTR-4RD-H-ML20L-DM1 / LTR-4RD-T-ML35K8MD-S

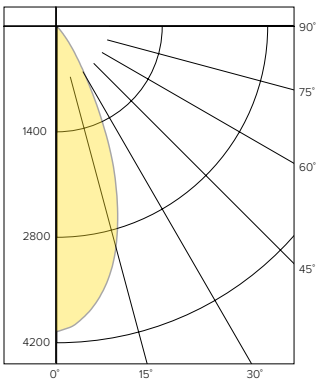
LUMINAIRE DATA

Test No.	**19.00533**
Description	**2000 lm, Medium, 3500K, 80 CRI**
Delivered Lumens	**2152**
Watts	**22.5W**
Efficacy	**95.6**
Mounting	**Recessed**
Spacing Criterion	**0.7**
Beam Angle (FWHM)	**44**

ZONAL LUMEN SUMMARY

Zone	Lumens	% Luminaire
0-40	2113	98.2
0-60	2151	99.9
0-90	2152	100.0
0-180	2152	100.0

POLAR GRAPH



CANDELA DISTRIBUTION

Degree	Candela
0	4053
5	3893
15	3037
25	1493
35	366
45	34
55	3
65	1
75	0
85	0
90	0

LUMINANCE DATA*

Vertical Angle	Average
45°	5931
55°	645
65°	292
75°	0
85°	0

*Candela/Square Meter

IES FILE

IES FILE

HUBBELL Lighting

LTR-4RD

LITEISTRY 4" ROUND DOWNLIGHT

PHOTOMETRY CONTINUED

LTR-4RD-H-ML20L-DM1 / LTR-4RD-T-ML35K8WD-S

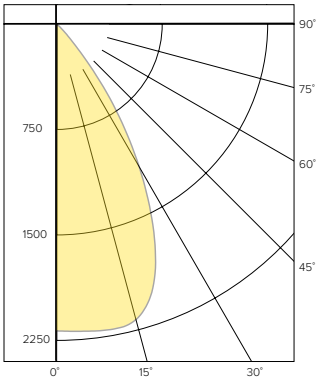
LUMINAIRE DATA

Test No.	**19.00534**
Description	**2000 lm, Wide, 3500K, 80 CRI**
Delivered Lumens	**2059**
Watts	**22.5W**
Efficacy	**91.6**
Mounting	**Recessed**
Spacing Criterion	**0.9**
Beam Angle (FWHM)	**61**

ZONAL LUMEN SUMMARY

Zone	Lumens	% Luminaire
0-40	1983	96.3
0-60	2056	99.8
0-90	2059	100.0
0-180	2059	100.0

POLAR GRAPH



CANDELA DISTRIBUTION

Degree	Candela
0	2201
5	2210
15	2051
25	1504
35	692
45	169
55	10
65	3
75	1
85	0
90	0

LUMINANCE DATA*

Vertical Angle	Average
45°	11338
55°	1075
65°	584
75°	477
85°	0

*Candela/Square Meter

IES FILE

LTR-4RD-H-ML20L-DM1 / LTR-4RD-T-ML35K8XW-S

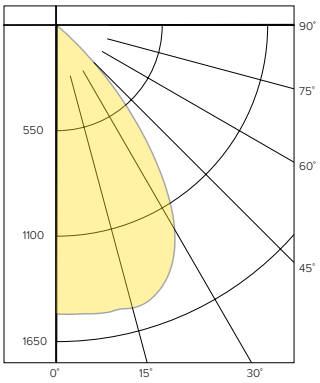
LUMINAIRE DATA

Test No.	**19.00535**
Description	**2000 lm, Extra Wide, 3500K, 80 CRI**
Delivered Lumens	**2028**
Watts	**22.5W**
Efficacy	**90.2**
Mounting	**Recessed**
Spacing Criterion	**1.2**
Beam Angle (FWHM)	**78**

ZONAL LUMEN SUMMARY

Zone	Lumens	% Luminaire
0-40	1794	88.5
0-60	2025	99.8
0-90	2028	100.0
0-180	2028	100.0

POLAR GRAPH



CANDELA DISTRIBUTION

Degree	Candela
0	1235
5	1252
15	1392
25	1454
35	1010
45	256
55	6
65	2
75	1
85	0
90	0

LUMINANCE DATA*

Vertical Angle	Average
45°	44656
55°	1290
65°	584
75°	231
85°	477

*Candela/Square Meter

IES FILE

LUMEN MULTIPLIER

Option	27K8	30K8	35K8	40K8	50K8	27K9	30K9	35K9	40K9
Multiplier	0.94	0.98	1.00	1.01	1.02	0.81	0.84	0.85	0.85

Photometrics are published below at a nominal 3500 Kelvin, 80+ CRI. This table may be used to approximate the lumen values at different Kelvin temperatures. Power consumption would stay the same.

REFLECTOR FINISH MULTIPLIER (Based on Clear (Standard) Color)

Option	Specular (S)	Semi-Specular (SS)	American Matte (MFC)	Softglow (VS)	Softsheen (VSS)
Multiplier	1	1	0.984	0.888	0.938

REFLECTOR COLOR MULTIPLIER (Based on Semi-Specular (SS) Finish)

Option	Clear (Standard)	Champagne Gold (CG)	Black (BL)	Light Wheat (LW)	Pewter (PW)	White Cone (WC)	Black Cone (BC)
Multiplier	1	0.974	0.444	0.861	0.915	0.984	0.442

Multiply FINISH x COLOR to calculate other reflector finish and color combinations. Example: SoftGlow Pewter (VSPW) = 0.888 (VS) x 0.915 (PW) = 0.813

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LTR-4RD

LITEISTRY 4" ROUND DOWNLIGHT

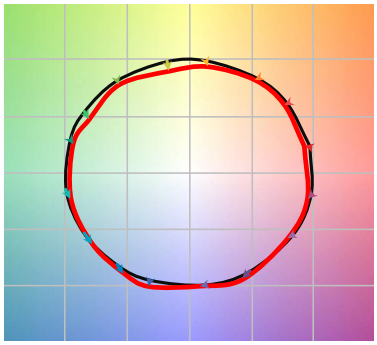
DATE: LOCATION:

TYPE: PROJECT:

CATALOG #:

TM-30 DATA

COLOR VECTOR GRAPHIC 3500K, 90 CRI

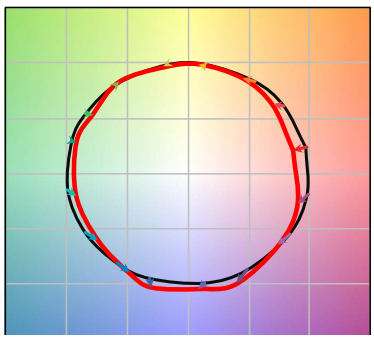


Reference Illuminant — Test Source

COLOR DISTORTION GRAPHIC 3500K, 90 CRI

TEST RESULTS - 3500K		
Value	80+ CRI	90+ CRI
R_f	84	88
R_g	95	95
CCT (K)	3411	3419
D_{UV}	0.0015	0.0042
x	0.4120	0.4147
y	0.3974	0.4052
CIE R_a	84	93
CIE R_9	11	62

COLOR VECTOR GRAPHIC 3500K, 80 CRI



Reference Illuminant — Test Source

COLOR DISTORTION GRAPHIC 3500K, 80 CRI

HUBBELL Lighting

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DATE: LOCATION:

TYPE: PROJECT:

CATALOG #:

LTR-4RD

LITEISTRY 4" ROUND DOWNLIGHT

ELECTRICAL DATA

DRIVER DATA		
Input Voltage	120-277 V	347 V
Input Frequency	50/60 Hz	50/60 Hz
Power Factor	≥0.90	≥0.90
THD	<20%	<20%
EMI Filtering (FCC 47 CFR Part 15)	Class A	Class A

* Values for DM1 option shown, values for other dimming options may vary.

WATTAGE DATA		
Lumen Output	Nominal Lumens	Wattage
06L	600	8
10L	1000	12
15L	1500	19
20L	2000	23
25L	2500	28
30L	3000	35
35L	3500	43
40L	4000	52

* Wattage may vary based on configuration and options selected

ADDITIONAL INFORMATION

DIMMING COMPATIBILITY CHART		
Dimming Driver	Manufacturer	Web Link
DM1 /DM01	Lutron DVTV	http://bit.ly/11jSvZg
DM1	Leviton AWRMG-7xx, AWSMG-7xx, AWSMT-7xx	http://bit.ly/1BJn2R9
EDM	Lutron	http://bit.ly/1vtjHAl
2DM	Lutron	http://bit.ly/1S4WjXK

DMX

See instruction sheet on www.prescolite.com for connection & installation information.

Central Inverters

For full fixture output in back-up mode, we recommend you visit www.dual-lite.com for your Central Lighting Inverter options. Please contact your local Hubbell representative for any assistance with proper sizing and loading of your inverter selection. Central lighting inverters must be ordered separately.
LiteGear: www.dual-lite.com/products/litegear_lg_series
LPS Series: www.dual-lite.com/products/lps

ENERGY STAR®

For a list of certified models, click on the ENERGY STAR® MODELS link or visit www.energystar.gov.

ENERGY STAR MODELS

HUBBELL Lighting

prescolite

DATE: LOCATION:

TYPE: PROJECT:

CATALOG #:

LTR-4RD

LITEISTRY 4" ROUND DOWNLIGHT

LITEISTRY

FEATURES

- 4" architectural LED downlight delivering 600 – 4000 lm
- Five beam distributions from 0.3 to 1.2 Spacing Criteria
- Quiet reflector appearance with superior 50° optical cutoff
- 2700K – 5000K, 80+ and 90+ CRI options
- Available for New Construction (non-IC), IC and Chicago Plenum applications
- Variety of dimming protocol options including 0–10V, DALI, DMX, Lutron Forward Phase and EcoSystem
- NX Distributed Intelligence™ wired and wireless controls capability available

WET LOCATION · C SA US · ENERGY STAR · BUY AMERICAN SOLUTIONS — See Certification Specifications

RELATED PRODUCTS

- LTR-4RD-RFH Retrofit
- LTR-4RD SpectraSync
- LTR-4RDPH PowerHUBB
- 3" LITEISTRY Family
- 4" LITEISTRY Family
- 6" LITEISTRY Family

CONTROL TECHNOLOGY

NX DISTRIBUTED™ INTELLIGENCE

SPECIFICATIONS

CONSTRUCTION

- Standard Non-IC. Chicago Plenum and IC options
- Painted black durable steel platform with pre-installed bar hangers
- Pre-wired junction box with snap-on covers for easy access
- Snap-in connection from driver compartment allows easy installation
- Light Engine connections use plenum rated (CMP) cable

OPTICS

- Visually pleasing 50° cutoff to source and source image
- The light distribution is free of distracting bright spots or pixelation and the perimeter has a smooth transition
- Optical grade silicone lens integral to light engine
- High purity spun aluminum reflector, self-flanged
- Flush Mount flange option with mud-in ring available
- Large selection of anodized finishes and colors
- Painted cones and flange options available

ELECTRICAL

- Chip-on-board LED with 2 SDCM
- Multiple CCTs, 80+ or 90+ CRI
- Long LED life: L90 at >55,000 hours (TM-21)
- Universal voltage 120V–277V driver, 347V optional
- UL Class 2, inherent short circuit and overload protection, RoHS compliant
- Flicker free 0-10V dimming with 1% or <1% performance
- DALI, DMX, and Lutron Forward Phase and EcoSystem options
- Integral and remote emergency controller and battery pack options available
- NX or Lutron Vive control options available
- Refer to additional spec sheets for information on SpectraSync™ Tunable White or Dim-to-Warm or PowerHUBB™ PoE enabled solutions

INSTALLATION

- Accommodates ceiling thickness up to 2"
- Universal adjustable mounting brackets also accept 0.5" EMT conduit or 1.5" or 0.75" lathing channel (by others) or Prescolite accessory bar hangers (B24 or B6)
- Light Engine/Driver fully serviceable from above or below the ceiling

CERTIFICATIONS

- cCSAus certified to UL 1598
- Suitable for wet locations, covered ceiling. EM/ EMR: Suitable for damp locations.
- EM/EMR: Certified under UL 924 standard for emergency lighting and power equipment
- Approved for 8 (4 in/4 out) No. 12AWG conductors rated for 90°C through wiring
- ENERGY STAR® certified models available (See list and additional information on page 7)
- This product qualifies as a "designated country construction material" per FAR 52.225-11 Buy American-Construction. Materials under Trade Agreements effective 6/6/2020. See Buy American Solutions.

WARRANTY

- 5 year warranty
- See HLI Standard Warranty for additional information

KEY DATA	
Lumen Range	600-4000
Wattage Range	8-52
Efficacy Range (LPW)	90-99*
Reported Life (Hours)	L90 / >55,000
Input Current (mA)	65-433 (120V)

*Based on Specular, 35K, 80 CRI

HUBBELL Lighting

prescolite

LTR-4RD

LITEISTRY 4" ROUND DOWNLIGHT

DATE: LOCATION:

TYPE: PROJECT:

CATALOG #:

ORDERING GUIDE

Example: LTR–4RD–H–SL10L–DM1–LTR–4RD–T–SL35K8MD–S

CATALOG #

HOUSING

LTR-4RD-H –

Aperture/Shape/Function		Lumen Package		Lumen Output	
LTR-4RD-H	4" Round Downlight New Construction Housing	**SL**	Standard Lumen	**06L**	600
				10L	1000
				15L	1500
		ML	Medium Lumen	**20L**	2000
				25L	2500
				30L	3000
		HL	High Lumen	**35L**	3500
				40L	4000

– –

Driver Options		Control Options		Voltage		Housing Options	
DM1	0-10V Dimming to 1%	**NXE**	NX Enabled, Dual SmartPorts [3]	*Standard 120-277V*		**CP**	Chicago Plenum [7, 9]
DM01	0-10V Dimming to < 1%	**NXWE**	NX Wireless Enabled [3]	**34**	347V [6]	**IC**	IC rated [8, 9]
DMX	DMX with RDM dimming to < 0.1% [2]	**NXWD**	NX Wireless Enabled, Dual SmartPorts [3]			**EM**	Emergency Battery Pack with integral test switch and indicator light [9]
DALI	DALI Dimming to 1%	**LV**	Lutron Vive Enabled, 0-10V (requires 0-10V driver)			**EMR**	Emergency Battery Pack with remote test switch and indicator light [9]
2DM	Lutron Hi-Lume 2-wire Dimming to 1% (120V Forward Phase only) [2]	**LVE**	Lutron Vive Enabled, EcoSystem, (requires EDM)			**DTS**	Device Transfer Switch with Dimming Bypass [9, 11]
EDM	Lutron Hi-Lume EcoSystem Dimming to 1% [2]					**GTD**	Generator Transfer Device [9]
						F	Fuse

TRIM

LTR-4RD-T –

Aperture/Shape/Function		Lumen Package		CCT		CRI		Distribution	
LTR-4RD-T	4" Round Downlight Light Engine/Trim Assembly	**SL**	Standard Lumen	**27K**	2700K	**8**	80+CRI	**VNR**	Very Narrow (0.3 SC/20°) [13]
		ML	Medium Lumen	**30K**	3000K	**9**	90+CRI	**NR**	Narrow (0.4 SC/29°)
		HL	High Lumen	**35K**	3500K			**MD**	Medium (0.7 SC/44°)
				40K	4000K			**WD**	Wide (0.9 SC/61°)
				50K	5000K [1]			**XW**	Extra Wide (1.2 SC/78°)

TRIM CONTINUED

–

Reflector Finish		Reflector Color		Flange Color Options		Lower Trim Options		Reflector Options	
Finish not applicable with painted reflectors (WC or BC)		*Standard Clear*		*Standard matches reflector color*		**EM**	Pre-punched reflector for EM integral test switch and indicator	**AM**	Antimicrobial Coating [5]
S	Specular	**CG**	Champagne Gold	**WT**	White Flange [4]	**FM**	Flush Mount Mud-in Ring [10]		
SS	Semi-Specular	**BL**	Black	**BT**	Black Flange [4]	**WF**	Wide Flange		
MFC	American Matte™	**LW**	Light Wheat						
VS	Softglow®	**PW**	Pewter						
VSS	SoftSheen™	**WC**	Painted White Cone and Flange						
		BC	Painted Black Cone and Flange						

Accessories	
☐ **B24**	Set of two (2) 24" bar hangers for T-bar ceilings
☐ **B6**	Set of two bar hangers for ceiling joist up to 24" centers
☐ **FMR4-R**	Flush Mount Mud-In Ring Accessory, 4" Round
☐ **LiteGear**	LiteGear® Inverter, 125VA-250VA
☐ **LPS Series**	LightPower Micro-Inverter, 20VA-55VA
☐ **MOR4-R-WH**	Metal Oversized Ring, 4" Round, White (8.25" outside diameter)
☐ **MOR4-R-BL**	Metal Oversized Ring, 4" Round, Black (8.25" outside diameter)
☐ **LTR-SCA4-__**	Sloped Ceiling Adapter, 4", White [12]

Notes:

1 5000K available in 80+ CRI only.
2 2DM, EDM, DMX available in 10L-35L.
3 NX requires DM1 driver option.
4 WT not needed for WC, BT not needed for BC.
5 AM available with WC or Specular Clear (S or SWT). Consult factory for other colors.
6 347V requires DM1 driver option; not available in 06L or with Controls F, DTS, GTD, EM, EMR.
7 CP available up to 20L; not available with DMX, Controls, or EMR options.
8 IC available up to 20L; not available with Controls options.
9 Housing options (except Fuse) not available in combination.
10 Flush Mount Flange (FM) requires FMR accessory (sold separately).
11 DTS available with DM1, DM01, DALI, or EDM; not available with LVE.
12 Specify slope angle 5°-35° in 5° increments. Not available with EM, WF, or FM options.
13 VNR available up to 30L.

701 Millennium Blvd • Greenville, SC 29607 / Tel 864.678.1000 / Website www.prescolite.com

HUBBELL Lighting

prescolite

LTR-4RD

LITEISTRY 4" ROUND DOWNLIGHT

DATE: LOCATION:

TYPE: PROJECT:

CATALOG #:

CONTROLS

NX Distributed Intelligence™ Lighting Controls:

Supports applications in a variety of deployment options- wired, wireless, hybrid. Integrates with and enables a wide array of luminaires including those with SpectraSync™ Color Tuning Technology.

NX DISTRIBUTED™ INTELLIGENCE

NX INTEGRATED CONTROLS REFERENCE								
NX Option	Sensor	Networkable	Scheduling	Occupancy	Daylight Harvesting	0–10V Dimming	On/off Control	Bluetooth® App Programming
NX Networked – Wired								
NXE	N/A	Yes	Yes	No	No	Yes	Yes	Requires NXBTC/R[1]
NX Networked – Wireless								
NXWE[2]	N/A	Yes	Yes	No	No	Yes	Yes	No[3]
NX Networked – Wired/Wireless								
NXWD	N/A	Yes	Yes	No	No	Yes	Yes	Requires NXBTC/R[1,3]

1 NXBTC/R needs to be plugged into an available NX SmartPort™ on the fixture network

2 Programming via App requires factory assistance

3 To program NXWE option, need to consult factory. If connected to an area controller, programming can be done from that

NX Design & Application Guide

NX Brochure

HUBBELL Lighting

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LTR-4RD

LITEISTRY 4" ROUND DOWNLIGHT

DATE: LOCATION:

TYPE: PROJECT:

CATALOG #:

PERFORMANCE DATA TABLE

Performance data provided below is for 3500K, 80 CRI with Specular Clear reflector finish/color

Lumen Package	Nominal Lumens	Distribution	"Delivered Lumens"	Watts	LPW
06L	600	Very Narrow	691	7.6	91
		Narrow	785	7.8	101
		Medium	726	7.8	93
		Wide	664	7.8	85
		Extra Wide	644	7.8	83
10L	1000	Very Narrow	1132	11.8	96
		Narrow	1255	12.0	105
		Medium	1160	12.0	97
		Wide	1062	12.0	89
		Extra Wide	1030	12.0	86
15L	1500	Very Narrow	1623	17.2	94
		Narrow	1795	18.6	97
		Medium	1660	18.6	89
		Wide	1519	18.6	82
		Extra Wide	1474	18.6	79
20L	2000	Very Narrow	2032	22.4	91
		Narrow	2238	22.5	99
		Medium	2152	22.5	96
		Wide	2059	22.5	92
		Extra Wide	2028	22.5	90
25L	2500	Very Narrow	2447	28.6	86
		Narrow	2985	27.8	107
		Medium	2760	27.8	99
		Wide	2526	27.8	91
		Extra Wide	2451	27.8	88
30L	3000	Very Narrow	2855	35.9	80
		Narrow	3583	34.6	104
		Medium	3313	34.6	96
		Wide	3032	34.6	88
		Extra Wide	2941	34.6	85
35L	3500	Narrow	4280	42.9	100
		Medium	3957	42.9	92
		Wide	3622	42.9	84
		Extra Wide	3514	42.9	82
40L	4000	Narrow	4885	51.5	95
		Medium	4517	51.5	88
		Wide	4134	51.5	80
		Extra Wide	4011	51.5	78

HUBBELL Lighting

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LTR-4RD

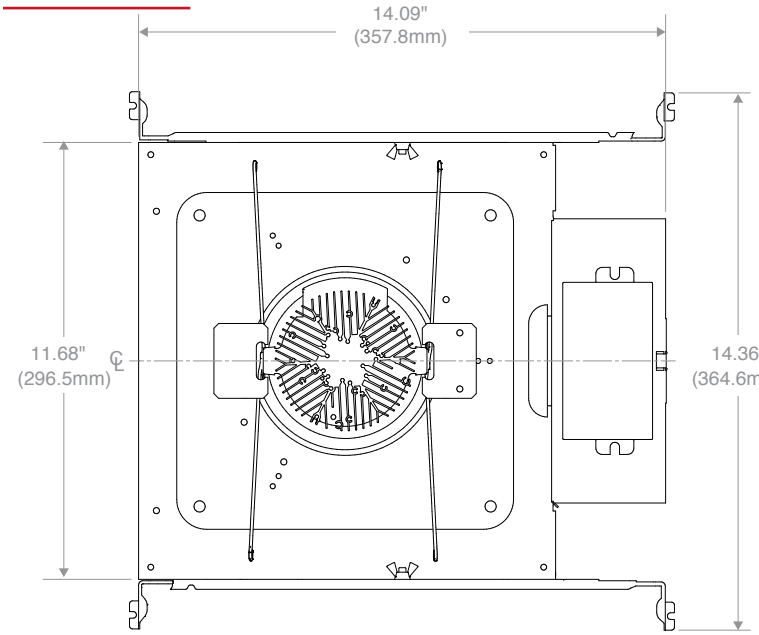
LITEISTRY 4" ROUND DOWNLIGHT

DATE: LOCATION:

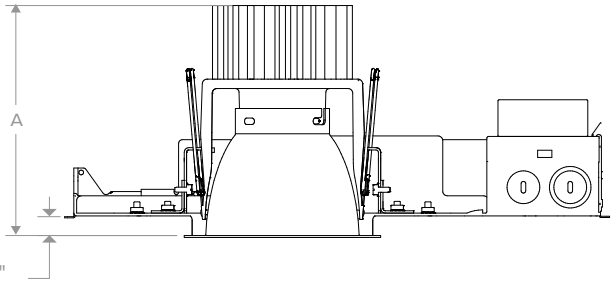
TYPE: PROJECT:

CATALOG #:

DIMENSIONS



Top View

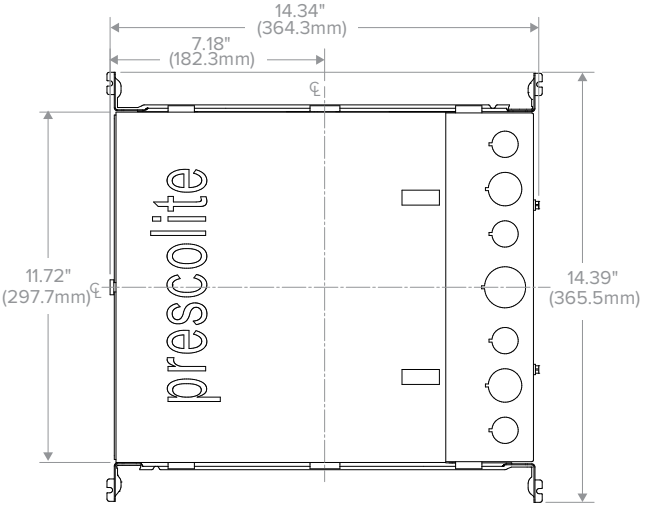


Dimensional Data		
Aperture		4.00" (101.6mm)
Flange:	Standard	5.25" (133.4mm)
	Flush Mount	4.50" (114.3mm)
Ceiling Cutout:	Standard	5.00" (127.0mm)
	Flush Mount	5.12" (130.0mm)
Ceiling Thickness:	Standard or w/ SCA 5-20° slope	0.50" to 2.00" (12.7mm to 50.8mm)
	With SCA 25-35° slope	0.50" to 1.75" (12.7mm to 44.6mm)

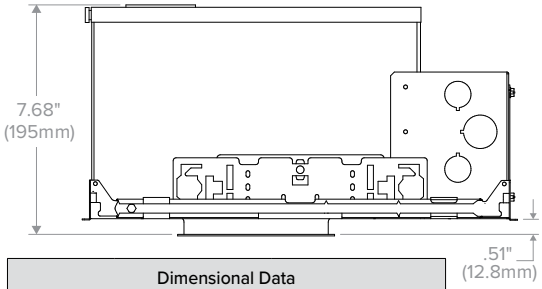
Lumen Package	"A"
06L-15L	4.97" (126.2mm)
20L-30L	6.15" (156.2mm)
35L-40L	7.33" (186.2mm)

SCA Sloped Ceiling Adapter accessory available, see LTR-SCA specification sheet and installation instructions for dimensional data and other details.

LTR-4RD-H New Construction



Top View



Dimensional Data		
Aperture		4.00" (101.6mm)
Flange:	Standard	5.25" (133.4mm)
	Flush Mount	4.50" (114.3mm)
Ceiling Cutout:	Standard	5.00" (127.0mm)
	Flush Mount	5.12" (130.0mm)
Ceiling Thickness:	Standard or w/ SCA 5-20° slope	0.50" to 2.00" (12.7mm to 50.8mm)
	With SCA 25-35° slope	0.50" to 1.75" (12.7mm to 44.6mm)

SCA Sloped Ceiling Adapter accessory available, see LTR-SCA specification sheet and installation instructions for dimensional data and other details.

LTR-4RD-H IC/CP

HUBBELL Lighting

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LTR-4RD

LITEISTRY 4" ROUND DOWNLIGHT

DATE: LOCATION:

TYPE: PROJECT:

CATALOG #:

PHOTOMETRY

LTR-4RD-H-ML20L-DM1 / LTR-4RD-T-ML35K8VNR-S

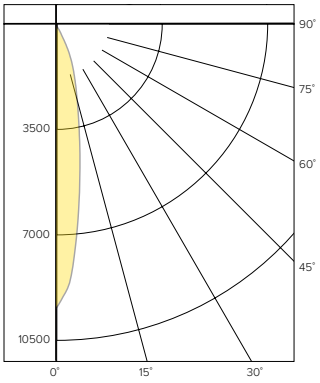
LUMINAIRE DATA

Test No.	**20.01331**
Description	**2000 lm, Very Narrow, 3500K, 80 CRI**
Delivered Lumens	**2032**
Watts	**22.4W**
Efficacy	**91**
Mounting	**Recessed**
Spacing Criterion	**0.3**
Beam Angle (FWHM)	**20**

ZONAL LUMEN SUMMARY

Zone	Lumens	% Luminaire
0-40	2011	99.0
0-60	2032	100.0
0-90	2032	100.0
0-180	2032	100.0

POLAR GRAPH



CANDELA DISTRIBUTION

Degree	Candela
0	9388
5	7360
15	2780
25	1073
35	198
45	20
55	0
65	0
75	0
85	0
90	0

LUMINANCE DATA*

Vertical Angle	Average
45°	3489
55°	0
65°	0
75°	0
85°	0

*Candela/Square Meter

LTR-4RD-H-ML20L-DM1 / LTR-4RD-T-ML35K8NR-S

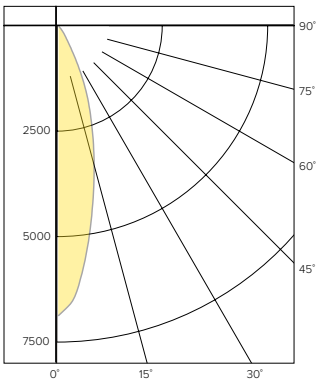
LUMINAIRE DATA

Test No.	**19.00532**
Description	**2000 lm, Narrow, 3500K, 80 CRI**
Delivered Lumens	**2238**
Watts	**22.5W**
Efficacy	**99.3**
Mounting	**Recessed**
Spacing Criterion	**0.4**
Beam Angle (FWHM)	**29**

ZONAL LUMEN SUMMARY

Zone	Lumens	% Luminaire
0-40	2208	98.6
0-60	2237	99.9
0-90	2238	100.0
0-180	2238	100.0

POLAR GRAPH



CANDELA DISTRIBUTION

Degree	Candela
0	6877
5	6035
15	3284
25	1313
35	260
45	26
55	3
65	1
75	0
85	0
90	0

LUMINANCE DATA*

Vertical Angle	Average
45°	4535
55°	645
65°	292
75°	0
85°	0

*Candela/Square Meter

LTR-4RD-H-ML20L-DM1 / LTR-4RD-T-ML35K8MD-S

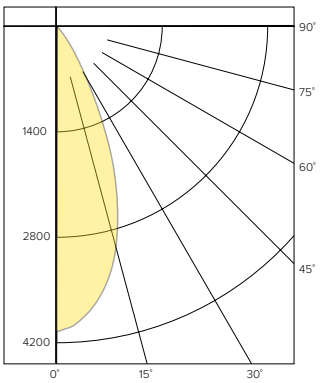
LUMINAIRE DATA

Test No.	**19.00533**
Description	**2000 lm, Medium, 3500K, 80 CRI**
Delivered Lumens	**2152**
Watts	**22.5W**
Efficacy	**95.6**
Mounting	**Recessed**
Spacing Criterion	**0.7**
Beam Angle (FWHM)	**44**

ZONAL LUMEN SUMMARY

Zone	Lumens	% Luminaire
0-40	2113	98.2
0-60	2151	99.9
0-90	2152	100.0
0-180	2152	100.0

POLAR GRAPH



CANDELA DISTRIBUTION

Degree	Candela
0	4053
5	3893
15	3037
25	1493
35	366
45	34
55	3
65	1
75	0
85	0
90	0

LUMINANCE DATA*

Vertical Angle	Average
45°	5931
55°	645
65°	292
75°	0
85°	0

*Candela/Square Meter

IES FILE

IES FILE

HUBBELL Lighting

LTR-4RD

LITEISTRY 4" ROUND DOWNLIGHT

PHOTOMETRY CONTINUED

LTR-4RD-H-ML20L-DM1 / LTR-4RD-T-ML35K8WD-S

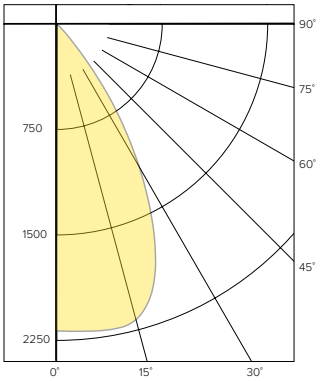
LUMINAIRE DATA

Test No.	**19.00534**
Description	**2000 lm, Wide, 3500K, 80 CRI**
Delivered Lumens	**2059**
Watts	**22.5W**
Efficacy	**91.6**
Mounting	**Recessed**
Spacing Criterion	**0.9**
Beam Angle (FWHM)	**61**

ZONAL LUMEN SUMMARY

Zone	Lumens	% Luminaire
0-40	1983	96.3
0-60	2056	99.8
0-90	2059	100.0
0-180	2059	100.0

POLAR GRAPH



CANDELA DISTRIBUTION

Degree	Candela
0	2201
5	2210
15	2051
25	1504
35	692
45	169
55	10
65	3
75	1
85	0
90	0

LUMINANCE DATA*

Vertical Angle	Average
45°	11338
55°	1075
65°	584
75°	477
85°	0

*Candela/Square Meter

IES FILE

LTR-4RD-H-ML20L-DM1 / LTR-4RD-T-ML35K8XW-S

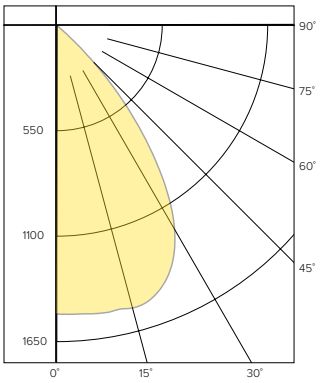
LUMINAIRE DATA

Test No.	**19.00535**
Description	**2000 lm, Extra Wide, 3500K, 80 CRI**
Delivered Lumens	**2028**
Watts	**22.5W**
Efficacy	**90.2**
Mounting	**Recessed**
Spacing Criterion	**1.2**
Beam Angle (FWHM)	**78**

ZONAL LUMEN SUMMARY

Zone	Lumens	% Luminaire
0-40	1794	88.5
0-60	2025	99.8
0-90	2028	100.0
0-180	2028	100.0

POLAR GRAPH



CANDELA DISTRIBUTION

Degree	Candela
0	1235
5	1252
15	1392
25	1454
35	1010
45	256
55	6
65	2
75	1
85	0
90	0

LUMINANCE DATA*

Vertical Angle	Average
45°	44656
55°	1290
65°	584
75°	231
85°	477

*Candela/Square Meter

IES FILE

LUMEN MULTIPLIER

Option	27K8	30K8	35K8	40K8	50K8	27K9	30K9	35K9	40K9
Multiplier	0.94	0.98	1.00	1.01	1.02	0.81	0.84	0.85	0.85

Photometrics are published below at a nominal 3500 Kelvin, 80+ CRI. This table may be used to approximate the lumen values at different Kelvin temperatures. Power consumption would stay the same.

REFLECTOR FINISH MULTIPLIER (Based on Clear (Standard) Color)

Option	Specular (S)	Semi-Specular (SS)	American Matte (MFC)	Softglow (VS)	Softsheen (VSS)
Multiplier	1	1	0.984	0.888	0.938

REFLECTOR COLOR MULTIPLIER (Based on Semi-Specular (SS) Finish)

Option	Clear (Standard)	Champagne Gold (CG)	Black (BL)	Light Wheat (LW)	Pewter (PW)	White Cone (WC)	Black Cone (BC)
Multiplier	1	0.974	0.444	0.861	0.915	0.984	0.442

Multiply FINISH x COLOR to calculate other reflector finish and color combinations. Example: SoftGlow Pewter (VSPW) = 0.888 (VS) x 0.915 (PW) = 0.813

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LTR-4RD

LITEISTRY 4" ROUND DOWNLIGHT

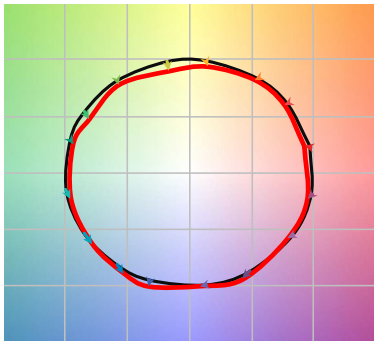
DATE: LOCATION:

TYPE: PROJECT:

CATALOG #:

TM-30 DATA

COLOR VECTOR GRAPHIC 3500K, 90 CRI

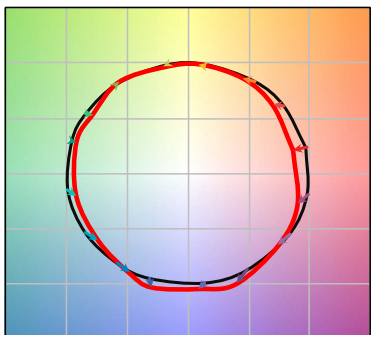


Reference Illuminant — Test Source

COLOR DISTORTION GRAPHIC 3500K, 90 CRI

TEST RESULTS - 3500K		
Value	80+ CRI	90+ CRI
R_f	84	88
R_g	95	95
CCT (K)	3411	3419
D_{UV}	0.0015	0.0042
x	0.4120	0.4147
y	0.3974	0.4052
CIE R_a	84	93
CIE R_9	11	62

COLOR VECTOR GRAPHIC 3500K, 80 CRI



Reference Illuminant — Test Source

COLOR DISTORTION GRAPHIC 3500K, 80 CRI

HUBBELL Lighting

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DATE: LOCATION:

TYPE: PROJECT:

CATALOG #:

LTR-4RD

LITEISTRY 4" ROUND DOWNLIGHT

ELECTRICAL DATA

DRIVER DATA		
Input Voltage	120-277 V	347 V
Input Frequency	50/60 Hz	50/60 Hz
Power Factor	≥0.90	≥0.90
THD	<20%	<20%
EMI Filtering (FCC 47 CFR Part 15)	Class A	Class A

* Values for DM1 option shown, values for other dimming options may vary.

WATTAGE DATA		
Lumen Output	Nominal Lumens	Wattage
06L	600	8
10L	1000	12
15L	1500	19
20L	2000	23
25L	2500	28
30L	3000	35
35L	3500	43
40L	4000	52

* Wattage may vary based on configuration and options selected

ADDITIONAL INFORMATION

DIMMING COMPATIBILITY CHART		
Dimming Driver	Manufacturer	Web Link
DM1 /DM01	Lutron DVTV	http://bit.ly/11jSvZg
DM1	Leviton AWRMG-7xx, AWSMG-7xx, AWSMT-7xx	http://bit.ly/1BJn2R9
EDM	Lutron	http://bit.ly/1vtjHAl
2DM	Lutron	http://bit.ly/1S4WjXK

DMX

See instruction sheet on www.prescolite.com for connection & installation information.

Central Inverters

For full fixture output in back-up mode, we recommend you visit www.dual-lite.com for your Central Lighting Inverter options. Please contact your local Hubbell representative for any assistance with proper sizing and loading of your inverter selection. Central lighting inverters must be ordered separately.
LiteGear: www.dual-lite.com/products/litegear_lg_series
LPS Series: www.dual-lite.com/products/lps

ENERGY STAR®

For a list of certified models, click on the ENERGY STAR® MODELS link or visit www.energystar.gov.

ENERGY STAR MODELS

HUBBELL Lighting

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DATE: LOCATION:

TYPE: PROJECT:

CATALOG #:

LTR-4RD

LITEISTRY 4" ROUND DOWNLIGHT

LITEISTRY

FEATURES

- 4" architectural LED downlight delivering 600 – 4000 lm
- Five beam distributions from 0.3 to 1.2 Spacing Criteria
- Quiet reflector appearance with superior 50° optical cutoff
- 2700K – 5000K, 80+ and 90+ CRI options
- Available for New Construction (non-IC), IC and Chicago Plenum applications
- Variety of dimming protocol options including 0–10V, DALI, DMX, Lutron Forward Phase and EcoSystem
- NX Distributed Intelligence™ wired and wireless controls capability available

WET LOCATION · C SA US · ENERGY STAR · BUY AMERICAN SOLUTIONS — See Certification Specifications

RELATED PRODUCTS

- LTR-4RD-RFH Retrofit
- LTR-4RD SpectraSync
- LTR-4RDPH PowerHUBB
- 3" LITEISTRY Family
- 4" LITEISTRY Family
- 6" LITEISTRY Family

CONTROL TECHNOLOGY

NX DISTRIBUTED™ INTELLIGENCE

SPECIFICATIONS

CONSTRUCTION

- Standard Non-IC. Chicago Plenum and IC options
- Painted black durable steel platform with pre-installed bar hangers
- Pre-wired junction box with snap-on covers for easy access
- Snap-in connection from driver compartment allows easy installation
- Light Engine connections use plenum rated (CMP) cable

OPTICS

- Visually pleasing 50° cutoff to source and source image
- The light distribution is free of distracting bright spots or pixelation and the perimeter has a smooth transition
- Optical grade silicone lens integral to light engine
- High purity spun aluminum reflector, self-flanged
- Flush Mount flange option with mud-in ring available
- Large selection of anodized finishes and colors
- Painted cones and flange options available

ELECTRICAL

- Chip-on-board LED with 2 SDCM
- Multiple CCTs, 80+ or 90+ CRI
- Long LED life: L90 at >55,000 hours (TM-21)
- Universal voltage 120V–277V driver, 347V optional
- UL Class 2, inherent short circuit and overload protection, RoHS compliant
- Flicker free 0-10V dimming with 1% or <1% performance
- DALI, DMX, and Lutron Forward Phase and EcoSystem options
- Integral and remote emergency controller and battery pack options available
- NX or Lutron Vive control options available
- Refer to additional spec sheets for information on SpectraSync™ Tunable White or Dim-to-Warm or PowerHUBB™ PoE enabled solutions

INSTALLATION

- Accommodates ceiling thickness up to 2"
- Universal adjustable mounting brackets also accept 0.5" EMT conduit or 1.5" or 0.75" lathing channel (by others) or Prescolite accessory bar hangers (B24 or B6)
- Light Engine/Driver fully serviceable from above or below the ceiling

CERTIFICATIONS

- cCSAus certified to UL 1598
- Suitable for wet locations, covered ceiling. EM/ EMR: Suitable for damp locations.
- EM/EMR: Certified under UL 924 standard for emergency lighting and power equipment
- Approved for 8 (4 in/4 out) No. 12AWG conductors rated for 90°C through wiring
- ENERGY STAR® certified models available (See list and additional information on page 7)
- This product qualifies as a "designated country construction material" per FAR 52.225-11 Buy American-Construction. Materials under Trade Agreements effective 6/6/2020. See Buy American Solutions.

WARRANTY

- 5 year warranty
- See HLI Standard Warranty for additional information

KEY DATA	
Lumen Range	600-4000
Wattage Range	8-52
Efficacy Range (LPW)	90-99*
Reported Life (Hours)	L90 / >55,000
Input Current (mA)	65-433 (120V)

*Based on Specular, 35K, 80 CRI

HUBBELL Lighting

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LTR-4RD

LITEISTRY 4" ROUND DOWNLIGHT

DATE: LOCATION:

TYPE: PROJECT:

CATALOG #:

ORDERING GUIDE

Example: LTR–4RD–H–SL10L–DM1–LTR–4RD–T–SL35K8MD–S

CATALOG #

HOUSING

LTR-4RD-H –

Aperture/Shape/Function		Lumen Package		Lumen Output	
LTR-4RD-H	4" Round Downlight New Construction Housing	**SL**	Standard Lumen	**06L**	600
				10L	1000
				15L	1500
		ML	Medium Lumen	**20L**	2000
				25L	2500
				30L	3000
		HL	High Lumen	**35L**	3500
				40L	4000

– –

Driver Options		Control Options		Voltage		Housing Options	
DM1	0-10V Dimming to 1%	**NXE**	NX Enabled, Dual SmartPorts [3]	*Standard 120-277V*		**CP**	Chicago Plenum [7, 9]
DM01	0-10V Dimming to < 1%	**NXWE**	NX Wireless Enabled [3]	**34**	347V [6]	**IC**	IC rated [8, 9]
DMX	DMX with RDM dimming to < 0.1% [2]	**NXWD**	NX Wireless Enabled, Dual SmartPorts [3]			**EM**	Emergency Battery Pack with integral test switch and indicator light [9]
DALI	DALI Dimming to 1%	**LV**	Lutron Vive Enabled, 0-10V (requires 0-10V driver)			**EMR**	Emergency Battery Pack with remote test switch and indicator light [9]
2DM	Lutron Hi-Lume 2-wire Dimming to 1% (120V Forward Phase only) [2]	**LVE**	Lutron Vive Enabled, EcoSystem, (requires EDM)			**DTS**	Device Transfer Switch with Dimming Bypass [9, 11]
EDM	Lutron Hi-Lume EcoSystem Dimming to 1% [2]					**GTD**	Generator Transfer Device [9]
						F	Fuse

TRIM

LTR-4RD-T –

Aperture/Shape/Function		Lumen Package		CCT		CRI		Distribution	
LTR-4RD-T	4" Round Downlight Light Engine/Trim Assembly	**SL**	Standard Lumen	**27K**	2700K	**8**	80+CRI	**VNR**	Very Narrow (0.3 SC/20°) [13]
		ML	Medium Lumen	**30K**	3000K	**9**	90+CRI	**NR**	Narrow (0.4 SC/29°)
		HL	High Lumen	**35K**	3500K			**MD**	Medium (0.7 SC/44°)
				40K	4000K			**WD**	Wide (0.9 SC/61°)
				50K	5000K [1]			**XW**	Extra Wide (1.2 SC/78°)

TRIM CONTINUED

–

Reflector Finish		Reflector Color		Flange Color Options		Lower Trim Options		Reflector Options	
Finish not applicable with painted reflectors (WC or BC)		*Standard Clear*		*Standard matches reflector color*		**EM**	Pre-punched reflector for EM integral test switch and indicator	**AM**	Antimicrobial Coating [5]
S	Specular	**CG**	Champagne Gold	**WT**	White Flange [4]	**FM**	Flush Mount Mud-in Ring [10]		
SS	Semi-Specular	**BL**	Black	**BT**	Black Flange [4]	**WF**	Wide Flange		
MFC	American Matte™	**LW**	Light Wheat						
VS	Softglow®	**PW**	Pewter						
VSS	SoftSheen™	**WC**	Painted White Cone and Flange						
		BC	Painted Black Cone and Flange						

Accessories	
☐ **B24**	Set of two (2) 24" bar hangers for T-bar ceilings
☐ **B6**	Set of two bar hangers for ceiling joist up to 24" centers
☐ **FMR4-R**	Flush Mount Mud-In Ring Accessory, 4" Round
☐ **LiteGear**	LiteGear® Inverter, 125VA-250VA
☐ **LPS Series**	LightPower Micro-Inverter, 20VA-55VA
☐ **MOR4-R-WH**	Metal Oversized Ring, 4" Round, White (8.25" outside diameter)
☐ **MOR4-R-BL**	Metal Oversized Ring, 4" Round, Black (8.25" outside diameter)
☐ **LTR-SCA4-__**	Sloped Ceiling Adapter, 4", White [12]

Notes:

1 5000K available in 80+ CRI only.
2 2DM, EDM, DMX available in 10L-35L.
3 NX requires DM1 driver option.
4 WT not needed for WC, BT not needed for BC.
5 AM available with WC or Specular Clear (S or SWT). Consult factory for other colors.
6 347V requires DM1 driver option; not available in 06L or with Controls F, DTS, GTD, EM, EMR.
7 CP available up to 20L; not available with DMX, Controls, or EMR options.
8 IC available up to 20L; not available with Controls options.
9 Housing options (except Fuse) not available in combination.
10 Flush Mount Flange (FM) requires FMR accessory (sold separately).
11 DTS available with DM1, DM01, DALI, or EDM; not available with LVE.
12 Specify slope angle 5°-35° in 5° increments. Not available with EM, WF, or FM options.
13 VNR available up to 30L.

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HUBBELL Lighting

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LTR-4RD

LITEISTRY 4" ROUND DOWNLIGHT

DATE: LOCATION:

TYPE: PROJECT:

CATALOG #:

CONTROLS

NX Distributed Intelligence™ Lighting Controls:

Supports applications in a variety of deployment options- wired, wireless, hybrid. Integrates with and enables a wide array of luminaires including those with SpectraSync™ Color Tuning Technology.

NX DISTRIBUTED™ INTELLIGENCE

NX INTEGRATED CONTROLS REFERENCE								
NX Option	Sensor	Networkable	Scheduling	Occupancy	Daylight Harvesting	0–10V Dimming	On/off Control	Bluetooth® App Programming
NX Networked – Wired								
NXE	N/A	Yes	Yes	No	No	Yes	Yes	Requires NXBTC/R[1]
NX Networked – Wireless								
NXWE[2]	N/A	Yes	Yes	No	No	Yes	Yes	No[3]
NX Networked – Wired/Wireless								
NXWD	N/A	Yes	Yes	No	No	Yes	Yes	Requires NXBTC/R[1,3]

1 NXBTC/R needs to be plugged into an available NX SmartPort™ on the fixture network

2 Programming via App requires factory assistance

3 To program NXWE option, need to consult factory. If connected to an area controller, programming can be done from that

NX Design & Application Guide

NX Brochure

HUBBELL Lighting

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LTR-4RD

LITEISTRY 4" ROUND DOWNLIGHT

DATE: LOCATION:

TYPE: PROJECT:

CATALOG #:

PERFORMANCE DATA TABLE

Performance data provided below is for 3500K, 80 CRI with Specular Clear reflector finish/color

Lumen Package	Nominal Lumens	Distribution	"Delivered Lumens"	Watts	LPW
06L	600	Very Narrow	691	7.6	91
		Narrow	785	7.8	101
		Medium	726	7.8	93
		Wide	664	7.8	85
		Extra Wide	644	7.8	83
10L	1000	Very Narrow	1132	11.8	96
		Narrow	1255	12.0	105
		Medium	1160	12.0	97
		Wide	1062	12.0	89
		Extra Wide	1030	12.0	86
15L	1500	Very Narrow	1623	17.2	94
		Narrow	1795	18.6	97
		Medium	1660	18.6	89
		Wide	1519	18.6	82
		Extra Wide	1474	18.6	79
20L	2000	Very Narrow	2032	22.4	91
		Narrow	2238	22.5	99
		Medium	2152	22.5	96
		Wide	2059	22.5	92
		Extra Wide	2028	22.5	90
25L	2500	Very Narrow	2447	28.6	86
		Narrow	2985	27.8	107
		Medium	2760	27.8	99
		Wide	2526	27.8	91
		Extra Wide	2451	27.8	88
30L	3000	Very Narrow	2855	35.9	80
		Narrow	3583	34.6	104
		Medium	3313	34.6	96
		Wide	3032	34.6	88
		Extra Wide	2941	34.6	85
35L	3500	Narrow	4280	42.9	100
		Medium	3957	42.9	92
		Wide	3622	42.9	84
		Extra Wide	3514	42.9	82
40L	4000	Narrow	4885	51.5	95
		Medium	4517	51.5	88
		Wide	4134	51.5	80
		Extra Wide	4011	51.5	78

HUBBELL Lighting

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LTR-4RD

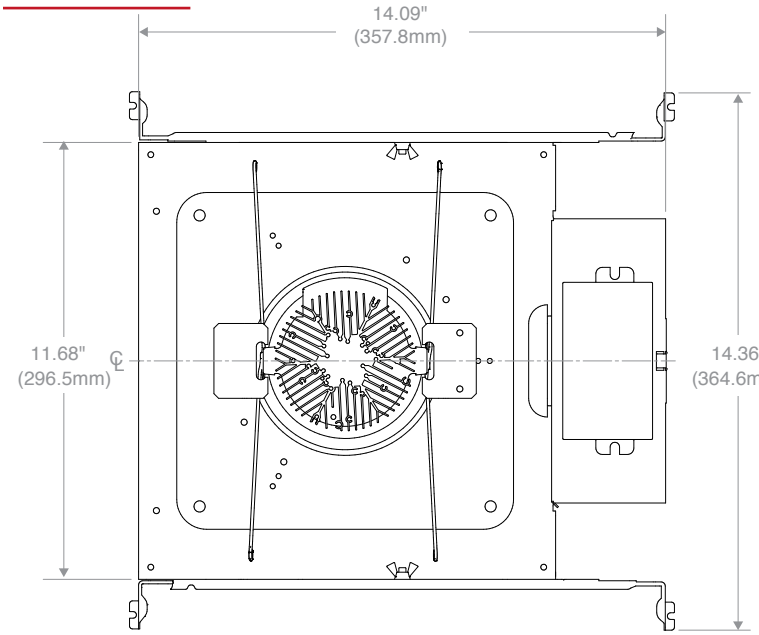
LITEISTRY 4" ROUND DOWNLIGHT

DATE: LOCATION:

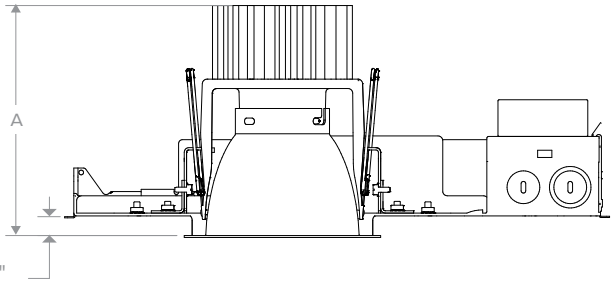
TYPE: PROJECT:

CATALOG #:

DIMENSIONS



Top View

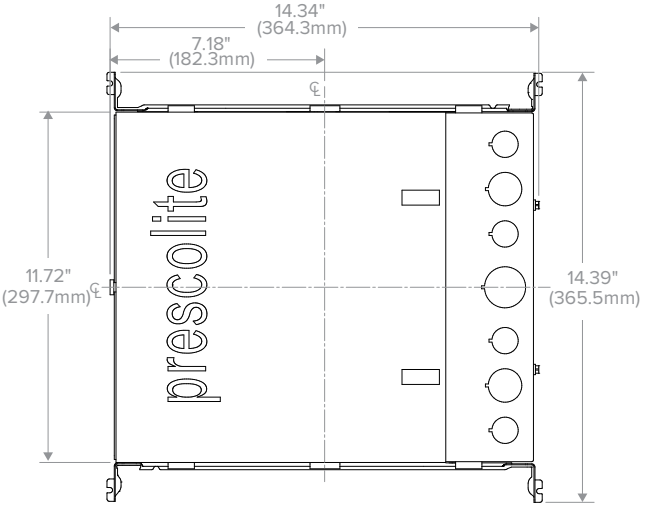


Dimensional Data		
Aperture		4.00" (101.6mm)
Flange:	Standard	5.25" (133.4mm)
	Flush Mount	4.50" (114.3mm)
Ceiling Cutout:	Standard	5.00" (127.0mm)
	Flush Mount	5.12" (130.0mm)
Ceiling Thickness:	Standard or w/ SCA 5-20° slope	0.50" to 2.00" (12.7mm to 50.8mm)
	With SCA 25-35° slope	0.50" to 1.75" (12.7mm to 44.6mm)

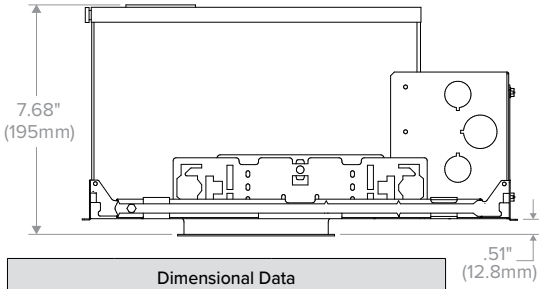
Lumen Package	"A"
06L-15L	4.97" (126.2mm)
20L-30L	6.15" (156.2mm)
35L-40L	7.33" (186.2mm)

SCA Sloped Ceiling Adapter accessory available, see LTR-SCA specification sheet and installation instructions for dimensional data and other details.

LTR-4RD-H New Construction



Top View



Dimensional Data		
Aperture		4.00" (101.6mm)
Flange:	Standard	5.25" (133.4mm)
	Flush Mount	4.50" (114.3mm)
Ceiling Cutout:	Standard	5.00" (127.0mm)
	Flush Mount	5.12" (130.0mm)
Ceiling Thickness:	Standard or w/ SCA 5-20° slope	0.50" to 2.00" (12.7mm to 50.8mm)
	With SCA 25-35° slope	0.50" to 1.75" (12.7mm to 44.6mm)

SCA Sloped Ceiling Adapter accessory available, see LTR-SCA specification sheet and installation instructions for dimensional data and other details.

LTR-4RD-H IC/CP

HUBBELL Lighting

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LTR-4RD

LITEISTRY 4" ROUND DOWNLIGHT

DATE: LOCATION:

TYPE: PROJECT:

CATALOG #:

PHOTOMETRY

LTR-4RD-H-ML20L-DM1 / LTR-4RD-T-ML35K8VNR-S

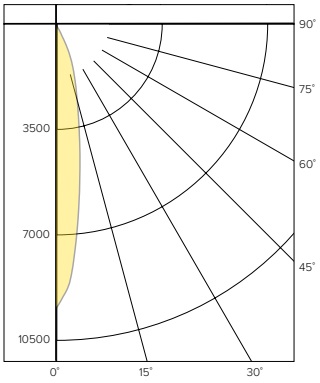
LUMINAIRE DATA

Test No.	**20.01331**
Description	**2000 lm, Very Narrow, 3500K, 80 CRI**
Delivered Lumens	**2032**
Watts	**22.4W**
Efficacy	**91**
Mounting	**Recessed**
Spacing Criterion	**0.3**
Beam Angle (FWHM)	**20**

ZONAL LUMEN SUMMARY

Zone	Lumens	% Luminaire
0-40	2011	99.0
0-60	2032	100.0
0-90	2032	100.0
0-180	2032	100.0

POLAR GRAPH



CANDELA DISTRIBUTION

Degree	Candela
0	9388
5	7360
15	2780
25	1073
35	198
45	20
55	0
65	0
75	0
85	0
90	0

LUMINANCE DATA*

Vertical Angle	Average
45°	3489
55°	0
65°	0
75°	0
85°	0

*Candela/Square Meter

LTR-4RD-H-ML20L-DM1 / LTR-4RD-T-ML35K8NR-S

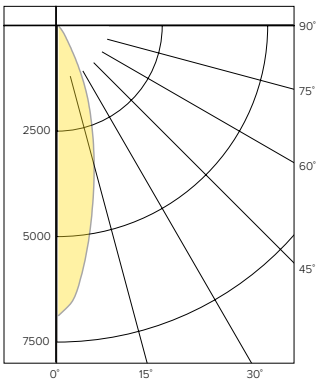
LUMINAIRE DATA

Test No.	**19.00532**
Description	**2000 lm, Narrow, 3500K, 80 CRI**
Delivered Lumens	**2238**
Watts	**22.5W**
Efficacy	**99.3**
Mounting	**Recessed**
Spacing Criterion	**0.4**
Beam Angle (FWHM)	**29**

ZONAL LUMEN SUMMARY

Zone	Lumens	% Luminaire
0-40	2208	98.6
0-60	2237	99.9
0-90	2238	100.0
0-180	2238	100.0

POLAR GRAPH



CANDELA DISTRIBUTION

Degree	Candela
0	6877
5	6035
15	3284
25	1313
35	260
45	26
55	3
65	1
75	0
85	0
90	0

LUMINANCE DATA*

Vertical Angle	Average
45°	4535
55°	645
65°	292
75°	0
85°	0

*Candela/Square Meter

LTR-4RD-H-ML20L-DM1 / LTR-4RD-T-ML35K8MD-S

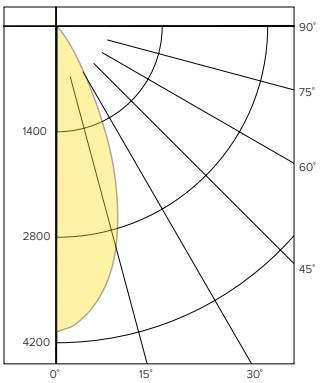
LUMINAIRE DATA

Test No.	**19.00533**
Description	**2000 lm, Medium, 3500K, 80 CRI**
Delivered Lumens	**2152**
Watts	**22.5W**
Efficacy	**95.6**
Mounting	**Recessed**
Spacing Criterion	**0.7**
Beam Angle (FWHM)	**44**

ZONAL LUMEN SUMMARY

Zone	Lumens	% Luminaire
0-40	2113	98.2
0-60	2151	99.9
0-90	2152	100.0
0-180	2152	100.0

POLAR GRAPH



CANDELA DISTRIBUTION

Degree	Candela
0	4053
5	3893
15	3037
25	1493
35	366
45	34
55	3
65	1
75	0
85	0
90	0

LUMINANCE DATA*

Vertical Angle	Average
45°	5931
55°	645
65°	292
75°	0
85°	0

*Candela/Square Meter

IES FILE

IES FILE

HUBBELL Lighting

LTR-4RD

LITEISTRY 4" ROUND DOWNLIGHT

PHOTOMETRY CONTINUED

LTR-4RD-H-ML20L-DM1 / LTR-4RD-T-ML35K8WD-S

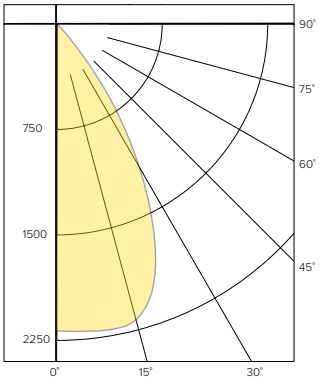
LUMINAIRE DATA

Test No.	**19.00534**
Description	**2000 lm, Wide, 3500K, 80 CRI**
Delivered Lumens	**2059**
Watts	**22.5W**
Efficacy	**91.6**
Mounting	**Recessed**
Spacing Criterion	**0.9**
Beam Angle (FWHM)	**61**

ZONAL LUMEN SUMMARY

Zone	Lumens	% Luminaire
0-40	1983	96.3
0-60	2056	99.8
0-90	2059	100.0
0-180	2059	100.0

POLAR GRAPH



CANDELA DISTRIBUTION

Degree	Candela
0	2201
5	2210
15	2051
25	1504
35	692
45	169
55	10
65	3
75	1
85	0
90	0

LUMINANCE DATA*

Vertical Angle	Average
45°	11338
55°	1075
65°	584
75°	477
85°	0

*Candela/Square Meter

IES FILE

LTR-4RD-H-ML20L-DM1 / LTR-4RD-T-ML35K8XW-S

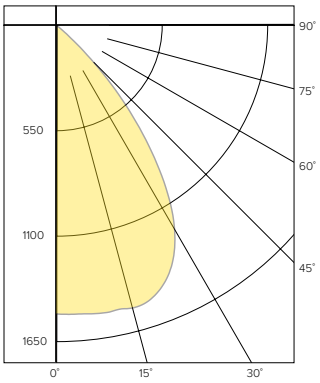
LUMINAIRE DATA

Test No.	**19.00535**
Description	**2000 lm, Extra Wide, 3500K, 80 CRI**
Delivered Lumens	**2028**
Watts	**22.5W**
Efficacy	**90.2**
Mounting	**Recessed**
Spacing Criterion	**1.2**
Beam Angle (FWHM)	**78**

ZONAL LUMEN SUMMARY

Zone	Lumens	% Luminaire
0-40	1794	88.5
0-60	2025	99.8
0-90	2028	100.0
0-180	2028	100.0

POLAR GRAPH



CANDELA DISTRIBUTION

Degree	Candela
0	1235
5	1252
15	1392
25	1454
35	1010
45	256
55	6
65	2
75	1
85	0
90	0

LUMINANCE DATA*

Vertical Angle	Average
45°	44656
55°	1290
65°	584
75°	231
85°	477

*Candela/Square Meter

IES FILE

LUMEN MULTIPLIER

Option	27K8	30K8	35K8	40K8	50K8	27K9	30K9	35K9	40K9
Multiplier	0.94	0.98	1.00	1.01	1.02	0.81	0.84	0.85	0.85

Photometrics are published below at a nominal 3500 Kelvin, 80+ CRI. This table may be used to approximate the lumen values at different Kelvin temperatures. Power consumption would stay the same.

REFLECTOR FINISH MULTIPLIER (Based on Clear (Standard) Color)

Option	Specular (S)	Semi-Specular (SS)	American Matte (MFC)	Softglow (VS)	Softsheen (VSS)
Multiplier	1	1	0.984	0.888	0.938

REFLECTOR COLOR MULTIPLIER (Based on Semi-Specular (SS) Finish)

Option	Clear (Standard)	Champagne Gold (CG)	Black (BL)	Light Wheat (LW)	Pewter (PW)	White Cone (WC)	Black Cone (BC)
Multiplier	1	0.974	0.444	0.861	0.915	0.984	0.442

Multiply FINISH x COLOR to calculate other reflector finish and color combinations. Example: SoftGlow Pewter (VSPW) = 0.888 (VS) x 0.915 (PW) = 0.813

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LTR-4RD

LITEISTRY 4" ROUND DOWNLIGHT

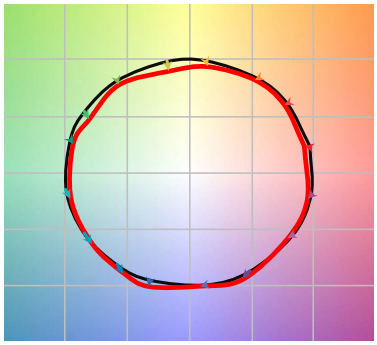
DATE: LOCATION:

TYPE: PROJECT:

CATALOG #:

TM-30 DATA

COLOR VECTOR GRAPHIC 3500K, 90 CRI

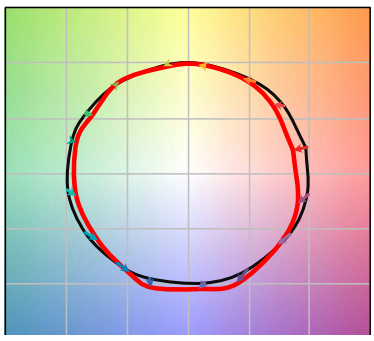


Reference Illuminant — Test Source

COLOR DISTORTION GRAPHIC 3500K, 90 CRI

TEST RESULTS - 3500K		
Value	80+ CRI	90+ CRI
R_f	84	88
R_g	95	95
CCT (K)	3411	3419
D_{UV}	0.0015	0.0042
x	0.4120	0.4147
y	0.3974	0.4052
CIE R_a	84	93
CIE R_9	11	62

COLOR VECTOR GRAPHIC 3500K, 80 CRI



Reference Illuminant — Test Source

COLOR DISTORTION GRAPHIC 3500K, 80 CRI

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DATE: LOCATION:

TYPE: PROJECT:

CATALOG #:

LTR-4RD

LITEISTRY 4" ROUND DOWNLIGHT

ELECTRICAL DATA

DRIVER DATA		
Input Voltage	120-277 V	347 V
Input Frequency	50/60 Hz	50/60 Hz
Power Factor	≥0.90	≥0.90
THD	<20%	<20%
EMI Filtering (FCC 47 CFR Part 15)	Class A	Class A

* Values for DM1 option shown, values for other dimming options may vary.

WATTAGE DATA		
Lumen Output	Nominal Lumens	Wattage
06L	600	8
10L	1000	12
15L	1500	19
20L	2000	23
25L	2500	28
30L	3000	35
35L	3500	43
40L	4000	52

* Wattage may vary based on configuration and options selected

ADDITIONAL INFORMATION

DIMMING COMPATIBILITY CHART		
Dimming Driver	Manufacturer	Web Link
DM1 /DM01	Lutron DVTV	http://bit.ly/11jSvZg
DM1	Leviton AWRMG-7xx, AWSMG-7xx, AWSMT-7xx	http://bit.ly/1BJn2R9
EDM	Lutron	http://bit.ly/1vtjHAl
2DM	Lutron	http://bit.ly/1S4WjXK

DMX

See instruction sheet on www.prescolite.com for connection & installation information.

Central Inverters

For full fixture output in back-up mode, we recommend you visit www.dual-lite.com for your Central Lighting Inverter options. Please contact your local Hubbell representative for any assistance with proper sizing and loading of your inverter selection. Central lighting inverters must be ordered separately.
LiteGear: www.dual-lite.com/products/litegear_lg_series
LPS Series: www.dual-lite.com/products/lps

ENERGY STAR®

For a list of certified models, click on the ENERGY STAR® MODELS link or visit www.energystar.gov.

ENERGY STAR MODELS

HUBBELL Lighting

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DATE: LOCATION:

TYPE: PROJECT:

CATALOG #:

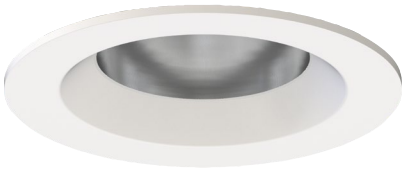
LTR-4RD (SH)

LITEISTRY 4" ROUND NON-CONDUCTIVE SHOWER DOWNLIGHT

LITEISTRY

FEATURES

- 4" architectural LED downlight delivering 600 – 2500 lm
- Non-conductive dead-front trim
- Available with four regressed lens options
- Suitable for wet locations, covered ceiling
- IP65 rated (room side)
- Anti-microbial finish, optional
- 2700K - 5000K, 80+ and 90+ CRI options
- Available for New Construction (non-IC), IC and Chicago Plenum applications
- Variety of dimming protocol options including 0-10V, DALI, DMX, Lutron Forward Phase and EcoSystem



WET LOCATION

C SA US

IP65

RELATED PRODUCTS

- 3" LITEISTRY Family
- 4" LITEISTRY Family
- 6" LITEISTRY Family

CONTROL TECHNOLOGY

NX DISTRIBUTED INTELLIGENCE

SPECIFICATIONS

CONSTRUCTION

- Standard Non-IC. Chicago Plenum and IC options
- Painted black durable steel platform with pre-installed bar hangers
- Pre-wired junction box with snap-on covers for easy access
- Snap-in connection from driver compartment allows easy installation
- Light Engine connections use plenum rated (CMP) cable

OPTICS

- Durable, non-conductive trim with 1/2" regressed lens
- Lens options include acrylic, polycarbonate, or tempered glass micro-prism, and clear acrylic
- Smooth room side lens surface for easy wipe down
- Available in white, black, or anti-microbial white trim color

ELECTRICAL

- Chip-on-board LED with 2 SDCM
- Multiple CCTs, 80+ or 90+ CRI
- Long LED life: L90 at >55,000 hours (TM-21)
- Universal voltage 120V–277V driver, 347V optional
- UL Class 2, inherent short circuit and overload protection, RoHS compliant
- Flicker free 0-10V dimming with 1% or <1% performance
- DALI, DMX, and Lutron Forward Phase and EcoSystem options
- Remote emergency controller and battery pack option available
- NX or Lutron Vive control options available

INSTALLATION

- Accommodates ceiling thickness up to 2"
- Universal adjustable mounting brackets also accept 0.5" EMT conduit or 1.5" or 0.75" lathing channel (by others) or Prescolite accessory bar hangers (B24 or B6)
- Light Engine/Driver fully serviceable from above or below the ceiling

CERTIFICATIONS

- cCSAus certified to UL 1598
- IP65 rated (room side) when properly installed per installation instructions
- Suitable for wet locations, covered ceiling. EMR: Suitable for damp locations.
- EMR: Certified under UL 924 standard for emergency lighting and power equipment
- Approved for 8 (4 in/4 out) No. 12AWG conductors rated for 90°C through wiring

WARRANTY

- 5 year warranty
- See HLI Standard Warranty for additional information

KEY DATA	
Lumen Range	600-2500
Wattage Range	8-28
Efficacy Range (LPW)	49-52*
Reported Life (Hours)	L90 / >55,000
Input Current (mA)	65-233 (120V)

*Based on 35K, 80 CRI

HUBBELL Lighting

prescolite

DATE: LOCATION:

TYPE: PROJECT:

CATALOG #:

LTR-4RD (SH)

LITEISTRY 4" ROUND NON-CONDUCTIVE SHOWER DOWNLIGHT

ORDERING GUIDE

Example: LTR–4RD–H–SL10L–DM1–LTR–4RD–-SHSL35K8-WTAML

CATALOG #

HOUSING

LTR-4RD-H –

Aperture/Shape/Function		Lumen Package		Lumen Output	
LTR-4RD-H	4" Round Downlight New Construction Housing	**SL**	Standard Lumen	**06L**	600
				10L	1000
				15L	1500
		ML	Medium Lumen	**20L**	2000
				25L	2500

–

Driver Options		Control Options		Voltage		Housing Options	
DM1	0-10V Dimming to 1%	**NXE**	NX Enabled, Dual SmartPorts [3]	*Standard 120-277V*		**CP**	Chicago Plenum [6, 8]
DM01	0-10V Dimming to < 1%	**NXWE**	NX Wireless Enabled [3]	**34**	347V [5]	**IC**	IC Rated [6, 9]
DMX	DMX with RDM dimming to < 0.1% [2]	**NXWD**	NX Wireless Enabled, Dual SmartPorts [3]			**EMR**	Emergency Battery Pack with remote test switch and indicator light [6]
DALI	DALI Dimming to 1%	**LV**	Lutron Vive Enabled, 0-10V (requires 0-10V driver)			**DTS**	Device Transfer Switch with Dimming Bypass [6, 7]
2DM	Lutron Hi-Lume 2-wire Dimming to 1% (120V Forward Phase only) [2]	**LVE**	Lutron Vive Enabled, EcoSystem, (requires EDM)			**GTD**	Generator Transfer Device [6]
EDM	Lutron Hi-Lume EcoSystem Dimming to 1% [2]					**F**	Fuse

TRIM

LTR-4RD-T –

Aperture/Shape/Function		Trim Style		Lumen Package		CCT		CRI	
LTR-4RD-T	4" Round Downlight Light Engine/Trim Assembly	**SH**	Non-Conductive Shower Trim	**SL**	Standard Lumen	**27K**	2700K	**8**	80+CRI
				ML	Medium Lumen	**30K**	3000K	**9**	90+CRI
						35K	3500K		
						40K	4000K		
						50K	5000K [1]		

TRIM CONTINUED

–

Trim Color		Lens Options		Options	
WT	White Trim and Flange	**AML**	Acrylic, Micro-prism	**AM**	Antimicrobial [4]
BT	Black Trim and Flange	**PML**	Polycarbonate, Micro-prism		
		GML	Tempered glass, Micro-prism		
		ACL	Acrylic, Clear		

Accessories	
☐ **B24**	Set of two (2) 24" bar hangers for T-bar ceilings
☐ **B6**	Set of two bar hangers for ceiling joist up to 24" centers
☐ **LiteGear**	LiteGear® Inverter, 125VA-250VA
☐ **LPS Series**	LightPower Micro-Inverter, 20VA-55VA

Notes:

1 5000K available in 80+ CRI only.
2 2DM, EDM, DMX available in 10L-25L.
3 NX requires DM1 driver option.
4 AM available with White (WT) only. Consult factory for other colors.
5 347V requires DM1 driver option; not available in 06L or with Controls F, DTS, GTD, EMR.
6 Housing options (except Fuse) not available in combination.
7 DTS available with DM1, DM01, DALI, or EDM; not available with LVE.
8 CP available up to 20L; not available with DMX, Controls, or EMR options.
9 IC available up to 20L; not available with Controls options.

HUBBELL Lighting

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DATE: LOCATION:

TYPE: PROJECT:

CATALOG #:

LTR-4RD (SH)

LITEISTRY 4" ROUND NON-CONDUCTIVE SHOWER DOWNLIGHT

CONTROLS

NX Distributed Intelligence™ Lighting Controls:

Supports applications in a variety of deployment options- wired, wireless, hybrid. Integrates with and enables a wide array of luminaires including those with SpectraSync™ Color Tuning Technology.

NX DISTRIBUTED™ INTELLIGENCE

NX INTEGRATED CONTROLS REFERENCE								
NX Option	Sensor	Networkable	Scheduling	Occupancy	Daylight Harvesting	0–10V Dimming	On/off Control	Bluetooth® App Programming
NX Networked – Wired								
NXE	N/A	Yes	Yes	No	No	Yes	Yes	Requires NXBTC/R[1]
NX Networked – Wireless								
NXWE[2]	N/A	Yes	Yes	No	No	Yes	Yes	No[3]
NX Networked – Wired/Wireless								
NXWD	N/A	Yes	Yes	No	No	Yes	Yes	Requires NXBTC/R[1,3]

1 NXBTC/R needs to be plugged into an available NX SmartPort™ on the fixture network

2 Programming via App requires factory assistance

3 To program NXWE option, need to consult factory. If connected to an area controller, programming can be done from that

PERFORMANCE DATA TABLE

Performance data provided below is for 3500K, 80 CRI.

Lumen Package	Nominal Lumens	Lens Description	Delivered Lumens	Watts	LPW
06L	600	Acrylic Micro-prism	358	7.8	46
		Polycarbonate Micro-prism	350	7.8	45
		Tempered Glass Micro-prism	366	7.8	47
		Acrylic Clear	366	7.8	47
10L	1000	Acrylic Micro-prism	572	12.0	48
		Polycarbonate Micro-prism	559	12.0	47
		Tempered Glass Micro-prism	586	12.0	49
		Acrylic Clear	586	12.0	49
15L	1500	Acrylic Micro-prism	818	18.6	44
		Polycarbonate Micro-prism	800	18.6	43
		Tempered Glass Micro-prism	838	18.6	45
		Acrylic Clear	838	18.6	45
20L	2000	Acrylic Micro-prism	1109	22.1	50
		Polycarbonate Micro-prism	1084	22.1	49
		Tempered Glass Micro-prism	1136	22.1	51
		Acrylic Clear	1136	22.1	51
25L	2500	Acrylic Micro-prism	1361	27.8	49
		Polycarbonate Micro-prism	1330	27.8	48
		Tempered Glass Micro-prism	1394	27.8	50
		Acrylic Clear	1394	27.8	50

NX Design & Application Guide
NX Brochure

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DATE: LOCATION:

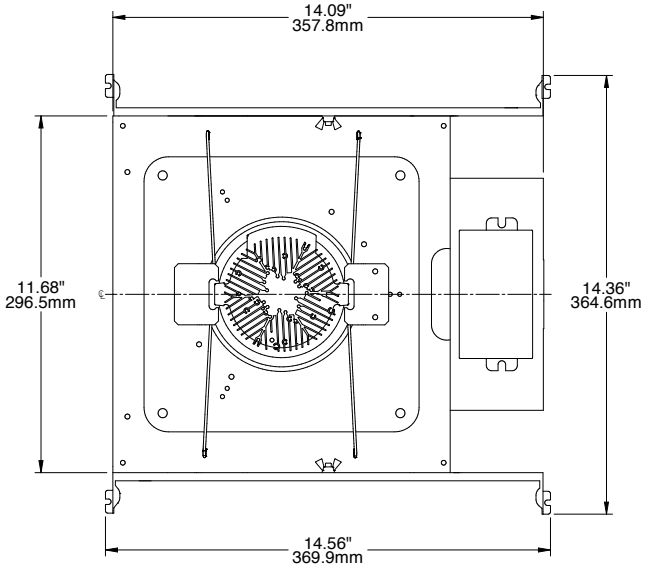
TYPE: PROJECT:

CATALOG #:

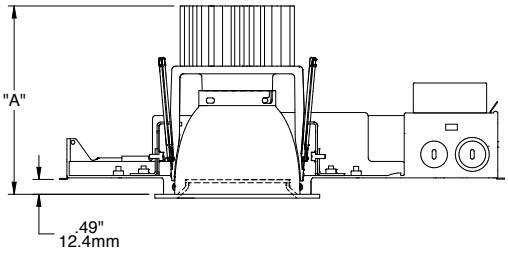
LTR-4RD (SH)

LITEISTRY 4" ROUND NON-CONDUCTIVE SHOWER DOWNLIGHT

DIMENSIONS



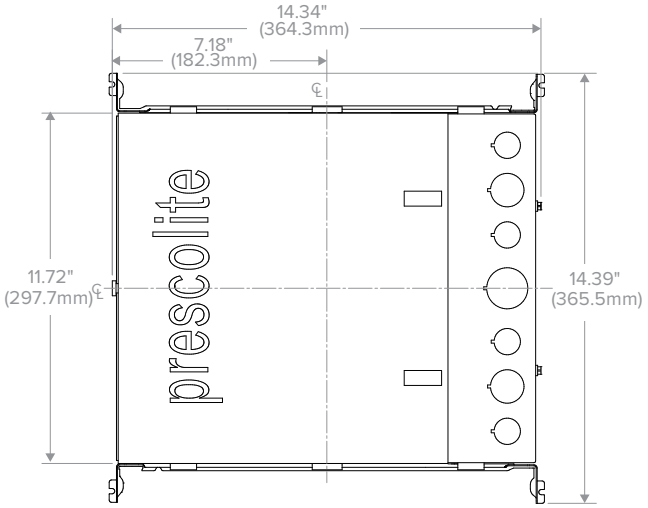
Top View



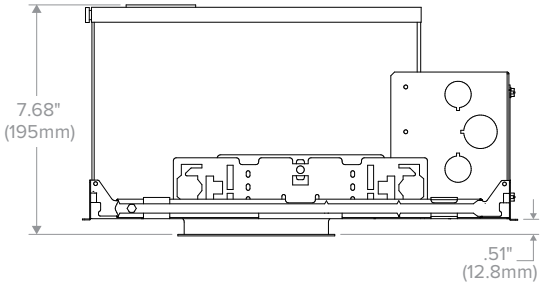
Dimensional Data		
Aperture		4.00" (101.6mm)
Flange	Standard	5.39" (136.9mm)
Ceiling Cutout	Standard	5.00" (127.0mm)
Ceiling Thickness		0.50" to 2.00" (12.7mm to 50.8mm)

Lumen Package	"A"
06L-15L	4.97" (126.2mm)
20L-25L	6.15" (156.2mm)

LTR-4RD-H-SH



Top View



Dimensional Data		
Aperture		4.00" (101.6mm)
Flange	Standard	5.39" (136.9mm)
Ceiling Cutout	Standard	5.00" (127.0mm)
Ceiling Thickness		0.50" to 2.00" (12.7mm to 50.8mm)

LTR-4RD-H-SH (IC/CP)

HUBBELL Lighting

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DATE: LOCATION:

TYPE: PROJECT:

CATALOG #:

LTR-4RD (SH)

LITEISTRY 4" ROUND NON-CONDUCTIVE SHOWER DOWNLIGHT

PHOTOMETRY

LTR-4RD-H-ML20L-DM1 / LTR-4RD-T-SHML35K8WTAML

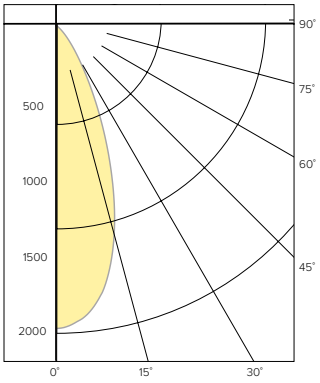
LUMINAIRE DATA

Test No.	**20.01609**
Description	**Acrylic Micro-prism lens, 3500K, 80 CRI**
Delivered Lumens	**1109**
Watts	**22.1W**
Efficacy	**50**
Mounting	**Recessed**
Spacing Criterion	**0.7**
Beam Angle (FWHM)	**41**

ZONAL LUMEN SUMMARY

Zone	Lumens	% Luminaire
0-40	1011	91.1
0-60	1093	98.5
0-90	1109	100.0
0-180	1109	100.0

POLAR GRAPH



CANDELA DISTRIBUTION

Degree	Candela
0	1977
5	1920
15	1412
25	654
35	226
45	75
55	24
65	11
75	4
85	1
90	0

LUMINANCE DATA*

Vertical Angle	Average
45°	14790
55°	5892
65°	3600
75°	2428
85°	1045

*Candela/Square Meter

LTR-4RD-H-ML20L-DM1 / LTR-4RD-T-SHML35K8WTPML

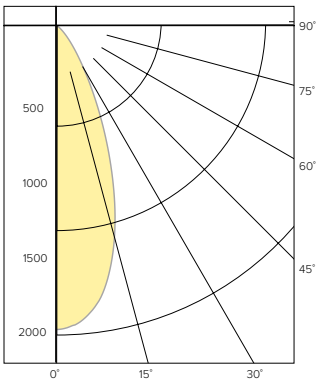
LUMINAIRE DATA

Test No.	**20.01611**
Description	**Polycarbonate Micro-prism lens, 3500K, 80 CRI**
Delivered Lumens	**1084**
Watts	**22.1W**
Efficacy	**49.1**
Mounting	**Recessed**
Spacing Criterion	**0.7**
Beam Angle (FWHM)	**41**

ZONAL LUMEN SUMMARY

Zone	Lumens	% Luminaire
0-40	989	91.3
0-60	1069	98.6
0-90	1084	100.0
0-180	1084	100.0

POLAR GRAPH



CANDELA DISTRIBUTION

Degree	Candela
0	1938
5	1882
15	1381
25	641
35	222
45	73
55	23
65	10
75	4
85	2
90	0

LUMINANCE DATA*

Vertical Angle	Average
45°	14450
55°	5607
65°	3262
75°	2152
85°	978

*Candela/Square Meter

LTR-4RD-H-ML20L-DM1 / LTR-4RD-T-SHML35K8WTGML

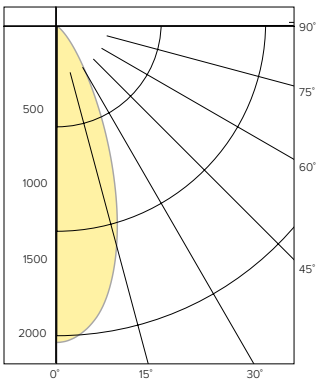
LUMINAIRE DATA

Test No.	**20.01612**
Description	**Tempered Glass Micro-prism lens, 3500K, 80 CRI**
Delivered Lumens	**1136**
Watts	**22.1W**
Efficacy	**51.5**
Mounting	**Recessed**
Spacing Criterion	**0.7**
Beam Angle (FWHM)	**41**

ZONAL LUMEN SUMMARY

Zone	Lumens	% Luminaire
0-40	1039	91.5
0-60	1119	98.5
0-90	1136	100.0
0-180	1136	100.0

POLAR GRAPH



CANDELA DISTRIBUTION

Degree	Candela
0	2065
5	1997
15	1458
25	672
35	228
45	73
55	23
65	10
75	5
85	1
90	0

LUMINANCE DATA*

Vertical Angle	Average
45°	14460
55°	5608
65°	3480
75°	2454
85°	1445

*Candela/Square Meter

HUBBELL Lighting

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DATE: LOCATION:

TYPE: PROJECT:

CATALOG #:

LTR-4RD (SH)

LITEISTRY 4" ROUND NON-CONDUCTIVE SHOWER DOWNLIGHT

PHOTOMETRY CONTINUED

LTR-4RD-H-ML20L-DM1 / LTR-4RD-T-SHML35K8WTACL

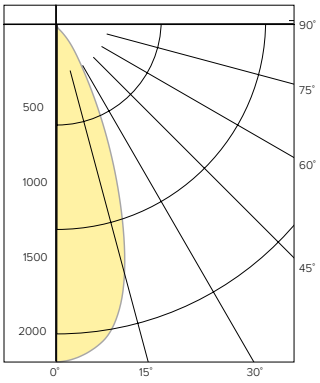
LUMINAIRE DATA

Test No.	**20.01613**
Description	**Acrylic Clear lens, 3500K, 80 CRI**
Delivered Lumens	**1136**
Watts	**22.1W**
Efficacy	**51.5**
Mounting	**Recessed**
Spacing Criterion	**0.7**
Beam Angle (FWHM)	**41**

ZONAL LUMEN SUMMARY

Zone	Lumens	% Luminaire
0-40	1078	94.9
0-60	1127	99.2
0-90	1136	100.0
0-180	1136	100.0

POLAR GRAPH



CANDELA DISTRIBUTION

Degree	Candela
0	2184
5	2136
15	1638
25	658
35	202
45	47
55	10
65	5
75	3
85	1
90	0

LUMINANCE DATA*

Vertical Angle	Average
45°	9400
55°	2390
65°	1794
75°	1420
85°	1191

*Candela/Square Meter

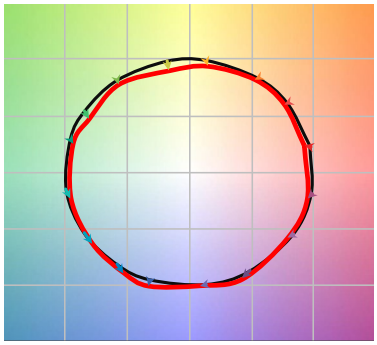
LUMEN MULTIPLIER

Option	27K8	30K8	35K8	40K8	50K8	27K9	30K9	35K9	40K9
Multiplier	0.94	0.98	1.00	1.01	1.02	0.81	0.84	0.85	0.85

Photometrics are published below at a nominal 3500 Kelvin, 80+ CRI. This table may be used to approximate the lumen values at different Kelvin temperatures. Power consumption would stay the same.

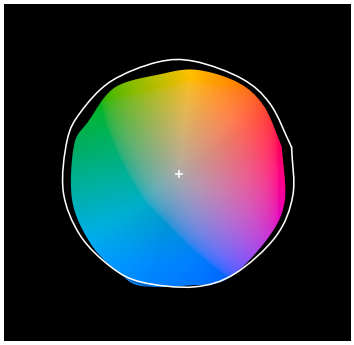
TM-30 DATA

COLOR VECTOR GRAPHIC 3500K, 90 CRI



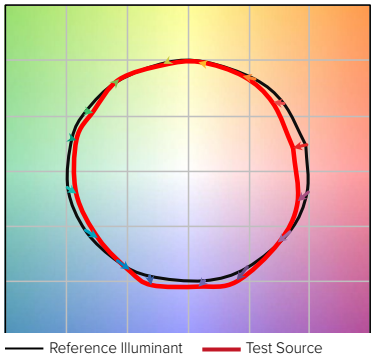
Reference Illuminant — Test Source

COLOR DISTORTION GRAPHIC 3500K, 90 CRI



TEST RESULTS - 3500K		
Value	80+ CRI	90+ CRI
R_f	84	88
R_g	95	95
CCT (K)	3411	3419
D_{UV}	0.0015	0.0042
x	0.4120	0.4147
y	0.3974	0.4052
CIE R_a	84	93
CIE R_9	11	62

COLOR VECTOR GRAPHIC 3500K, 80 CRI



Reference Illuminant — Test Source

COLOR DISTORTION GRAPHIC 3500K, 80 CRI

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DATE: LOCATION:

TYPE: PROJECT:

CATALOG #:

LTR-4RD (SH)

LITEISTRY 4" ROUND NON-CONDUCTIVE SHOWER DOWNLIGHT

ELECTRICAL DATA

DRIVER DATA		
Input Voltage	120-277 V	347 V
Input Frequency	50/60 Hz	50/60 Hz
Power Factor	≥0.90	≥0.90
THD	<20%	<20%
EMI Filtering (FCC 47 CFR Part 15)	Class A	Class A

* Values for DM1 option shown, values for other dimming options may vary.

WATTAGE DATA		
Lumen Output	Nominal Lumens	Wattage
06L	600	8
10L	1000	12
15L	1500	19
20L	2000	23
25L	2500	28

* Wattage may vary based on configuration and options selected

ADDITIONAL INFORMATION

DIMMING COMPATIBILITY CHART		
Dimming Driver	Manufacturer	Web Link
DM1 /DM01	Lutron DVTV	http://bit.ly/11jSvZg
DM1	Leviton AWRMG-7xx, AWSMG-7xx, AWSMT-7xx	http://bit.ly/1BJn2R9
EDM	Lutron	http://bit.ly/1vtjHAl
2DM	Lutron	http://bit.ly/1S4WjXK

DMX

See instruction sheet on www.prescolite.com for connection & installation information.

Central Inverters

For full fixture output in back-up mode, we recommend you visit www.dual-lite.com for your Central Lighting Inverter options. Please contact your local Hubbell representative for any assistance with proper sizing and loading of your inverter selection. Central lighting inverters must be ordered separately.
LiteGear: www.dual-lite.com/products/litegear_lg_series
LPS Series: www.dual-lite.com/products/lps

HUBBELL Lighting

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DATE: LOCATION:

TYPE: PROJECT:

CATALOG #:

LTC-6RDW

LITEISTRY 6" ROUND CYLINDER

LITEISTRY

FEATURES

- 6" architectural LED downlight and wall wash cylinder delivering 600 - 7000 lm
- Five beam distributions from 0.3 to 1.1 Spacing Criteria
- Quiet reflector appearance with 50° optical cutoff
- 2700K - 5000K, 80+ and 90+ CRI options
- Available in Surface, Wall, Pendant, or Cord Mount configurations
- Variety of dimming protocol options including 0-10V, DALI, DMX, Forward Phase and EcoSystem

WET LOCATION (Select Models)

C SA US

BUY AMERICAN SOLUTIONS See Certification Specifications

RELATED PRODUCTS

LTC-6RDW SpectraSync

LTC-6RDWPH PowerHUBB

3" LITEISTRY Family

4" LITEISTRY Family

6" LITEISTRY Family

CONTROL TECHNOLOGY

NX DISTRIBUTED INTELLIGENCE

SPECIFICATIONS

CONSTRUCTION

- Seamless heavy gauge aluminum cylinder body with a clean appearance
- Select from 4 durable powder coat paint architectural finishes or Brushed Aluminum
- Available in Surface, Wall, Pendant, or Cable/Cord mounting options
- Wall Mount: One piece die cast aluminum mounting arm
- Pendant Mount: Swivel canopy allows sloped ceiling mounting up to 45 degrees
- Integral driver versions allow direct mounting to a standard 4" octagonal or square junction box
- Some configurations require remote mount driver assembly (see line art)

OPTICS

- Visually pleasing 50° cutoff to source and source image
- The light distribution is free of distracting bright spots or pixelation and the perimeter has a smooth transition
- Optical grade silicone lens integral to light engine
- High purity spun aluminum reflector, self-flanged
- Large selection of anodized finishes and colors
- Painted cones and flange options available

ELECTRICAL

- Chip-on-board (COB) LED with 2 SDCM
- Multiple CCTs, 80+ or 90+ CRI
- Long LED life: L90 at >55,000 (TM-21)
- Universal voltage 120V-277V driver, 347V optional
- UL Class 2, inherent short circuit and overload protection, RoHS compliant
- Flicker free 0-10V dimming with 1% or <1% performance
- DALI, DMX, and Lutron Forward Phase and EcoSystem options

INSTALLATION

- Light Engine/Trim assembly is mechanically secured with torsion springs for ease of installation
- A quick connect is provided for easy maintenance or upgrade
- Remote mount driver/jbox assembly requires 6" plenum clearance
- Remote driver is accessible from above or below the ceiling
- NX or Lutron Vive control options available
- Refer to additional spec sheets for information on SpectraSync™ Tunable White or Dim-to-Warm or PowerHUBB™ PoE enabled solutions

CERTIFICATIONS

- cCSAus certified to UL 1598
- Wall Mount up to 55L: Suitable for wet locations
- Pendant Mount up to 55L: Suitable for wet locations under covered ceiling
- 60L-70L Pendant & Wall, all Surface, Cord Mount and all Wall Wash: Suitable for damp locations
- This product qualifies as a "designated country construction material" per FAR 52.225-11 Buy American-Construction. Materials under Trade Agreements effective 6/6/2020. See Buy American Solutions.

WARRANTY

- 5 year warranty
- See HLI Standard Warranty for additional information

KEY DATA	
Lumen Range	600-7000
Wattage Range	8-72
Efficacy Range (LPW)	94-104*
Reported Life (Hours)	L90 / >55,000
Input Current (mA)	67-600 (120V)

*Based on Specular, 35K, 80 CRI

PHOTOMETRY

DIMENSIONAL DRAWINGS

HUBBELL Lighting

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LTC-6RDW

LITEISTRY 6" ROUND CYLINDER

DATE: LOCATION:

TYPE: PROJECT:

CATALOG #:

ORDERING GUIDE

Example: LTC-6RD-P-15L35K9WD-DM1-SS-WH

CATALOG # LTC-6RD – – – – –

Aperture/Shape/Function	
LTC-6RD	6" Round Downlight Cylinder
LTC-6RW	6" Round Wall Wash Cylinder

Cylinder Mounting	
S	Surface
W	Wall
P	Pendant (18" Stem Standard)
CM	Cable/Cord (6 ft. Cord Standard) [5]

Lumen Output	
06L	600 Lumens
10L	1000 Lumens
15L	1500 Lumens
20L	2000 Lumens
25L	2500 Lumens
30L	3000 Lumens
35L	3500 Lumens
40L	4000 Lumens
45L	4500 Lumens
50L	5000 Lumens
55L	5500 Lumens
60L	6000 Lumens [8]
70L	7000 Lumens [8]

CCT	
27K	2700K
30K	3000K
35K	3500K
40K	4000K
50K	5000K [1]

CRI	
8	80+ CRI
9	90+ CRI

Distribution	
VNR	Very Narrow (0.3 SC/18°) [10]
NR	Narrow (0.5 SC/29°)
MD	Medium (0.6 SC/37°)
WD	Wide (0.9 SC/59°)
XW	Extra Wide (1.1 SC/76°)
WW	Wall Wash

– – – – –

Driver Options [3]	
DM1	0-10V Dimming to 1% [9]
DM01	0-10V Dimming to <1%
DMX	DMX with RDM dimming to <0.1% [7]
DALI	DALI Dimming to 1%
2DM	Lutron Hi-Lume 2-wire Dimming to 1% (120V Forward Phase only)
EDM	Lutron Hi-Lume EcoSystem Dimming to 1%

Control Options [3, 7]	
NXE	NX Enabled, Dual SmartPorts [2]
NXWE	NX Wireless Enabled [2]
NXWD	NX Wireless Enabled, Dual SmartPorts [2]
LV	Lutron Vive Enabled, 0-10V (requires DM1 driver)
LVE	Lutron Vive Enabled, EcoSystem, (requires EDM)

Voltage	
Standard 120-277V	
34	347V [3, 6]

Reflector Finish	
Finish not applicable with painted reflectors (WC or BC)	
S	Specular
SS	Semi-Specular
MFC	American Matte™
VS	Softglow®
VSS	SoftSheen™

Reflector Color	
Standard Clear	
CG	Champagne Gold
BL	Black
LW	Light Wheat
PW	Pewter
WC	Painted White Cone and Flange
BC	Painted Black Cone and Flange

Flange Color Options	
Standard matches reflector color	
WT	White Flange [4]
BT	Black Flange [4]

Exterior Cylinder Color	
BA	Brushed Aluminum
BZ	Bronze
BL	Matte Black
WH	Matte White
SVR	Silver

Notes:

1 5000K available in 80+ CRI only.
2 NX requires DM1 driver.
3 For lumen outputs/configurations available, see chart on page 3.
4 WT not needed for WC, BT not needed for BC.
5 CM standard cord color is Clear.
6 347V requires DM1 driver option; Not available with Controls.
7 Controls not available with wall mount (W): S, P, CM with DMX or controls options require remote driver, see line art for details.
8 60L and 70L require vented cylinder.
9 DM1 on >60L is 0-10V to 5% dimming.
10 VNR not available with IC or CP options.

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HUBBELL Lighting

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LTC-6RDW

LITEISTRY 6" ROUND CYLINDER

DATE: LOCATION:

TYPE: PROJECT:

CATALOG #:

DRIVER/CONTROL OPTION AVAILABILITY

Driver and Control options listed below are available in the configurations and lumen packages as shown.

Driver/Control Option		Cylinder Mounting [1]	Integral Remote Driver [1]	06L	10L	15L	20L	25L	30L	35L	40L	45L	50L	55L	60L	70L [4]
DM1	0-10V 1% [4]	W	Integral	●	●	●	●	●	●	●	●	●	●	●	▼	▼
		S/P/CM	Integral	●	●	●	●	●	●	●	●	●	●	●	▼	▼
DM01	0-10V <1%	W	Integral	●	●	●	●	●								
		S/P/CM	Integral	●	●	●	●	●								
DALI	DALI 1%	W	Integral	●	●	●	●	●								
		S/P/CM	Integral	●	●	●	●	●								
DMX	DMX w/ RDM <0.1%	W	Integral		●	●	●	●	●	●						
		S/P/CM	Remote (IC Rated)		●	●										
2DM	Lutron Hi-Lume 2-wire 1%	W	Integral		●	●	●	●								
		S/P/CM	Integral		●	●	●	●								
EDM	Lutron Hi-Lume EcoSysytem 1%	W	Integral		●	●	●	●	●							
		S/P/CM	Integral		●	●	●	●	●							
347V [3]	347 Volts (DM1 required)	W	Integral		●	●	●	●	●	●	●	●	●	●	▼	
		S/P/CM	Integral		●	●	●	●	●	●	●	●	●	●	▼	
NX (All)	NX (DM1 required)	W	N/A													
		S/P/CM	Remote (Non-IC)	●	●	●	●									
LV	Lutron Vive® (DM1 required)	W	N/A													
		S/P/CM	Remote (IC Rated)	●	●	●	●									
LVE	Lutron Vive® (EDM required)	W	N/A													
		S/P/CM	Remote (Non-IC)		●	●	●									

▼ Vented cylinder required, see line art for more details.

1 See Cylinder Mounting chart for details.

2 See line art for more details.

3 Not available with Controls.

4 70L DM1 option is 0-10V to 5%.

Cylinder Mounting	
W	Wall Mount
S	Surface Mount
CM	Cable/Cord Mount
P	Pendant Mount

CONTROLS

NX Distributed Intelligence™ Lighting Controls:

Supports applications in a variety of deployment options- wired, wireless, hybrid. Integrates with and enables a wide array of luminaires including those with SpectraSync™ Color Tuning Technology.

NX DISTRIBUTED™ INTELLIGENCE

NX INTEGRATED CONTROLS REFERENCE								
NX Option	Sensor	Networkable	Scheduling	Occupancy	Daylight Harvesting	0–10V Dimming	On/off Control	Bluetooth® App Programming
NX Networked – Wired								
NXE	N/A	Yes	Yes	No	No	Yes	Yes	Requires NXBTC/R[1]
NX Networked – Wireless								
NXWE[2]	N/A	Yes	Yes	No	No	Yes	Yes	No[3]
NX Networked – Wired/Wireless								
NXWD	N/A	Yes	Yes	No	No	Yes	Yes	Requires NXBTC/R[1,3]

1 NXBTC/R needs to be plugged into an available NX SmartPort™ on the fixture network

2 Programming via App requires factory assistance

3 To program NXWE option, need to consult factory. If connected to an area controller, programming can be done from that

NX Design & Application Guide

NX Brochure

HUBBELL Lighting

prescolite

LTC-6RDW

LITEISTRY 6" ROUND CYLINDER

DATE: LOCATION:

TYPE: PROJECT:

CATALOG #:

PERFORMANCE DATA TABLE

Performance data provided below is for 3500K, 80 CRI with Specular Clear reflector finish/color

Lumen Package	Nominal Lumens	Distribution	Delivered Lumens	Watts	LPW
06L	600	Very Narrow	806	7.8	103
		Narrow	717	7.8	92
		Medium	746	7.8	96
		Wide	691	7.8	89
		Extra Wide	665	7.8	85
		Open Single Wall Wash	711	7.8	91
10L	1000	Very Narrow	1288	12.0	107
		Narrow	1146	12.0	96
		Medium	1192	12.0	99
		Wide	1104	12.0	92
		Extra Wide	1063	12.0	89
		Open Single Wall Wash	1136	12.0	95
15L	1500	Very Narrow	1851	18.7	99
		Narrow	1623	18.7	87
		Medium	1712	18.7	92
		Wide	1586	18.7	85
		Extra Wide	1527	18.7	82
		Open Single Wall Wash	1631	18.7	87
20L	2000	Very Narrow	2355	22.6	104
		Narrow	2263	22.7	100
		Medium	2265	22.6	100
		Wide	2180	22.7	96
		Extra Wide	2139	22.7	94
		Open Single Wall Wash	2211	22.8	97
25L	2500	Very Narrow	3093	27.7	112
		Narrow	2751	27.7	99
		Medium	2860	27.7	103
		Wide	2650	27.7	96
		Extra Wide	2551	27.7	92
		Open Single Wall Wash	2726	27.7	98
30L	3000	Very Narrow	3686	34.3	107
		Narrow	3278	34.3	96
		Medium	3409	34.3	99
		Wide	3158	34.3	92
		Extra Wide	3040	34.3	89
		Open Single Wall Wash	3248	34.3	95
35L	3500	Very Narrow	4477	43.0	104
		Narrow	3942	43.0	93
		Medium	4477	43.0	104
		Wide	3836	43.0	89
		Extra Wide	3693	43.0	86
		Open Single Wall Wash	3946	43.0	92

HUBBELL Lighting

prescolite

LTC-6RDW

LITEISTRY 6" ROUND CYLINDER

DATE: LOCATION:

TYPE: PROJECT:

CATALOG #:

PERFORMANCE DATA TABLE CONTINUED

Performance data provided below is for 3500K, 80 CRI with Specular Clear reflector finish/color

Lumen Package	Nominal Lumens	Distribution	Delivered Lumens	Watts	LPW
40L	4000	Very Narrow	5117	51.6	99
		Narrow	4552	51.6	88
		Medium	4733	51.6	92
		Wide	4385	51.6	85
		Extra Wide	4221	51.6	82
		Open Single Wall Wash	4510	51.6	87
45L	4500	Very Narrow	5371	55.1	98
		Narrow	4775	55.1	87
		Medium	4967	55.1	90
		Wide	4602	55.1	84
		Extra Wide	4430	55.1	80
		Open Single Wall Wash	4734	55.1	86
50L	5000	Very Narrow	5740	48.7	118
		Narrow	5105	48.7	105
		Medium	5308	48.7	109
		Wide	4918	48.7	101
		Extra Wide	4734	48.7	97
		Open Single Wall Wash	5059	48.7	104
55L	5500	Very Narrow	6365	53.9	119
		Narrow	5662	53.9	105
		Medium	5887	53.9	109
		Wide	5454	53.9	101
		Extra Wide	5250	53.9	97
		Open Single Wall Wash	5610	53.9	104
60L	6000	Very Narrow	7090	60.7	117
		Narrow	6299	60.7	104
		Medium	6557	60.7	108
		Wide	6075	60.7	100
		Extra Wide	5848	60.7	96
		Open Single Wall Wash	6249	60.7	103
70L	7000	Very Narrow	8266	72.1	115
		Narrow	7353	72.1	102
		Medium	7645	72.1	106
		Wide	7083	72.1	98
		Extra Wide	6819	72.1	95
		Open Single Wall Wash	7285	72.1	101

HUBBELL Lighting

prescolite

LTC-6RDW

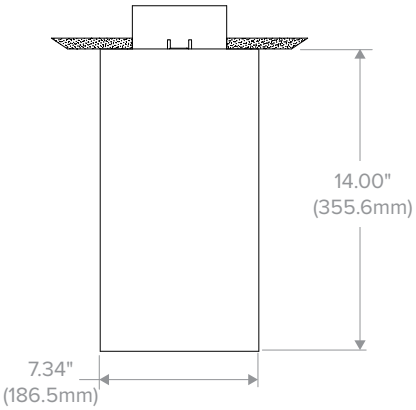
LITEISTRY 6" ROUND CYLINDER

DATE: LOCATION:

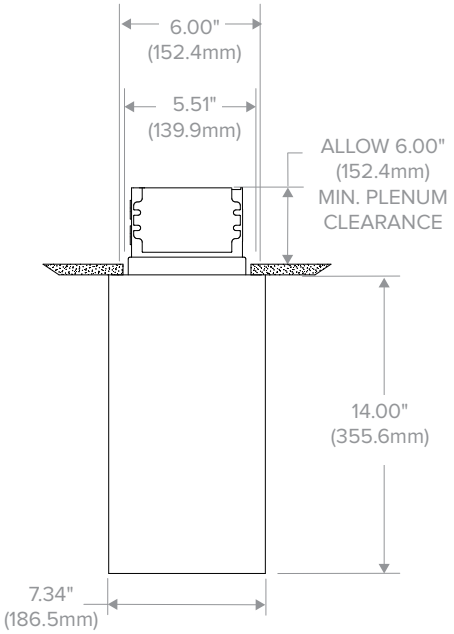
TYPE: PROJECT:

CATALOG #:

DIMENSIONS

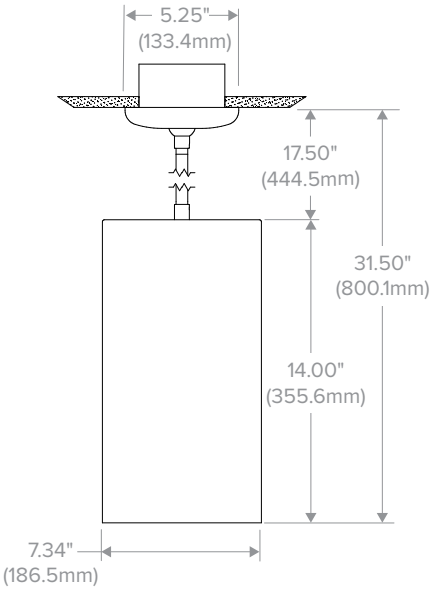


Integral Driver

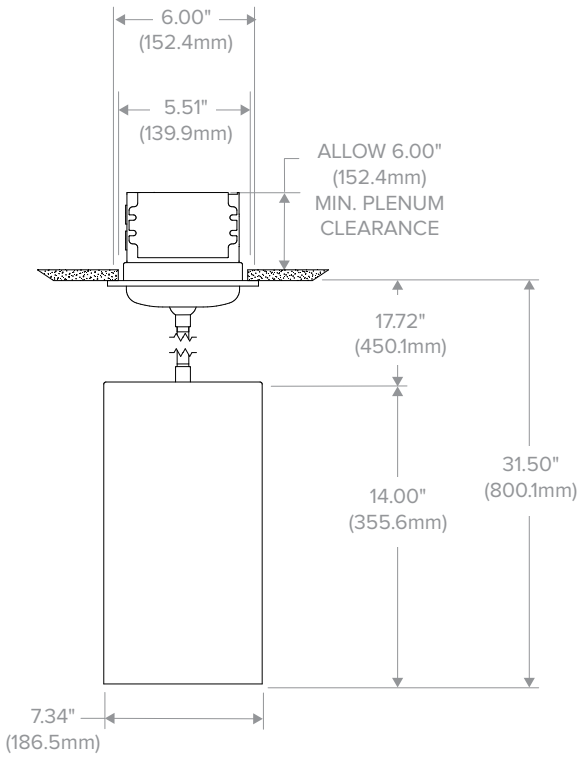


Remote Driver
For DMX, all NX or Lutron Vive Controls

Surface (-S)



Integral Driver



Remote Driver
For DMX, all NX or Lutron Vive Controls

Pendant (-P)

HUBBELL Lighting

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LTC-6RDW

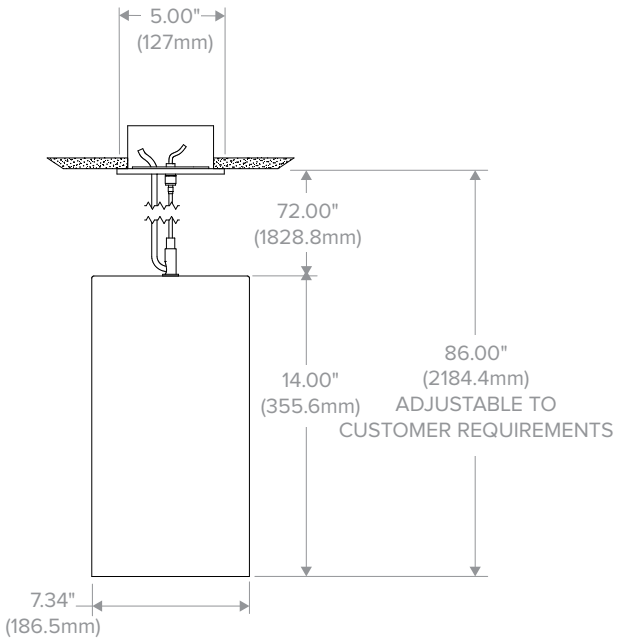
LITEISTRY 6" ROUND CYLINDER

DATE: LOCATION:

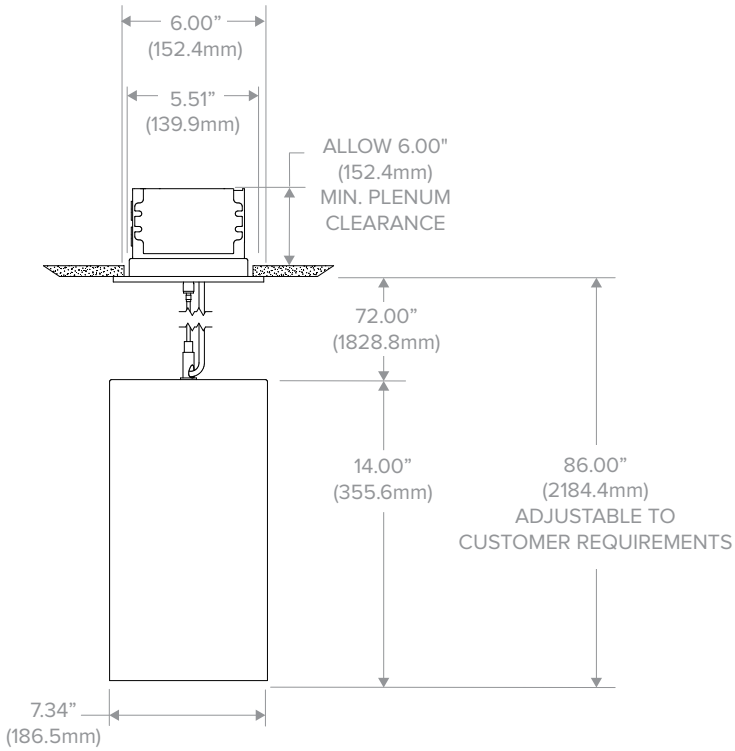
TYPE: PROJECT:

CATALOG #:

DIMENSIONS CONTINUED

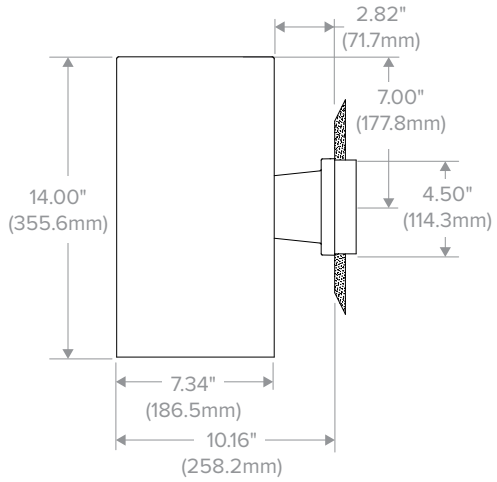


Integral Driver



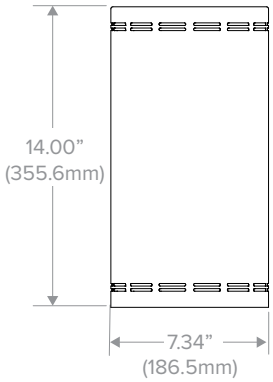
Remote Driver
For all NX or Lutron Vive Controls

Cord (-CM)



Integral Driver

Wall (-W)



Vented Detail View
(60L & 70L)
(All Mountings)

HUBBELL Lighting

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LTC-6RDW

LITEISTRY 6" ROUND CYLINDER

DATE: LOCATION:

TYPE: PROJECT:

CATALOG #:

PHOTOMETRY

LTC-6RD-P-20L35K8VNR-DM1-S-BL

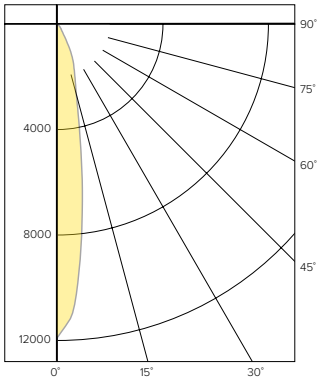
LUMINAIRE DATA

Test No.	**R19.00588-C01**
Description	**2000 lm, Very Narrow, 3500K, 80 CRI**
Delivered Lumens	**2355**
Watts	**22.6W**
Efficacy	**104.0**
Mounting	**Pendant**
Spacing Criterion	**0.3**
Beam Angle (FWHM)	**18**

ZONAL LUMEN SUMMARY

Zone	Lumens	% Luminaire
0-40	2290	97.2
0-60	2355	100.0
0-90	2355	100.0
0-180	2355	100.0

POLAR GRAPH



CANDELA DISTRIBUTION

Degree	Candela
0	11881
5	9399
15	2776
25	1236
35	255
45	74
55	0
65	0
75	0
85	0
90	0

LUMINANCE DATA*

Vertical Angle	Average
45°	6247
55°	0
65°	0
75°	0
85°	0

*Candela/Square Meter

LTC-6RD-P-20L35K8NR-DM1-S-BL

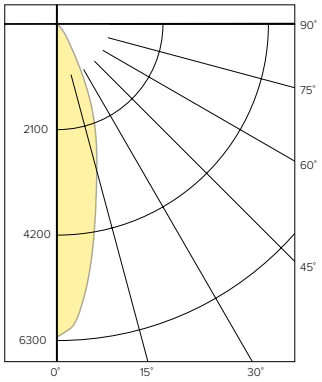
LUMINAIRE DATA

Test No.	**R20.01439-C01**
Description	**2000 lm, Narrow, 3500K, 80 CRI**
Delivered Lumens	**2263**
Watts	**22.1W**
Efficacy	**103.0**
Mounting	**Pendant**
Spacing Criterion	**0.5**
Beam Angle (FWHM)	**29**

ZONAL LUMEN SUMMARY

Zone	Lumens	% Luminaire
0-40	2185	96.6
0-60	2260	99.9
0-90	2263	100.0
0-180	2263	100.0

POLAR GRAPH



CANDELA DISTRIBUTION

Degree	Candela
0	6222
5	5603
15	3035
25	1354
35	348
45	83
55	5
65	2
75	1
85	0
90	0

LUMINANCE DATA*

Vertical Angle	Average
45°	6712
55°	498
65°	271
75°	221
85°	0

*Candela/Square Meter

LTC-6RD-P-20L35K8MD-DM1-S-BL

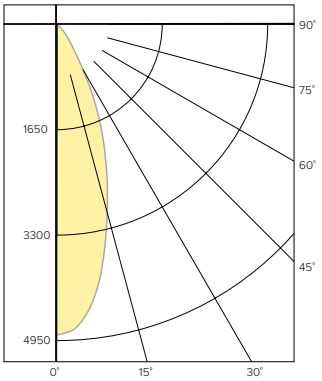
LUMINAIRE DATA

Test No.	**R19.00587-01**
Description	**2000 lm, Medium, 3500K, 80 CRI**
Delivered Lumens	**2265**
Watts	**22.6W**
Efficacy	**100.0**
Mounting	**Pendant**
Spacing Criterion	**0.6**
Beam Angle (FWHM)	**37**

ZONAL LUMEN SUMMARY

Zone	Lumens	% Luminaire
0-40	2171	95.9
0-60	2262	99.9
0-90	2265	100.0
0-180	2265	100.0

POLAR GRAPH



CANDELA DISTRIBUTION

Degree	Candela
0	4851
5	4619
15	3007
25	1450
35	386
45	99
55	6
65	2
75	1
85	0
90	0

LUMINANCE DATA*

Vertical Angle	Average
45°	8357
55°	624
65°	282
75°	231
85°	0

*Candela/Square Meter

IES FILE

HUBBELL Lighting

LTC-6RDW

LITEISTRY 6" ROUND CYLINDER

PHOTOMETRY CONTINUED

LTC-6RD-P-20L35K8WD-DM1-S-BL

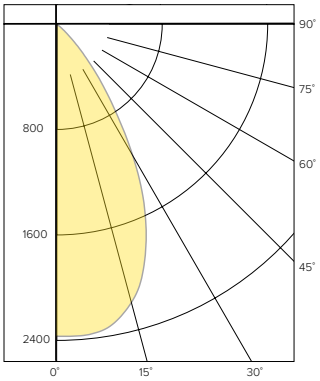
LUMINAIRE DATA

Test No.	**R19.00585-01**
Description	**2000 lm, Wide, 3500K, 80 CRI**
Delivered Lumens	**2180**
Watts	**22.6W**
Efficacy	**96.1**
Mounting	**Pendant**
Spacing Criterion	**0.9**
Beam Angle (FWHM)	**59**

ZONAL LUMEN SUMMARY

Zone	Lumens	% Luminaire
0-40	2014	92.4
0-60	2176	99.8
0-90	2180	100.0
0-180	2180	100.0

POLAR GRAPH



CANDELA DISTRIBUTION

Degree	Candela
0	2368
5	2371
15	2189
25	1591
35	726
45	177
55	10
65	3
75	1
85	0
90	0

LUMINANCE DATA*

Vertical Angle	Average
45°	14942
55°	1041
65°	424
75°	231
85°	0

*Candela/Square Meter

LTC-6RD-P-20L35K8XW-DM1-S-BL

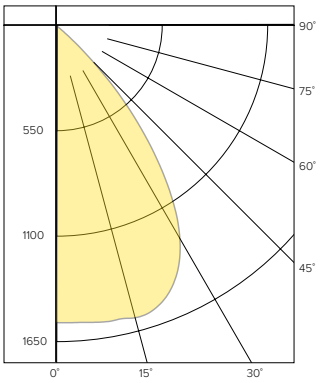
LUMINAIRE DATA

Test No.	**R19.00586-01**
Description	**2000 lm, Extra Wide, 3500K, 80 CRI**
Delivered Lumens	**2139**
Watts	**22.7W**
Efficacy	**94.4**
Mounting	**Pendant**
Spacing Criterion	**1.1**
Beam Angle (FWHM)	**76**

ZONAL LUMEN SUMMARY

Zone	Lumens	% Luminaire
0-40	1875	87.7
0-60	2134	99.8
0-90	2139	100.0
0-180	2139	100.0

POLAR GRAPH



CANDELA DISTRIBUTION

Degree	Candela
0	1547
5	1552
15	1576
25	1461
35	1007
45	301
55	9
65	3
75	1
85	0
90	0

LUMINANCE DATA*

Vertical Angle	Average
45°	25409
55°	937
65°	424
75°	231
85°	0

*Candela/Square Meter

LUMEN MULTIPLIER

Option	27K8	30K8	35K8	40K8	50K8	27K9	30K9	35K9	40K9
Multiplier	0.94	0.98	1.00	1.01	1.02	0.81	0.84	0.85	0.85

Photometrics are published below at a nominal 3500 Kelvin, 80+ CRI. This table may be used to approximate the lumen values at different Kelvin temperatures. Power consumption would stay the same.

prescolite

LTC-6RDW

LITEISTRY 6" ROUND CYLINDER

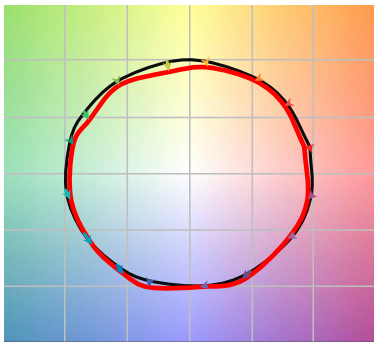
DATE: LOCATION:

TYPE: PROJECT:

CATALOG #:

TM-30 DATA

COLOR VECTOR GRAPHIC 3500K, 90 CRI

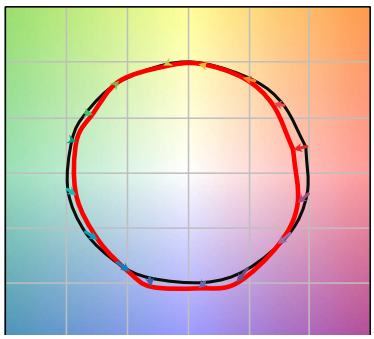


Reference Illuminant — Test Source

COLOR DISTORTION GRAPHIC 3500K, 90 CRI

TEST RESULTS - 3500K		
Value	80+ CRI	90+ CRI
R_f	84	88
R_g	95	95
CCT (K)	3411	3419
D_{UV}	0.0015	0.0042
x	0.4120	0.4147
y	0.3974	0.4052
CIE R_a	84	93
CIE R_g	11	62

COLOR VECTOR GRAPHIC 3500K, 80 CRI



Reference Illuminant — Test Source

COLOR DISTORTION GRAPHIC 3500K, 80 CRI

HUBBELL Lighting

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LTC-6RDW

LITEISTRY 6" ROUND CYLINDER

DATE: LOCATION:

TYPE: PROJECT:

CATALOG #:

ELECTRICAL DATA

DRIVER DATA		
Input Voltage	120-277 V	347 V
Input Frequency	50/60 Hz	50/60 Hz
Power Factor	≥0.90	≥0.90
THD	<20%	<20%
EMI Filtering (FCC 47 CFR Part 15)	Class A	Class A

* Values for DM1 option shown, values for other dimming options may vary.

WATTAGE DATA		
Lumen Output	Nominal Lumens	WATTAGE
06L	600	8
10L	1000	12
15L	1500	19
20L	2000	23
25L	2500	28
30L	3000	35
35L	3500	43
40L	4000	52
45L	4500	55
50L	5000	49
55L	5500	54
60L	6000	61
70L	7000	72

* Wattage may vary based on configuration and options selected

ADDITIONAL INFORMATION

DIMMING COMPATIBILITY CHART		
Dimming Driver	Manufacturer	Web Link
DM1 /DM01	Lutron DVTV	http://bit.ly/11jSvZg
DM1	Leviton AWRMG-7xx, AWSMG-7xx, AWSMT-7xx	http://bit.ly/1BJn2R9
EDM	Lutron	http://bit.ly/1vtjHAl
2DM	Lutron	http://bit.ly/1S4WjXK

DMX

See instruction sheet on www.prescolite.com for connection & installation information.

Central Inverters

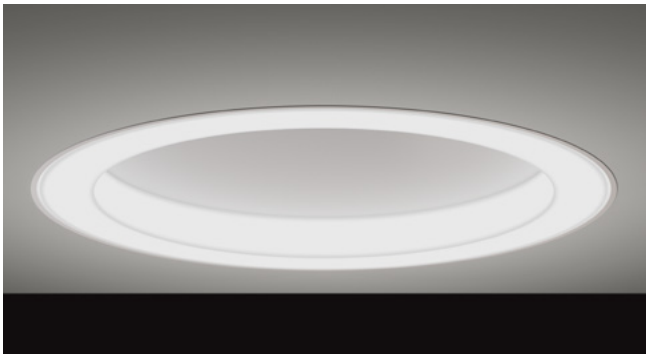
For full fixture output in back-up mode, we recommend you visit www.dual-lite.com for your Central Lighting Inverter options. Please contact your local Hubbell representative for any assistance with proper sizing and loading of your inverter selection. Central lighting inverters must be ordered separately.
LiteGear: www.dual-lite.com/products/litegear_lg_series
LPS Series: www.dual-lite.com/products/lps

HUBBELL Lighting

OCL ARCHITECTURAL LIGHTING

PROJECT NAME: _____ TYPE: _____

QTY: _____



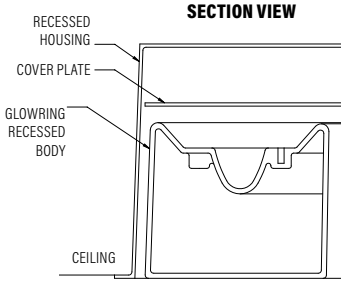
Glowring™

RECESSED

FEATURES

- AVAILABLE IN 80+ CRI AND 90+ CRI (R9>50)
- SEAMLESS ONE PIECE MOLDED DIFFUSER
- FULLY ENCLOSED TOP SURFACE TO MINIMIZE ACCUMULATION OF DUST AND DEBRIS
- MINIMAL LUMINAIRE CROSS SECTION SIZE
- MOUNTING OPTIONS FOR GRID OR HARD CEILING
- FIELD REPLACEABLE LEDS AND DRIVERS
- 3 STEP LED BINNING

SECTION VIEW



MADE IN USA

CATALOG CODES

GL1	-	C1NB	-	C	-	MW	-	E	-	F	-	UNV	-	I	-	J
SERIES		HANGING SYSTEM		SIZE		DIFFUSER		FINISH		LIGHT SOURCE		VOLTAGE		CONTROL		OPTIONS

SPECIFY CATALOG CODE

A — SERIES

GL1 GLOWRING

B — HANGING SYSTEM

C1NB RECESSED CEILING MOUNT

C — SIZE

24

36

48

D — DIFFUSER

MW MATTE WHITE

E — FINISH*

POWDER COAT FINISHES

BKP	BLACK	**MWP**	MATTE WHITE
BMP	BRASS METALLIC	**SGP**	STEEL GRAY
BNP	BRONZE	**SMP**	SILVER METALLIC
BTP	BLACK TEXTURED	**SWP**	SKY WHITE
GRP	GRAPHITE	**WTP**	WHITE TEXTURED
GLP	GOLDTASTIC		

PREMIUM METAL FINISHES

BAL BRUSHED ALUMINUM

F — LIGHT SOURCE

LED OUTPUT	COLOR TEMP (80+ CRI)	COLOR TEMP (90+ CRI)
LED1	**27K**	**927K**
LED2	**30K**	**930K**
	35K	**935K**
	40K	**940K**

G — VOLTAGE

UNV 120-277

H — CONTROL

DM1 0-10V DIMMING 1%

DM3 LUTRON HI-LUME ECOSYSTEM 1% (LDE1)

OPTIONS

ULD DAMP LABEL

MOD MODIFIED LUMINAIRE (CONTACT LOCAL REP)

SAMPLE CODE: GL1-C1NB-36-MW-MWP-LED1/35K-UNV-DM1

*Finish choice is for the cover plate inside of the diffuser opening ; visible trim on the housing is matte white paint (MWP)

UP TO 84 LM/W

LUMENS AND WATTAGE CHART

		24"	36"	48"
LED1	LUMENS DELIVERED	2940	4620	5900
	SYSTEM WATTAGE	35	55	70
LED2	LUMENS DELIVERED	4620	7140	10120
	SYSTEM WATTAGE	55	85	115

This chart was created for a 35K color temp. Multiply by 0.93 for 27k color temp, 0.97 for 30k color temp, and 1.01 for 40k color temp.

Values shown for 80+ CRI. For 90+ CRI lumens use 0.85 multiplier.

MODS, NOTES, & COMMENTS

This product meets the material restrictions of Article 4 of the RoHS Directive (2011/65/EU), including Commission Delegated Directive 2015/863

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HANGING SYSTEM

C1NB RECESSED CEILING MOUNT

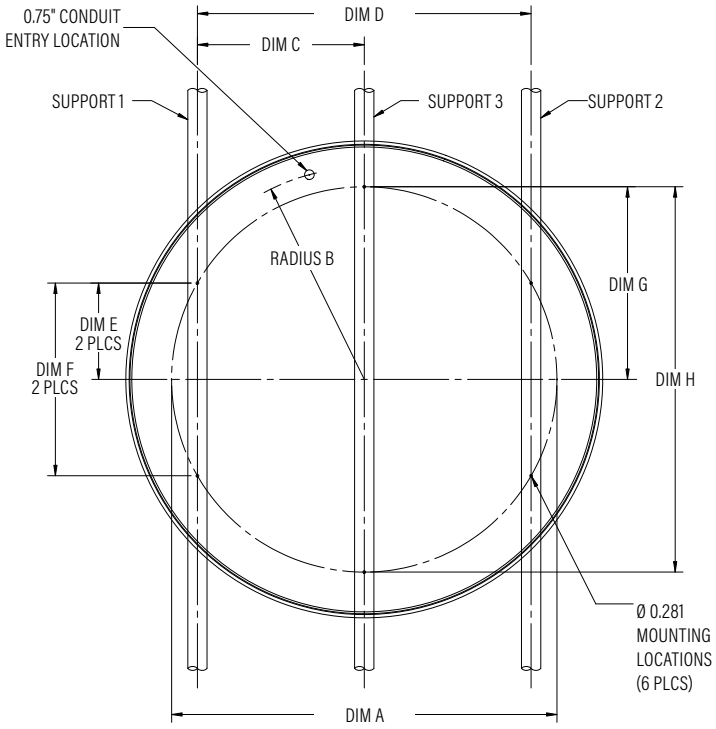
MOUNTING INFORMATION CHART

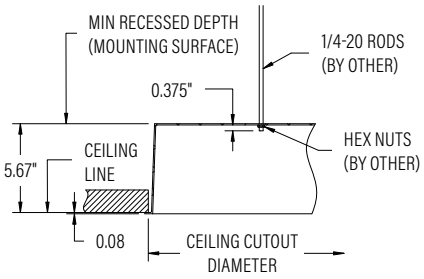
LUMINAIRE DIAMETER	LUMINAIRE WEIGHT	DIM A	RADIUS B	SUPPORT POSITIONS		MOUNTING HOLE POSITIONS					CEILING CUTOUT DIA. (+/- 0.125)
				DIM C	DIM D	DIM E	DIM F	DIM G	DIM H	MOUNTING POINTS	
24"	16 LBS	16"	10"	5.66"	11.31"	5.66"	11.31"	-	-	4	25.125"
36"	28 LBS	28"	16"	9.9"	19.8"	9.9"	19.8"	-	-	4	37.125"
48"	60 LBS	40"	22"	17.32"	34.64"	10"	20"	20"	40"	6	49.125"

24" & 36" USE SUPPORT 1 & 2 ONLY; HAS 4x 0.281 MOUNTING LOCATIONS SPACED AT 90˚

48" USES ALL 3 SUPPORTS; HAS 6x 0.281 MOUNTING LOCATIONS SPACED AT 60˚

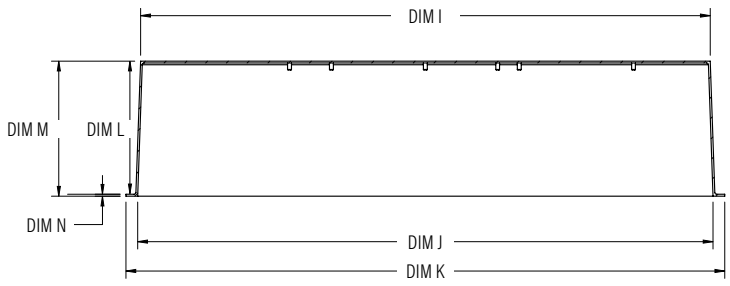
TOP VIEW

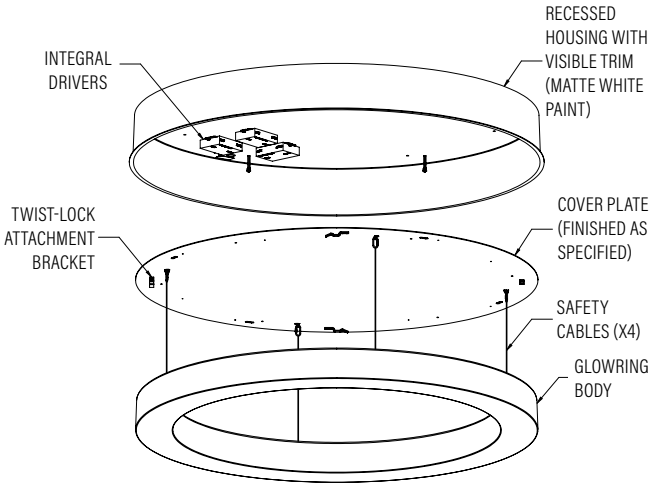




NOTE: GLOWRING RECESSED CAN BE MOUNTED TO A GRID OR HARD CEILING. THERE ARE PROVISIONS IN THE RECESSED HOUSING FOR 0.75" CONDUIT CONNECTIVITY. FOR DETAILED INSTALLATION INFORMATION REFER TO OCL INSTALLATION INSTRUCTIONS FOR GLOWRING RECESSED.

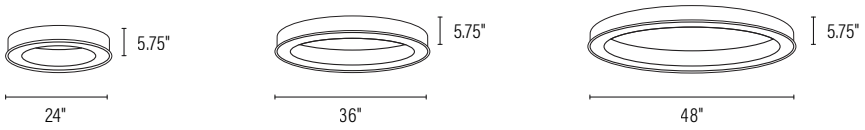
SIDE VIEW





LUMINAIRE DIAMETER	DIM I	DIM J	DIM K	DIM L	DIM M	DIM N
24"	Ø 24.259"	Ø 24.5"	Ø 25.5"	5.670"	5.750"	0.080"
36"	Ø 36.259"	Ø 36.5"	Ø 37.5"	5.670"	5.750"	0.080"
48"	Ø 48.259"	Ø 48.5"	Ø 49.5"	5.670	5.750"	0.080"

SIZES



DIFFUSER

MWP
MATTE WHITE

FINISH

METALLIC POWDER COAT FINISHES:

SMP SILVER
GRP GRAPHITE
SGP STEEL GRAY
GLP GOLDTASTIC
BMP BRASS
BNP BRONZE

PREMIUM METAL FINISHES:

BAL
BRUSHED ALUMINUM

SOLID POWDER COAT FINISHES:

SWP SKY WHITE
MWP MATTE WHITE
BKP BLACK

TEXTURED POWDER COAT FINISHES:

BTP BLACK TEXTURED
WTP WHITE TEXTURED

RAL®, Pantone® or custom finishes are also available.

These colors are for reference only. Please be aware that colors may vary per monitor. Contact your local rep for finish samples or with any questions.

LIGHT SOURCE

		LUMENS AND WATTAGE CHART		
		24"	**36"**	**48"**
LED1	LUMENS DELIVERED	2940	4620	5900
	SYSTEM WATTAGE	35	55	70
LED2	LUMENS DELIVERED	4620	7140	10120
	SYSTEM WATTAGE	55	85	115

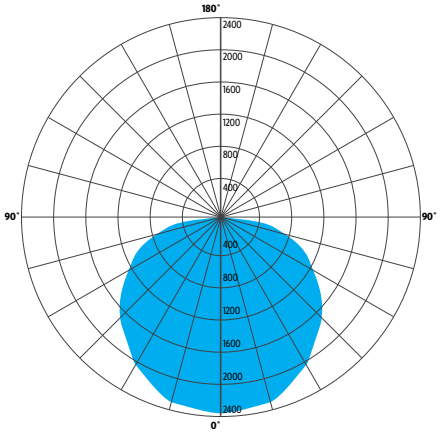
This chart was created for a 35K color temp. Multiply by 0.95 for 27k color temp, 0.97 for 30k color temp, and 1.03 for 40k color temp.

Values shown for 80+ CRI. For 90+ CRI lumens use 0.85 multiplier.

PHOTOMETRY:

LUMINAIRE:	GL1-C1NB-48-MW-MWP-LED2-35K-UNV-DMO
COLOR TEMP #:	3500K
OUTPUT:	10120
EFFICACY:	84 LM/W
TEST REPORT:	TEST NO. 20515.0

STANDARD COLOR TEMPERATURE OPTIONS	CRI (RA)	
2700K	80+	90+
3000K	80+	90+
3500K	80+	90+
4000K	80+	90+



LUMEN MAINTENANCE

REPORTED:	L70 AT >60,000 HRS
CALCULATED:	L70 AT 182,000 HRS
REPORTED:	L90 AT 53,000 HRS
CALCULATED:	L90 AT 53,000 HRS

Derived from EPA TM-21 calculator. Based on typical conditions. Consult the factory for additional details

ZONE	LUMENS	% OF LUMINAIRE
0-30	1823	23%
0-60	5550	70%
0-90	7897	100%

CONTROL

DM1 0-10V DIMMING 1%

- 0-10V DIMMING
- 1% MINIMUM DIM LEVEL
- ELECTRONIC DRIVER
- POWER FACTOR >0.9
- THD <20%
- MINIMUM AMBIENT OPERATING TEMPERATURE -22°F
- FIELD REPLACEABLE

DM3 LUTRON HI-LUME ECOSYSTEM 1% (LDE1)

- LUTRON HI-LUME SOFT-ON, FADE-TO-BLACK 1%, ECOSYSTEM, LDE1
- ELECTRONIC DRIVER
- POWER FACTOR >0.9
- THD <20%
- MINIMUM AMBIENT OPERATING TEMPERATURE: -32°F
- FIELD REPLACEABLE

OPTIONS

ULD DAMP LABEL LUMINAIRE

- MAY BE USED IN A OUTDOOR AREA THAT IS PROTECTED FROM DIRECT CONTACT WITH WIND, RAIN, SNOW OR EXCESSIVE MOISTURE

MOD MODIFIED LUMINAIRE

- LUMINAIRE IS MODIFIED FROM STANDARD OPTIONS. CONTACT LOCAL REP FOR MORE INFORMATION

SPECIFICATIONS

CONSTRUCTION

- RECESSED HOUSING IS ALUMINUM MATTE WHITE POWDER COAT PAINT
- COVER PLATE IS FABRICATED FROM ALUMINUM FINISHED AS SPECIFIED
- DIFFUSER IS MOLDED IN ONE PIECE WITHOUT VISIBLE SEAMS OR JOINTS
- LED REFLECTOR ASSEMBLY IS MATTE ANODIZED ALUMINUM
- HARDWARE IS ZINC PLATED OR STAINLESS STEEL

ELECTRICAL

- DIMMING ELECTRONIC DRIVER(S), COMES STANDARD WITH 0-10V DOWN TO 1%
- LUTRON (LDE1) ECOSYSTEM 1% ALSO AVAILABLE
- OCL PROPRIETARY LED ARRAYS USE NICHIA 757 DIODES
- 80+ CRI = 80 RA, R9 > 0 (10-15 TYP.)
- 90+ CRI = 90 RA, R9 > 50
- LUMINAIRE CONNECTS TO BUILDING SUPPLY (120V-277V 50/60HZ) UNLESS DRIVERS ARE REMOTE

LISTING

- ETL LISTED TO UL 1598 FOR INDOOR, DRY LOCATION

WARRANTY

- 5 YEAR; ALL ELECTRICAL COMPONENTS RETAIN THE MANUFACTURER'S WARRANTY

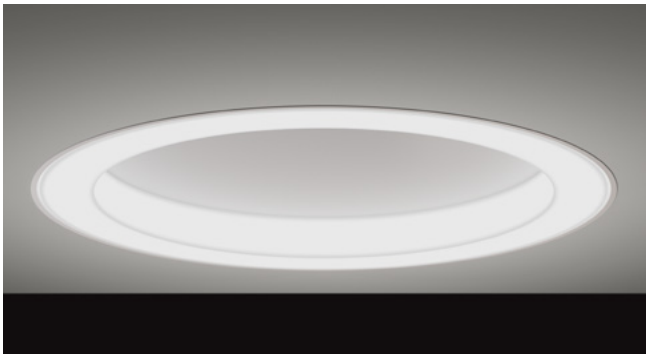
SUSTAINABILITY

- THIS PRODUCT MEETS THE MATERIAL RESTRICTIONS OF ARTICLE 4 OF THE **ROHS** DIRECTIVE (2011/65/EU), INCLUDING COMMISSION DELEGATED DIRECTIVE 2015/863

OCL ARCHITECTURAL LIGHTING

PROJECT NAME: _____ TYPE: _____

QTY: _____



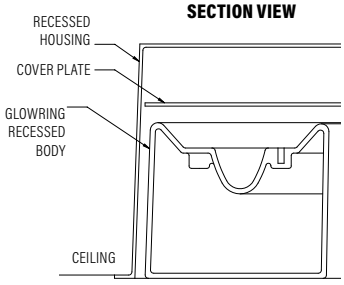
Glowring™

RECESSED

FEATURES

- AVAILABLE IN 80+ CRI AND 90+ CRI (R9>50)
- SEAMLESS ONE PIECE MOLDED DIFFUSER
- FULLY ENCLOSED TOP SURFACE TO MINIMIZE ACCUMULATION OF DUST AND DEBRIS
- MINIMAL LUMINAIRE CROSS SECTION SIZE
- MOUNTING OPTIONS FOR GRID OR HARD CEILING
- FIELD REPLACEABLE LEDS AND DRIVERS
- 3 STEP LED BINNING

SECTION VIEW



MADE IN USA

CATALOG CODES

GL1	-	C1NB	-	C	-	MW	-	E	-	F	-	UNV	-	I	-	J
SERIES		HANGING SYSTEM		SIZE		DIFFUSER		FINISH		LIGHT SOURCE		VOLTAGE		CONTROL		OPTIONS

SPECIFY CATALOG CODE

A — SERIES

GL1 GLOWRING

B — HANGING SYSTEM

C1NB RECESSED CEILING MOUNT

C — SIZE

24

36

48

D — DIFFUSER

MW MATTE WHITE

E — FINISH*

POWDER COAT FINISHES

BKP	BLACK	**MWP**	MATTE WHITE
BMP	BRASS METALLIC	**SGP**	STEEL GRAY
BNP	BRONZE	**SMP**	SILVER METALLIC
BTP	BLACK TEXTURED	**SWP**	SKY WHITE
GRP	GRAPHITE	**WTP**	WHITE TEXTURED
GLP	GOLDTASTIC		

PREMIUM METAL FINISHES

BAL BRUSHED ALUMINUM

F — LIGHT SOURCE

LED OUTPUT	COLOR TEMP (80+ CRI)	COLOR TEMP (90+ CRI)
LED1	**27K**	**927K**
LED2	**30K**	**930K**
	35K	**935K**
	40K	**940K**

G — VOLTAGE

UNV 120-277

H — CONTROL

DM1 0-10V DIMMING 1%

DM3 LUTRON HI-LUME ECOSYSTEM 1% (LDE1)

OPTIONS

ULD DAMP LABEL

MOD MODIFIED LUMINAIRE (CONTACT LOCAL REP)

SAMPLE CODE: GL1-C1NB-36-MW-MWP-LED1/35K-UNV-DM1

*Finish choice is for the cover plate inside of the diffuser opening ; visible trim on the housing is matte white paint (MWP)

UP TO 84 LM/W

LUMENS AND WATTAGE CHART

		24"	36"	48"
LED1	LUMENS DELIVERED	2940	4620	5900
	SYSTEM WATTAGE	35	55	70
LED2	LUMENS DELIVERED	4620	7140	10120
	SYSTEM WATTAGE	55	85	115

This chart was created for a 35K color temp. Multiply by 0.93 for 27k color temp, 0.97 for 30k color temp, and 1.01 for 40k color temp.

Values shown for 80+ CRI. For 90+ CRI lumens use 0.85 multiplier.

MODS, NOTES, & COMMENTS

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HANGING SYSTEM

C1NB RECESSED CEILING MOUNT

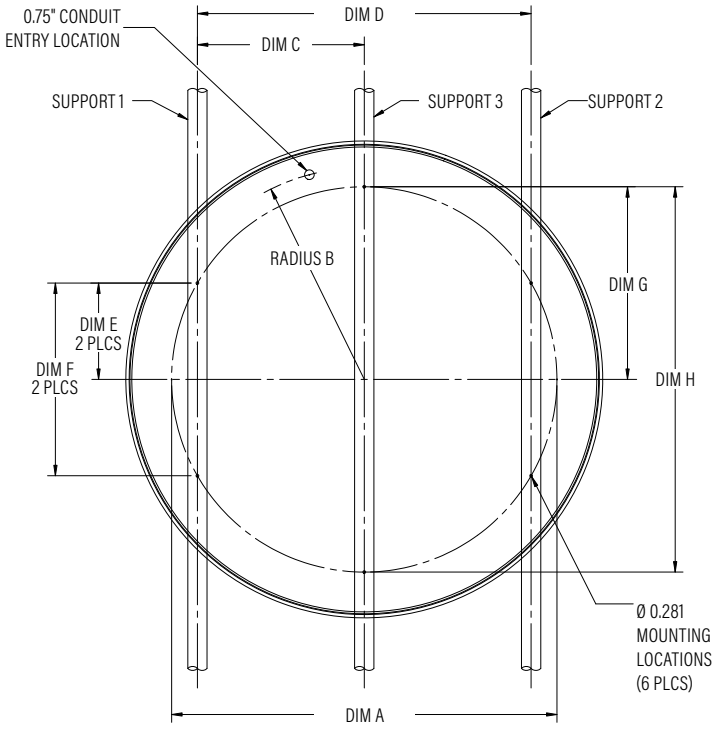
MOUNTING INFORMATION CHART

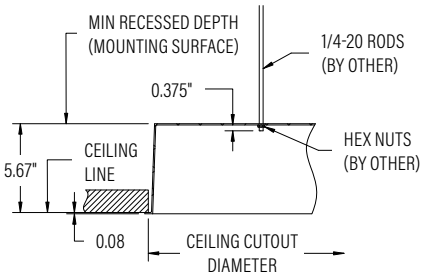
LUMINAIRE DIAMETER	LUMINAIRE WEIGHT	DIM A	RADIUS B	SUPPORT POSITIONS		MOUNTING HOLE POSITIONS					CEILING CUTOUT DIA. (+/- 0.125)
				DIM C	DIM D	DIM E	DIM F	DIM G	DIM H	MOUNTING POINTS	
24"	16 LBS	16"	10"	5.66"	11.31"	5.66"	11.31"	-	-	4	25.125"
36"	28 LBS	28"	16"	9.9"	19.8"	9.9"	19.8"	-	-	4	37.125"
48"	60 LBS	40"	22"	17.32"	34.64"	10"	20"	20"	40"	6	49.125"

24" & 36" USE SUPPORT 1 & 2 ONLY; HAS 4x 0.281 MOUNTING LOCATIONS SPACED AT 90˚

48" USES ALL 3 SUPPORTS; HAS 6x 0.281 MOUNTING LOCATIONS SPACED AT 60˚

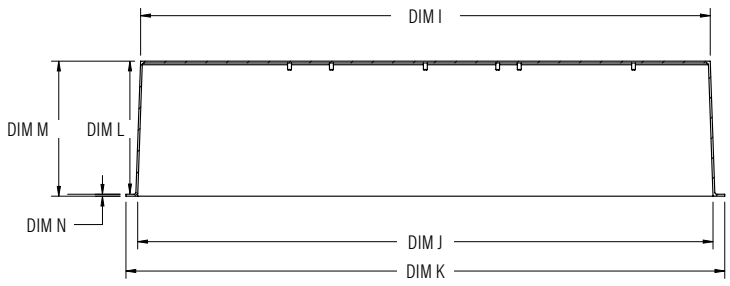
TOP VIEW

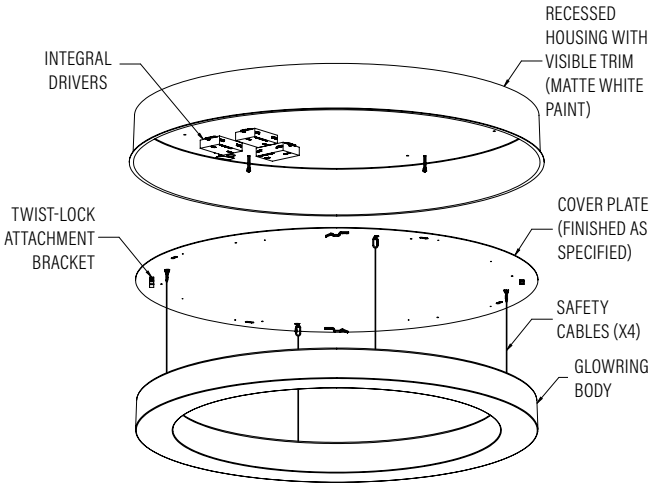




NOTE: GLOWRING RECESSED CAN BE MOUNTED TO A GRID OR HARD CEILING. THERE ARE PROVISIONS IN THE RECESSED HOUSING FOR 0.75" CONDUIT CONNECTIVITY. FOR DETAILED INSTALLATION INFORMATION REFER TO OCL INSTALLATION INSTRUCTIONS FOR GLOWRING RECESSED.

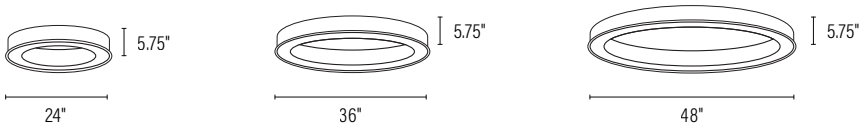
SIDE VIEW





LUMINAIRE DIAMETER	DIM I	DIM J	DIM K	DIM L	DIM M	DIM N
24"	Ø 24.259"	Ø 24.5"	Ø 25.5"	5.670"	5.750"	0.080"
36"	Ø 36.259"	Ø 36.5"	Ø 37.5"	5.670"	5.750"	0.080"
48"	Ø 48.259"	Ø 48.5"	Ø 49.5"	5.670	5.750"	0.080"

SIZES



DIFFUSER

MWP
MATTE WHITE

FINISH

METALLIC POWDER COAT FINISHES:

SMP SILVER
GRP GRAPHITE
SGP STEEL GRAY
GLP GOLDTASTIC
BMP BRASS
BNP BRONZE

PREMIUM METAL FINISHES:

BAL
BRUSHED ALUMINUM

SOLID POWDER COAT FINISHES:

SWP SKY WHITE
MWP MATTE WHITE
BKP BLACK

TEXTURED POWDER COAT FINISHES:

BTP BLACK TEXTURED
WTP WHITE TEXTURED

RAL®, Pantone® or custom finishes are also available.

These colors are for reference only. Please be aware that colors may vary per monitor. Contact your local rep for finish samples or with any questions.

LIGHT SOURCE

		LUMENS AND WATTAGE CHART		
		24"	**36"**	**48"**
LED1	LUMENS DELIVERED	2940	4620	5900
	SYSTEM WATTAGE	35	55	70
LED2	LUMENS DELIVERED	4620	7140	10120
	SYSTEM WATTAGE	55	85	115

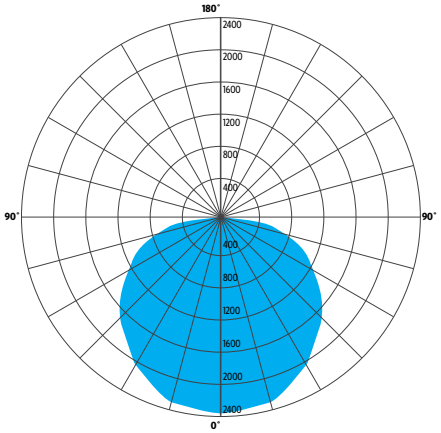
This chart was created for a 35K color temp. Multiply by 0.95 for 27k color temp, 0.97 for 30k color temp, and 1.03 for 40k color temp.

Values shown for 80+ CRI. For 90+ CRI lumens use 0.85 multiplier.

PHOTOMETRY:

LUMINAIRE:	GL1-C1NB-48-MW-MWP-LED2-35K-UNV-DMO
COLOR TEMP #:	3500K
OUTPUT:	10120
EFFICACY:	84 LM/W
TEST REPORT:	TEST NO. 20515.0

STANDARD COLOR TEMPERATURE OPTIONS	CRI (RA)	
2700K	80+	90+
3000K	80+	90+
3500K	80+	90+
4000K	80+	90+



LUMEN MAINTENANCE

REPORTED:	L70 AT >60,000 HRS
CALCULATED:	L70 AT 182,000 HRS
REPORTED:	L90 AT 53,000 HRS
CALCULATED:	L90 AT 53,000 HRS

Derived from EPA TM-21 calculator. Based on typical conditions. Consult the factory for additional details

ZONE	LUMENS	% OF LUMINAIRE
0-30	1823	23%
0-60	5550	70%
0-90	7897	100%

CONTROL

DM1 0-10V DIMMING 1%

- 0-10V DIMMING
- 1% MINIMUM DIM LEVEL
- ELECTRONIC DRIVER
- POWER FACTOR >0.9
- THD <20%
- MINIMUM AMBIENT OPERATING TEMPERATURE -22°F
- FIELD REPLACEABLE

DM3 LUTRON HI-LUME ECOSYSTEM 1% (LDE1)

- LUTRON HI-LUME SOFT-ON, FADE-TO-BLACK 1%, ECOSYSTEM, LDE1
- ELECTRONIC DRIVER
- POWER FACTOR >0.9
- THD <20%
- MINIMUM AMBIENT OPERATING TEMPERATURE: -32°F
- FIELD REPLACEABLE

OPTIONS

ULD DAMP LABEL LUMINAIRE

- MAY BE USED IN A OUTDOOR AREA THAT IS PROTECTED FROM DIRECT CONTACT WITH WIND, RAIN, SNOW OR EXCESSIVE MOISTURE

MOD MODIFIED LUMINAIRE

- LUMINAIRE IS MODIFIED FROM STANDARD OPTIONS. CONTACT LOCAL REP FOR MORE INFORMATION

SPECIFICATIONS

CONSTRUCTION

- RECESSED HOUSING IS ALUMINUM MATTE WHITE POWDER COAT PAINT
- COVER PLATE IS FABRICATED FROM ALUMINUM FINISHED AS SPECIFIED
- DIFFUSER IS MOLDED IN ONE PIECE WITHOUT VISIBLE SEAMS OR JOINTS
- LED REFLECTOR ASSEMBLY IS MATTE ANODIZED ALUMINUM
- HARDWARE IS ZINC PLATED OR STAINLESS STEEL

ELECTRICAL

- DIMMING ELECTRONIC DRIVER(S), COMES STANDARD WITH 0-10V DOWN TO 1%
- LUTRON (LDE1) ECOSYSTEM 1% ALSO AVAILABLE
- OCL PROPRIETARY LED ARRAYS USE NICHIA 757 DIODES
- 80+ CRI = 80 RA, R9 > 0 (10-15 TYP.)
- 90+ CRI = 90 RA, R9 > 50
- LUMINAIRE CONNECTS TO BUILDING SUPPLY (120V-277V 50/60HZ) UNLESS DRIVERS ARE REMOTE

LISTING

- ETL LISTED TO UL 1598 FOR INDOOR, DRY LOCATION

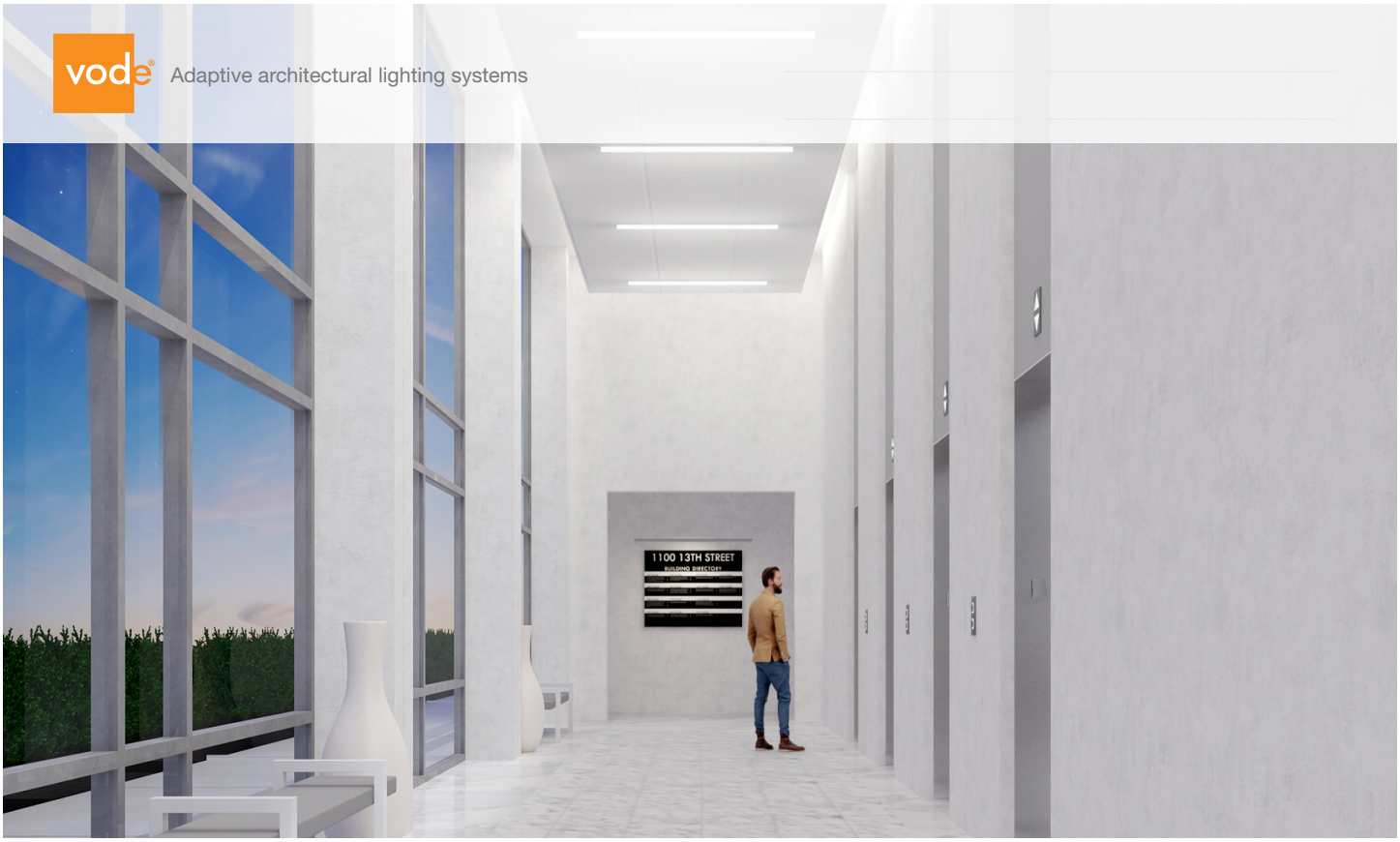
WARRANTY

- 5 YEAR; ALL ELECTRICAL COMPONENTS RETAIN THE MANUFACTURER'S WARRANTY

SUSTAINABILITY

- THIS PRODUCT MEETS THE MATERIAL RESTRICTIONS OF ARTICLE 4 OF THE **ROHS** DIRECTIVE (2011/65/EU), INCLUDING COMMISSION DELEGATED DIRECTIVE 2015/863

LT-06



Spec Guide

ZipTwo® | Square 3535 | 707

Direct lighting for open office and ambient applications.

Square 3535, Critical Edge, white

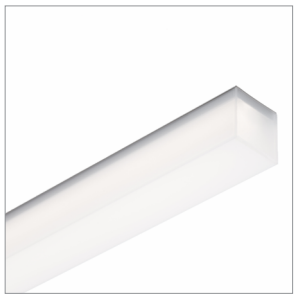
Benefits & Features

Low Profile Design
Square profile. 1.38" (35mm) x 1.42" (36mm).

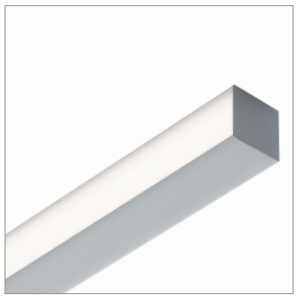
Superior Light Quality & Performance
Output up to 1316 lm/ft (4318 lm/m) (HO), 135 lm/W (SO). 80 or 90 CRI & tunable white (2200K-5000K) available.

Versatile Mounting, Easy Installation
Magnet with tape-on metal strip or low profile clip allow for mounting to almost any surface or T-Bar ceiling.

Extensive Optics
Options of Diffuse, Critical Edge, and Side Diffuse give designers the power to create and design their space using one product.



Square 3535, Diffuse, white



Square 3535, Side Diffuse, white

Build Your Specification

707-Z2	SL				0

System & Rail Type
707-Z2 ZipTwo

System Type
SL Standard Linear

System Length
Specify overall system length in ft/in or M/mm.

Corner and Shapes Available ***See Guide*** *for details*

Rail Length
24 24" (610mm)
36 36" (914mm)
48 48" (1219mm)
60 60" (1524mm)
72 72" (1829mm)
96 96" (2438mm)
ZZ Other rail length or layout (please specify)

See ***Rail Length Chart*** *for more details*

Mounting
C Clip
CM Clip with Micro J-Box
T Magnet with Tape-On Metal Strip
T1 9/16" T-Bar Clip, low profile
T2 15/16" T-Bar Clip, low profile
T3 15/16" T-Bar Clip, medium profile
T4 15/16" T-Bar Clip, concealed
T5 9/16" T-Bar Clip, medium profile
T6 Slotted T-Bar Clip
T7 Dimensional T-Bar Clip
SC Armstrong DynaMax
DM Strut Channel Clip
ZZ Other (please specify)

Arm/Cord Length
0 None

RP				Z

Power Location
Remote Power

RP25 25' (7.62m) Wire Harness
RP50 50' (15.24m) Wire Harness
RP75 75' (22.86m) Wire Harness
RP100 100' (30.48m) Wire Harness

Power Type
Flexible 1 to 1 Power

AE eldoLED 0-10v, 1.0% Dimming
AT eldoLED 0-10v, 0.1% Dimming
AD eldoLED DALI, 0.1% Dimming
AX eldoLED DMX, 100-0% Dimming
AH Hi-lume 1% EcoSystem, Soft On / Fade to Black Technology, LDE1
AH2 Hi-lume 1% 2-wire LTEA2W (120V forward phase only)

Optomized Power

AEO eldoLED 0-10v, 1.0% Dimming
ATO eldoLED 0-10v, 0.1% Dimming
ADO eldoLED DALI, 0.1% Dimming
AXO eldoLED DMX,100-0% dimming

ZZ Other (please specify)

See* ***Power Guide* *for driver features & limitations.*

Voltage
1 120v
2 120v-277v
X Not Yet Specified

Emergency Power
0 No Emergency Power
ZZ Emergency Power *(specify requirements)*

LED Type
Z Zipper Board™

Lumen Output
LO Low Output
SO Standard Output
HO High Output*
ZZ Other (please specify)

See ***IES Files*** *page for details.*
See* ***Power Guide* *for driver features & limitations.*

Color Temperature
80+ CRI

27 2700K
30 3000K
35 3500K
40 4000K

90+ CRI

279 2700K
309 3000K
359 3500K
409 4000K

ZZ Tunable White Available ***See Guide*** for details

Optics
S5 Square 3535, Critical Edge
S6 Square 3535, Diffuse
S9 Square 3535, Side Diffuse
SA Square 3535, Single Side Diffuse

Sensors
0 None
ZZ Other (please specify)[1]

Finish
WH White
BL Black

Options
0 None
9 9' 18/3 Cord and Plug

NOTES & LIMITATIONS

[1] *Sensors are available please contact* ***Vode*** *for more information.*

5 Year Limited Warranty. See full Vode warranty description ***here*** *or at vode.com.*

Listed to UL standards for damp location by a Nationally Recognized Testing Laboratory (NRTL) recognized by OSHA.

Applications

General Interior and Open Office

Confidential Client

Vode Headquarters, Sonoma, CA

Open Office

Applications

General Interior and Open Office

Open Office

Conference Room

Structure

Rail Lengths	24” (610mm), 36” (914mm), 48” (1219mm), 60” (1524mm), 72” (1829mm, 96” (2438mm).
Rail Dimensions	1.38” (35mm) x 1.42” (36mm). See dimensions section for details
Construction	Extruded and machined 6063 aluminum.
Mounting	Clip, Clip with Micro J-Box, Magnet with Tape-On Metal Strip, T-Bar Clips for most grid/panel construction, Strut Channel Clip.
Run Length	24” (610mm) minimum. Rail lengths may be installed end-to-end to any length.
Operating Temperature	32°F to 104°F (0°C to 40°C).
Humidity	0-95%, non-condensing. Suitable for damp locations.
System Weight	0.25lbs per ft (0.11kg per 305mm). *Power supply and housing not included.*

Materials

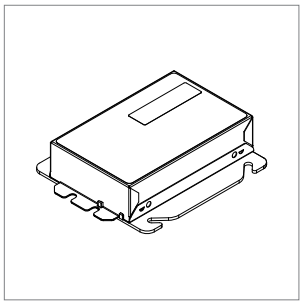
LED Board Construction	Aluminum core PCB, black LCP connectors, RoHS compliant.
Lens	High-impact extruded acrylic glass (PMMA).
Power Cable	Ø3mm, 33/2 AWG, Plenum (CMP) rated semi-rigid PVC or FEP, flame tested UL-910 *(PVC free in 2020)*
Cable Connectors	Unfilled black nylon, rated UL 94 V-0, halogen free, PVC or FEP overmold, RoHS compliant *(PVC free in 2020)*
Remote Linear Power Housing (RLP)	20.7” x 2.375” x 2.53”, 0.054” formed Galvanized Steel
Remote Brick Power Housing (RBP)	4.32” x 3.37” x .078” Galvanized Steel mounting plate

Power and Controls

Power Type	Class 2 (<60v output) constant current driver
Dimming Controls	Dimming (0.1%, 1%), 0-10v, DALI, DMX, Lutron Hi-lume 1% are available. *See **Power Guide** for details.*
Input Voltage	120v - 277v, 50/60hz
Power Location	Remote power. Maximum remote distance up to 100’ (30.5m) *depending* on driver selection. *See **Power Guide** for details.*

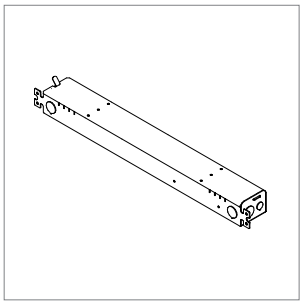
Remote power is locating the power supply away from the fixture. Remote power comes in two housing styles: brick style and linear style. Consult ***Power Guide*** to determine which type you will receive.

Remote Brick Power Housing



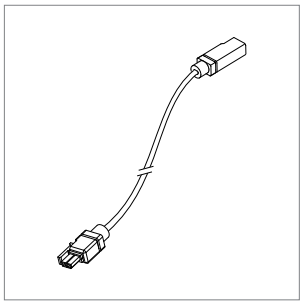
Supplied for some remote power applications. One remote power supply housing is supplied for each rail. Provided driver mounting plate fits standard 4” metal, square J-Boxes with a minimum volume of 21 in^3 (J-Box not provided).
See ***Tech Sheet*** for details.

Remote Linear Power Housing



One remote power supply housing is supplied with each power supply. All Vode linear remote drivers come in a 0.054” (0.8mm) formed galvanized steel power supply housing with five (5) knockouts: (4) 1-1/8”, (1) 7/8“ and (1) 9/16”. Accommodates standard linear power supplies.
See ***Tech Sheet*** for details.

Wire Harness

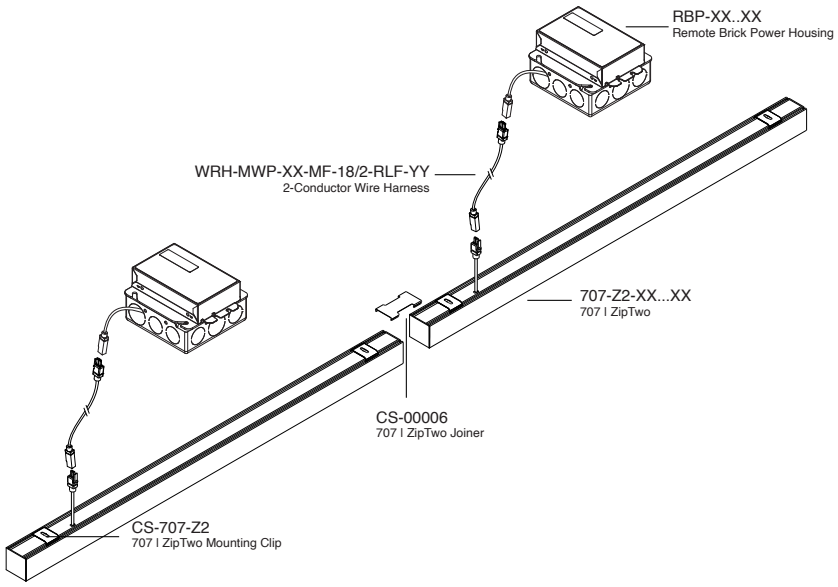


Wire harness connects driver to rail. Wire hareness is 25’ (7.6m) with micro fit molex connectors for quick and easy installation. Multiple harnesses can be combined for a total length of up to 100’ (30.5m).
See ***Tech Sheet*** for details.

Power and Controls

Flexible 1 to 1 power

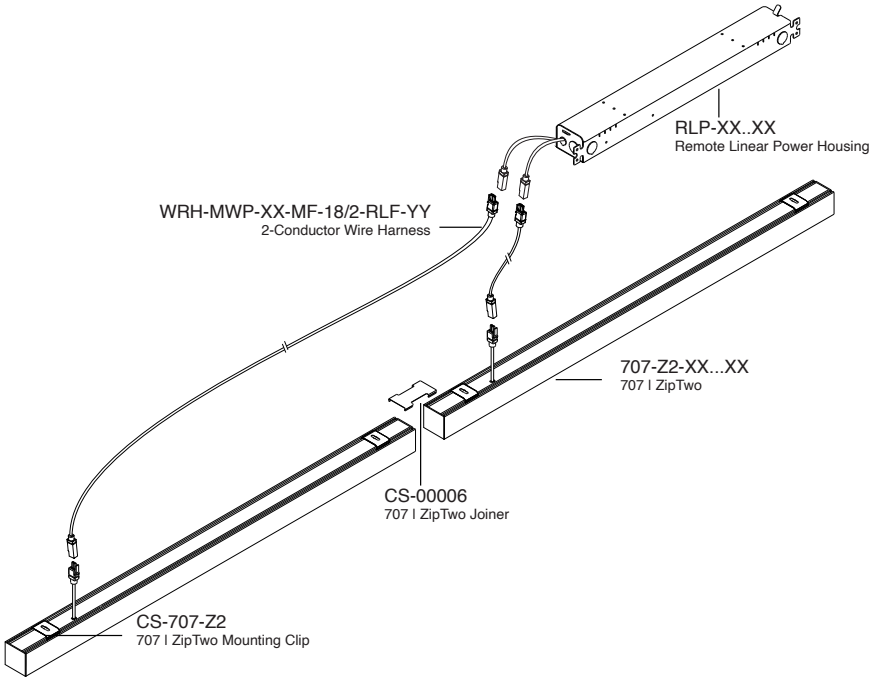
For Flexible 1 to 1 Power, Vode supplies one single output driver per fixture, allowing each fixture to be controlled independently. Direct/Indirect fixtures are supplied with two single output drivers, allowing the direct and indirect lighting to be controlled independently. Consult ***Power Guide*** to determine which type you will receive.



Optimized Power

To optimize power, Vode configures specifications with drivers that have 2 or 4 outputs. Depending on system configurations and power requirements, up to 4 fixtures can be powered from a 4-output driver. Consult ***Power Guide*** to determine which type you will receive.

IMPORTANT: Each fixture will still require individual wire harnesses, as shown below.

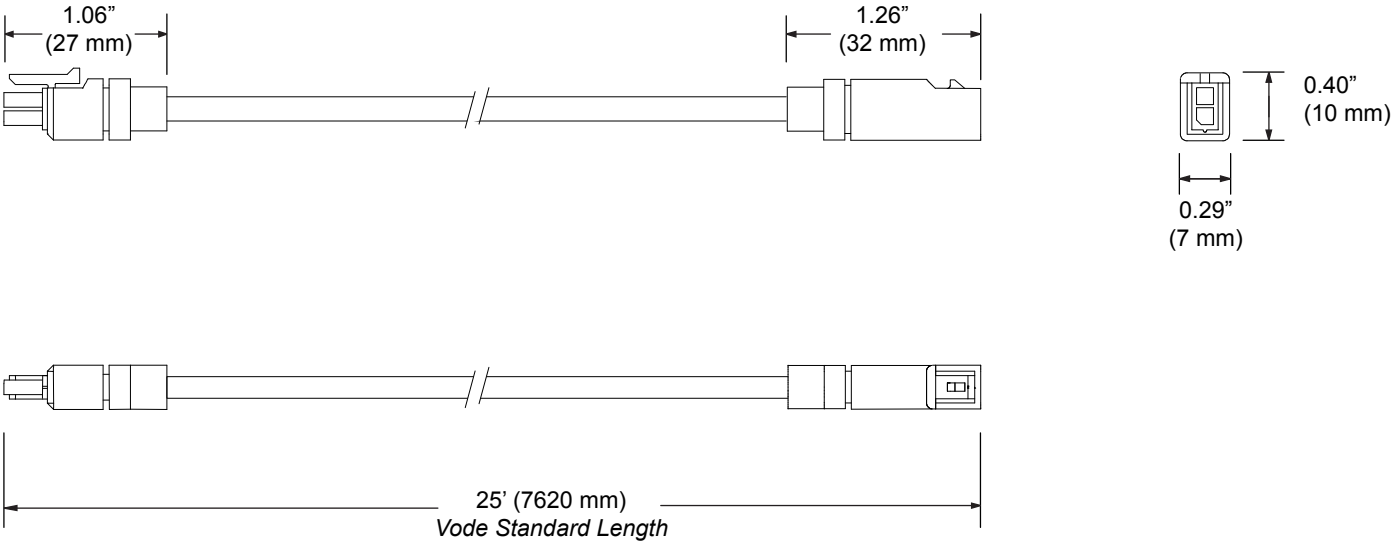


Note: Drawings not to scale, for reference only.

Power and Controls

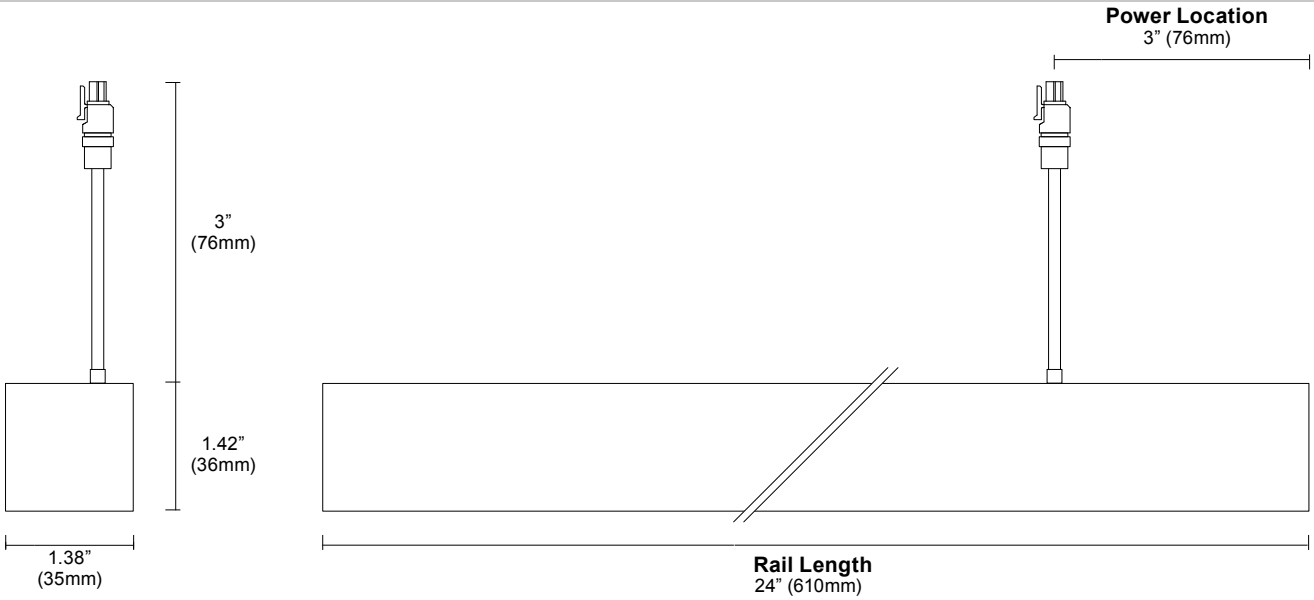
Wire Harness

Low voltage wire harness connects driver to rail. Wire hareness is 25’ (7.6m) 18/2 AWG stranded wire with provided micro fit molex connectors on either end for quick and easy installation. Multiple haresses can be combined for a total length of up to 100’ (30.5m). Refer to Vode Power Guide for max remote distance based on power selection. Consult ***Power Guide*** to determine which type you will receive.



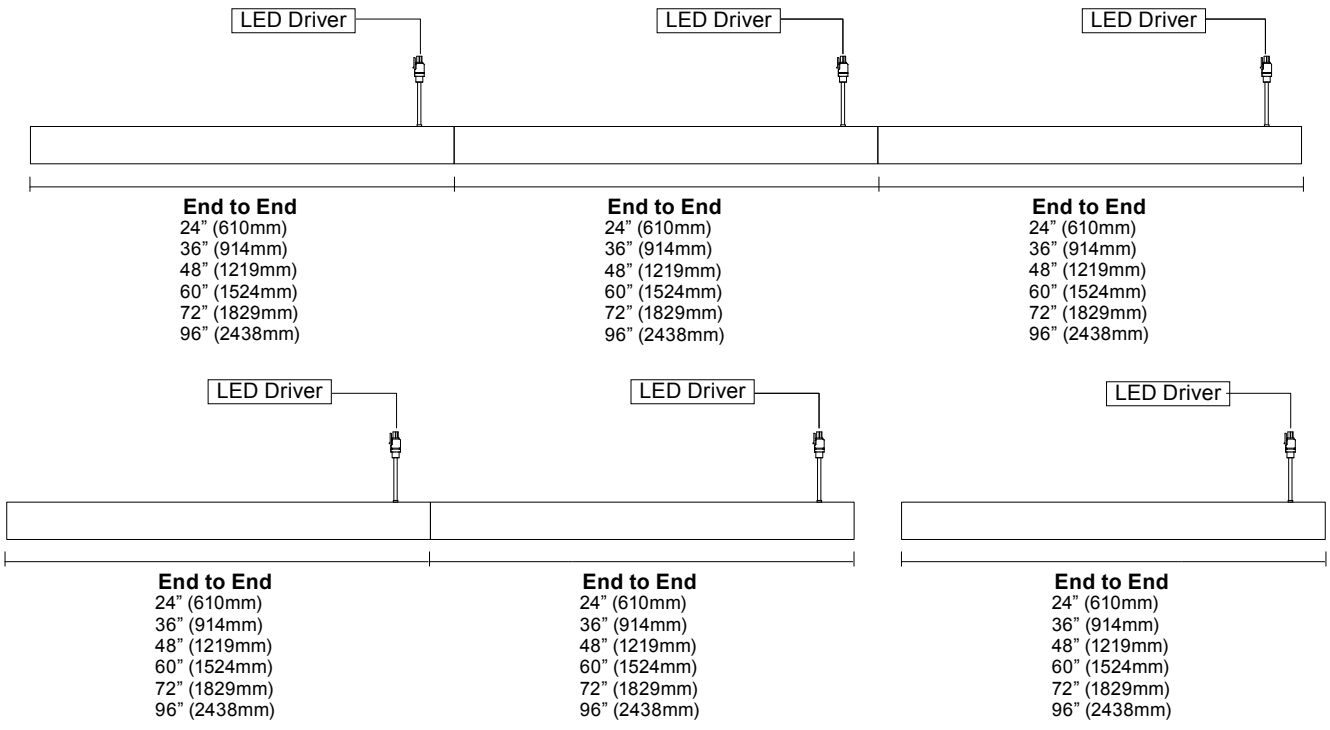
Note: Drawings not to scale, for reference only.

Dimensions



Rail Length
24” (610mm)
36” (914mm)
48” (1219mm)
60” (1524mm)
72” (1829mm)
96” (2438mm)

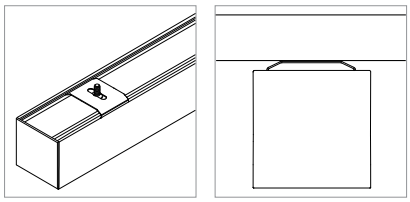
Layout

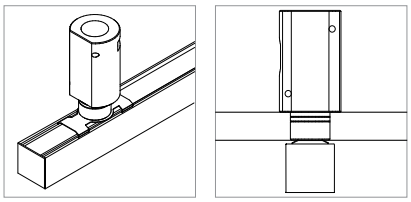


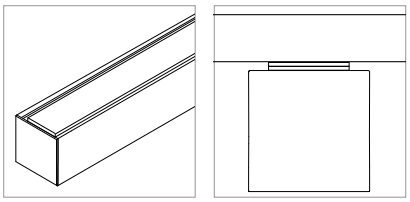
End to End
24” (610mm)
36” (914mm)
48” (1219mm)
60” (1524mm)
72” (1829mm)
96” (2438mm)

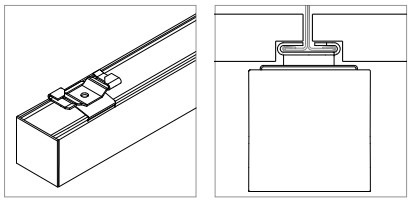
Corner and Shapes Available (Square, Rectangle, L-Shape, U-Shape, ZigZag)

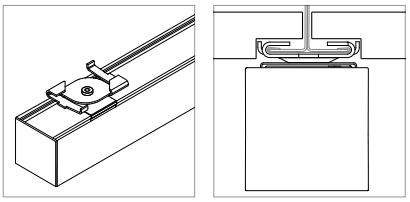
Mounting Options

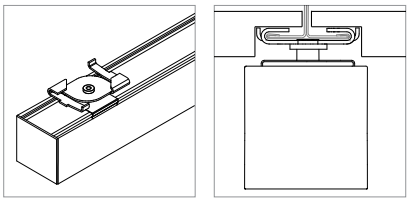

Clip (C)

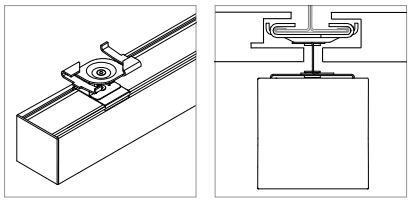

Clip with Micro J-Box (CM)

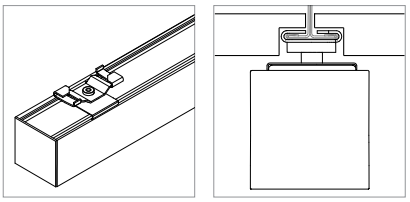

Magnet with Tape-On Metal Strip (T)

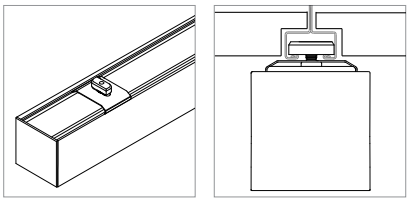

9/16” T-Bar Clip, low profile (T1)

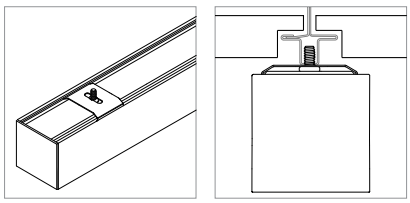

15/16” T-Bar Clip, low profile (T2)

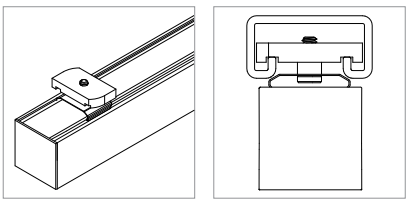

15/16” T-Bar Clip, medium profile (T3)

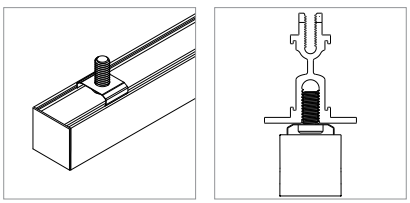

15/16” T-Bar Clip, concealed (T4)


9/16” T-Bar Clip, medium profile (T5)


Slotted T-Bar Clip (T6)


Dimensional T-Bar Clip (T7)


Strut Channel Clip (SC)

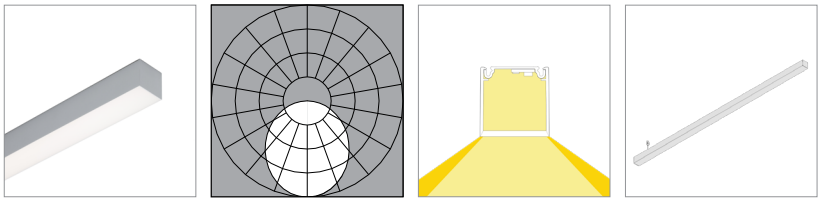

Armstrong DynaMax (DM)

See ***ZipTwo Clip Guide*** to check compatibility.

Performance | Zipper LED

Zipper Board has 72 diodes per foot (305mm). Testing based on a 4' rail section. Lumen measurement complies with IES-LM-79-08 testing procedures.

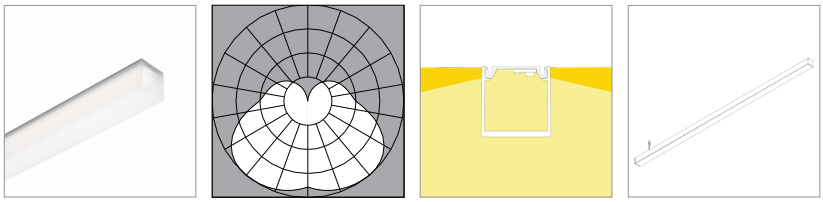
Square 3535, Critical Edge (S5)



L80 >60,000 hours

	80 CRI (80min., 84 avg.)				**90 CRI** (90min., 96 avg.)			
Low Output (LO)	2700K	3000K	3500K	4000K	2700K	3000K	3500K	4000K
Efficacy - Lumens per Watt	64	66	67	67	55	57	58	58
Lumens per foot (305mm)	235	243	248	248	203	209	214	216
Watts per foot (305mm)	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8
Standard Output (SO)								
Efficacy - Lumens per Watt	73	75	76	76	63	65	66	67
Lumens per foot (305mm)	471	486	496	496	406	419	427	432
Watts per foot (305mm)	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6
High Output (HO)								
Efficacy - Lumens per Watt	72	74	76	76	62	64	65	66
Lumens per foot (305mm)	706	729	744	744	609	628	641	647
Watts per foot (305mm)	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9

Square 3535, Diffuse (S6)



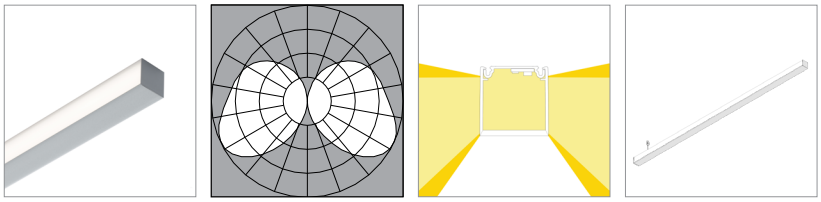
L80 >60,000 hours

	80 CRI (80min., 84 avg.)				**90 CRI** (90min., 96 avg.)			
Low Output (LO)	2700K	3000K	3500K	4000K	2700K	3000K	3500K	4000K
Efficacy - Lumens per Watt	127	131	134	134	110	113	115	117
Lumens per foot (305mm)	471	486	496	496	406	419	428	432
Watts per foot (305mm)	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8
Standard Output (SO)								
Efficacy - Lumens per Watt	145	150	153	153	125	129	132	133
Lumens per foot (305mm)	943	973	992	992	813	838	856	864
Watts per foot (305mm)	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6
High Output (HO)								
Efficacy - Lumens per Watt	144	148	151	151	124	128	130	132
Lumens per foot (305mm)	1414	1459	1489	1489	1219	1258	1283	1296
Watts per foot (305mm)	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9

Performance | Zipper LED

Zipper Board has 72 diodes per foot (305mm). Testing based on a 4' rail section. Lumen measurement complies with IES-LM-79-08 testing procedures.

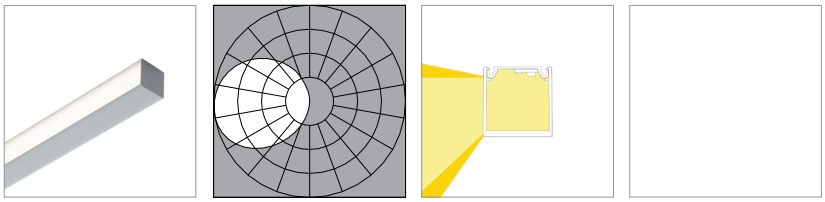
Square 3535, Side Diffuse (S9)



L80 >60,000 hours

	80 CRI (80min., 84 avg.)				**90 CRI** (90min., 96 avg.)			
Low Output (LO)	2700K	3000K	3500K	4000K	2700K	3000K	3500K	4000K
Efficacy - Lumens per Watt	86	89	91	91	74	77	78	79
Lumens per foot (305mm)	319	329	336	336	275	284	290	292
Watts per foot (305mm)	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8
Standard Output (SO)								
Efficacy - Lumens per Watt	98	101	103	103	85	87	89	90
Lumens per foot (305mm)	638	658	672	672	550	567	579	585
Watts per foot (305mm)	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6
High Output (HO)								
Efficacy - Lumens per Watt	97	100	102	102	84	87	88	89
Lumens per foot (305mm)	957	987	1007	1007	825	851	869	877
Watts per foot (305mm)	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9

Square 3535, Single Side Diffuse (SA)



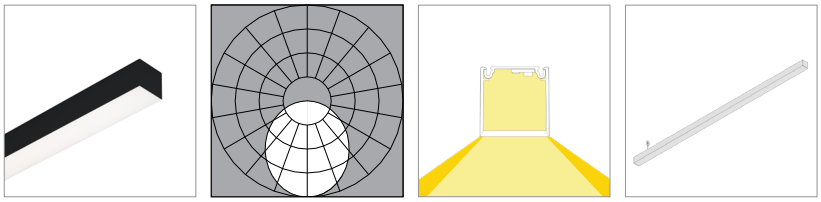
L80 >60,000 hours

	80 CRI (80min., 84 avg.)				**90 CRI** (90min., 96 avg.)			
Low Output (LO)	2700K	3000K	3500K	4000K	2700K	3000K	3500K	4000K
Efficacy - Lumens per Watt	78	80	82	82	67	69	71	72
Lumens per foot (305mm)	289	298	304	304	249	257	262	264
Watts per foot (305mm)	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8
Standard Output (SO)								
Efficacy - Lumens per Watt	89	92	94	94	77	79	81	82
Lumens per foot (305mm)	577	595	607	607	497	513	524	529
Watts per foot (305mm)	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6
High Output (HO)								
Efficacy - Lumens per Watt	88	91	93	93	76	78	80	81
Lumens per foot (305mm)	866	893	911	911	746	770	785	793
Watts per foot (305mm)	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9

Performance | Zipper LED

Zipper Board has 72 diodes per foot (305mm). Testing based on a 4' rail section. Lumen measurement complies with IES-LM-79-08 testing procedures.

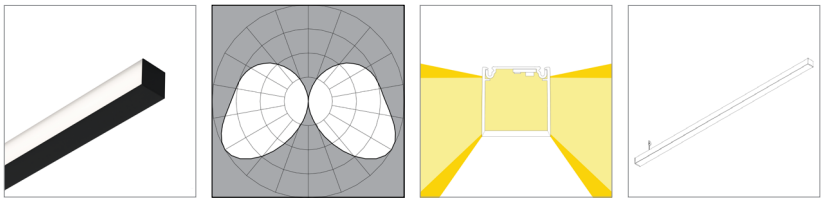
Square 3535, Critical Edge (S5), black finish (S5-BL)



L80 >60,000 hours

	80 CRI (80min., 84 avg.)				**90 CRI** (90min., 96 avg.)			
Low Output (LO)	2700K	3000K	3500K	4000K	2700K	3000K	3500K	4000K
Efficacy - Lumens per Watt	76	78	79	79	65	67	69	69
Lumens per foot (305mm)	279	288	294	294	241	248	253	256
Watts per foot (305mm)	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8
Standard Output (SO)								
Efficacy - Lumens per Watt	86	89	91	91	74	77	78	79
Lumens per foot (305mm)	559	576	588	588	482	497	507	512
Watts per foot (305mm)	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6
High Output (HO)								
Efficacy - Lumens per Watt	85	88	90	90	74	76	77	78
Lumens per foot (305mm)	838	864	882	882	722	745	760	768
Watts per foot (305mm)	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9

Square 3535, Side Diffuse (S9), black finish (S9-BL)



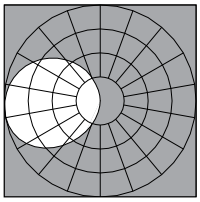
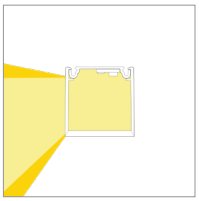
L80 >60,000 hours

	80 CRI (80min., 84 avg.)				**90 CRI** (90min., 96 avg.)			
Low Output (LO)	2700K	3000K	3500K	4000K	2700K	3000K	3500K	4000K
Efficacy - Lumens per Watt	94	97	99	99	81	84	85	86
Lumens per foot (305mm)	348	360	367	367	300	310	316	319
Watts per foot (305mm)	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8
Standard Output (SO)								
Efficacy - Lumens per Watt	107	111	113	113	92	95	97	98
Lumens per foot (305mm)	697	719	734	734	601	620	632	639
Watts per foot (305mm)	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6
High Output (HO)								
Efficacy - Lumens per Watt	106	110	112	112	92	95	96	97
Lumens per foot (305mm)	1045	1079	1101	1101	901	930	949	958
Watts per foot (305mm)	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9

Performance | Zipper LED

Zipper Board has 72 diodes per foot (305mm). Testing based on a 4' rail section. Lumen measurement complies with IES-LM-79-08 testing procedures.

Square 3535, Single Side Diffuse (SA), black finsh (SA-BL)


L80 >60,000 hours

	80 CRI (80min., 84 avg.)				**90 CRI** (90min., 96 avg.)			
Low Output (LO)	2700K	3000K	3500K	4000K	2700K	3000K	3500K	4000K
Efficacy - Lumens per Watt	74	76	78	78	64	66	67	68
Lumens per foot (305mm)	272	281	287	287	235	242	247	250
Watts per foot (305mm)	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8
Standard Output (SO)								
Efficacy - Lumens per Watt	84	87	88	88	72	75	76	77
Lumens per foot (305mm)	545	562	574	574	470	485	495	499
Watts per foot (305mm)	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6
High Output (HO)								
Efficacy - Lumens per Watt	83	86	88	88	72	74	76	76
Lumens per foot (305mm)	817	843	860	860	705	727	742	749
Watts per foot (305mm)	9.9	9.9	9.9	9.9	9.9	9.9	9.9	9.9

Date: _____ Customer: _____

Project: _____

Type: _____ Qty: _____

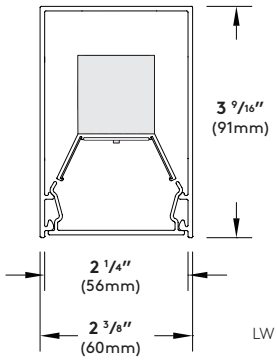
selux

M60
LED Direct

Order Code: L60 - _____ - _____ - _____ - _____ - _____ - _____ - _____ - _____ - _____ - _____ - _____ - _____

L60	Series	**L60** M60 LED Direct	
_____	Light Engine	**1C45**[1,2,3] 80CRI-1018lm 90CRI-855lm 11.1W per foot **1C40**[1,2,3] 80CRI-954lm 90CRI-802lm 9.9W per foot **1C35**[1] 80CRI-834lm 90CRI-701lm 8.7W per foot **1C30**[1,2] 80CRI-746lm 90CRI-627lm 7.3W per foot **1C25**[1,2] 80CRI-594lm 90CRI-500lm 6.1W per foot **1C20**[1,2] 80CRI-494lm 90CRI-415lm 4.9W per foot	[1] Values calculated from a 4' fixture at 3500K, 90+ CRI using LW shielding and DIM driver. For additional information please see page 2. [2] Available starting at 2' and up. [3] Not available with Lutron.
_____	CCT	**927** 2700K 90+ CRI **930** 3000K 90+ CRI **935** 3500K 90+ CRI **940** 4000K 90+ CRI **827**[4] 2700K 80+ CRI **830**[4] 3000K 80+ CRI **835**[4] 3500K 80+ CRI **840**[4] 4000K 80+ CRI **RGBW** (consult factory)	[4] Consult factory for lead times
_____	Shielding	**LW** LED Optimized White Lens **MI** Clear Lens with Microprism **NB** LMO Symmetric with Satine Lens **A2** LMO Asymmetric 20° Wall Washer with Satine Lens **A5** LMO Asymmetric 5° Wall Grazer with Satine Lens **BW** LMO Batwing with Satine Lens	
_____	Mounting	**C** Cable **S** Swivel Stem **RS** Rigid Stem **W**[5] Wall Mount **F**[6] Surface Mount	[5] Consult factory for lengths under 2' [6] Over 8' supplied with 2 or more housings that are joined in the field.
_____	Nominal Fixture Length	**01*** 1 ft. **02** 2 ft. **03** 3 ft. **04** 4 ft. **05** 5 ft. **06** 6 ft. **07** 7 ft. **08** 8 ft. **09** 9 ft. **10** 10 ft. **11** 11 ft. **12** 12 ft. **XX** Runs (over 12') and Configurations, round up to the nearest foot and replace the "xx" with the # (i.e. 13=13' nominal) **1' fixture only available with 1C35 light engine.* *Individual fixtures, Runs and Configurations are supplied in nominal lengths to ensure full, even, illumination. See pages 2 through 6 for additional details.*	
_____	Finish	**WH*** White **BL** Semi-Matte Black **SV** Silver **SP** Specify Premium Color	** Custom colors are available, please consult factory*
_____	Voltage	**1** 120V **2** 277V **U** 120V through 277V 50/60hz capable **3**[7] 347V (consult factory)	[7] 347V not available with EM integral battery option
_____	Driver	**DIM**[8] 0-10V 1% (Linear) **DIL**[8,9] eldoLED 1% ECOdrive 0-10V (Logarithmic) **DED**[8,9] eldoLED 1% ECOdrive DALI (Logarithmic) **D01**[8,9] eldoLED 0.1% SOLOdrive 0-10V (Linear) **DL01**[8,9] eldoLED 0.1% SOLOdrive 0-10V (Logarithmic) **DC2**[8,9,10] Lutron 1% 2-Wire **DE1**[8,9] Lutron 1% EcoSystem **DC5** Lutron 5% 5-Series (consult factory) **DC3** Lutron 1% 3-Wire (consult factory)	[8] See page 7 for full details [9] Not available for 1' length or with [10] 120V only
_____	Fixture Options	**DL** Damp Location Rated **FS** In-line Fuse **SS**[11] Separate Switching	[11] See page 10 for details
_____	Sensor Options	**xE**[12,13] Enlighted **xS1**[12,13] Sensor Switch Daylight **xS2**[12,13] Sensor Switch Occ/Vac **xS3**[12,13] Sensor Switch Occ/Vac/ Daylight **xSN** nLight enabled (consult factory) **xV** Lutron Vive (consult factory) Replace "x" with quantity	[12] Minimum fixture length 2'. See page 10 for full details and restrictions [13] Requires DIM driver (0-10V)
_____	Emergency Options	**EC**[14,15] Emergency Circuit Wiring **EMR** Remote Micro Inverter (consult factory) **EM**[14,15,16] Integral EM battery pack	[14] See page 8 for full details and restrictions [15] For emergency options with sensors, please consult factory. [16] For EM available in 4' and ≥ 6'. Please consult factory for 5'.
_____	Configuration Options	**L9** Lit Horizontal 90° Corner **V9** Lit Inverted 90° Corner **T9** Lit "T" section **X9** Lit "X" section	* See page 12 for full details and restrictions

All options indicated with the green truck symbol are available with 4-week ship time. Mixed orders will defer to the longest lead time.



LW lens shown for reference

Construction:

Housing - Continuous, low copper 6063-T6 extruded aluminum profile with aluminum endcaps, available as Individual fixtures (up to 12') or Runs.

Geartray - Low copper 6063-T6 extruded aluminum profile.

Shielding - Extruded, impact resistant acrylic lens:
- LED Optimized White Lens (LW)
- Clear Lens with Microprism (MI)

"LMO" refers to the Selux proprietary LED optical system - Light modulation optics. These lenses are offered in M60 behind a Satine Lens for even illumination and comfortable lit appearance.
- "LMO" Symmetric Lens (NB)
- "LMO" Asymmetric 20° Wall Washer (A2)
- "LMO" Asymmetric 5° Wall Grazer (A5)
- "LMO" Batwing (BW)

Mounting(s) - 1/16" Aircraft Cable, Ø5/8" Swivel or Rigid Steel Stem, Wall Bracket, Surface mounting (see pages 3 through 6 for details).
** Cable, Stem and Wall mountings may not be symmetrical for Runs and Configurations due to the use of modular housing lengths. If symmetrical suspensions are required please consult the factory.

Standard Luminaire lengths - All standard luminaires are supplied in nominal lengths to ensure full, even, illumination. Runs and Configurations are available in approximately 1/4" increments starting at the nominal 12' fixture length.
** Individual luminaires are not joinable in the field.

Exact length luminaires - Individual luminaires, Runs, and Configurations are available in exact lengths to meet your project needs. Please consult factory with your requirements.
** Lens luminance may soften at the very ends of the straight sections for exact length luminaire.

L60 Joiner(s) - Runs and Configurations are supplied in multiple housings that are joined together in the field using the supplied L60 Joiner System. This allows ease of installation and ensures a uniform appearance (see page 9 for detail).

Weight: 2.4 lb. per foot.

Electrical/Performance:

LED Light Engine - Brand-name mid-power LEDs create a high efficiency LED light engine able to provide a lumen maintenance of 95% at 25,000 hours and 90% at 60,000 hours at 25°C per TM-21 reports. Reported L70 greater than 60,000 hours.

Photometrics - Consult website or factory for IES Files. Independent photometric lumen measurement complies with IES LM-79-08 testing procedures. Due to the LED manufacturer's tolerances, the listed output has a ±5% tolerance. For outputs based on different optics or CCT, please see page 13 for details.

CCT - Available in 2700K, 3000K, 3500K and 4000K, tolerance within a 3-step MacAdam ellipse.

CRI - 90+ and 80+ CRI. Consult factory for lead times of 80 CRI.

All Drivers - High efficiency, constant current, soft start, Electronic Class 2 with a PFC>0.90. For more detailed information on the available drivers please see page 7.

Sensors - Selux offers a variety of integral sensor options. For details and specifications, please refer to page 10.

Emergency - There are multiple emergency options available - Emergency Circuit, Remote Micro Inverter, and Integral EM Battery Pack. All options compliant with UL 924 listed emergency luminaire. Please consult factory for use of sensors with emergency options. For more details on EC and EM options, see page 9.

Thermal Performance:

Ambient Operating Temperature - Luminaires suitable for maximum ambient temperature of 35°C (95°F) for all drivers.

Luminaires are suitable for minimum ambient temperatures of -40°C (-40°F) for DIM, DIL, DED, D01, and DL01 drivers; 0°C (32°F) for DC2 and DE1 drivers.

Luminaire Finish:

Powder Coat - All Selux luminaries are finished in high quality polyester powder coating in our Tiger Drylac certified facility and are tested in accordance with test specifications for coatings from ASTM and PCI.

All products undergo a five stage intensive pretreatment process where product is thoroughly cleaned, phosphated, and sealed. Selux powder coated products provide excellent salt and humidity resistance as well as ultra violet resistance for color retention.

Standard interior colors are White (WH), Semi-Matte Black (BL), and Silver (SV). Selux premium colors (SP) are available, please specify from your Selux color selection guide.

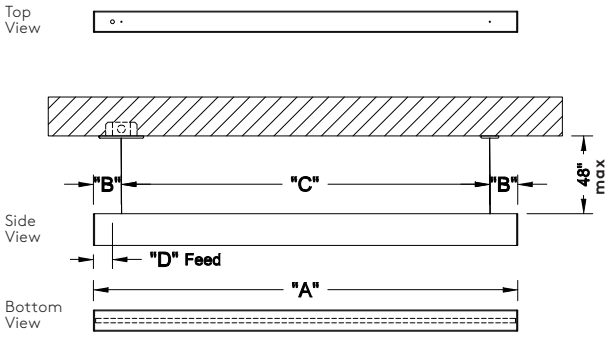
Warranty:

5 Year Limited LED Luminaire Warranty - Selux offers a 5 Year Limited Warranty to the original purchaser that the M60 series LED luminaire shall be free from defects in material and workmanship for up to five (5) years from date of shipment. This limited warranty covers the LED driver and LED light engine when installed according to Selux instructions and operated within the Ambient Temperature. For additional details and exclusions, see "Selux Terms and Condition of Sale."

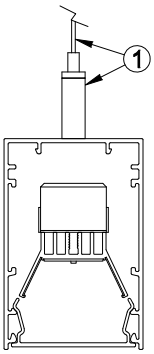
Certifications and Compliance:

NRTL - For Dry and Damp location
(I.E. cULus; cCSAus)
ADA Compliant
ARRA Compliant
RoHS Compliant

Cable Mounting (C)



Cable Mounting (C)

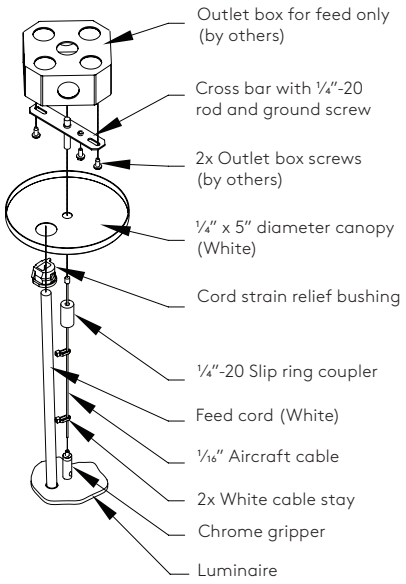


1. Ø 1⁄16" Aircraft Cable with chrome gripper for easy adjustment (48" max. from ceiling to luminaire).

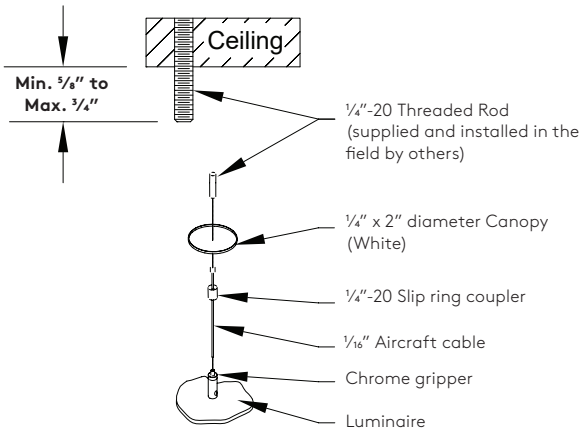
Cable Mounting (C) - Dimensions								
Nominal Length	**"A" Housing Length**		*** "B" (Ref.) End Suspensions**		**"C" Mid. Suspension**		**"D" Feed Location**	
	Feet/Inch	**MM**	**Feet/Inch**	**MM**	**Feet/Inch**	**MM**	**Feet/Inch**	**MM**
01 (1ft.)	1' - 1⁄4"	311	0' - 2 1⁄8"	54	0' - 8"	203	0' - 1 1⁄8"	29
02 (2ft.)	2' - 1⁄4"	616	0' - 2 1⁄8"	54	1' - 8"	508	0' - 1 1⁄8"	29
03 (3ft.)	3' - 1⁄4"	921	0' - 3 1⁄8"	79	2' - 6"	762	0' - 2 1⁄8"	54
04 (4ft.)	4' - 1⁄4"	1226	0' - 3 1⁄8"	79	3' - 6"	1067	0' - 2 1⁄8"	54
05 (5ft.)	5' - 1⁄4"	1530	0' - 3 1⁄8"	79	4' - 6"	1372	0' - 2 1⁄8"	54
06 (6ft.)	6' - 1⁄4"	1835	0' - 3 1⁄8"	79	5' - 6"	1676	0' - 2 1⁄8"	54
07 (7ft.)	7' - 1⁄4"	2140	0' - 3 1⁄8"	79	6' - 6"	1981	0' - 2 1⁄8"	54
08 (8ft.)	8' - 1⁄4"	2445	0' - 3 1⁄8"	79	7' - 6"	2286	0' - 2 1⁄8"	54
09 (9ft.)	9' - 1⁄4"	2750	0' - 3 1⁄8"	79	8' - 6"	2591	0' - 2 1⁄8"	54
10 (10ft.)	10' - 1⁄4"	3054	0' - 3 1⁄8"	79	9' - 6"	2896	0' - 2 1⁄8"	54
11 (11ft.)	11' - 1⁄4"	3359	0' - 3 1⁄8"	79	10' - 6"	3200	0' - 2 1⁄8"	54
12 (12ft.)	12' - 1⁄4"	3664	0' - 3 1⁄8"	79	11' - 6"	3505	0' - 2 1⁄8"	54

*Dimension(s) rounded to the nearest 1⁄16" with a ± 1⁄16" (1mm) tolerance.

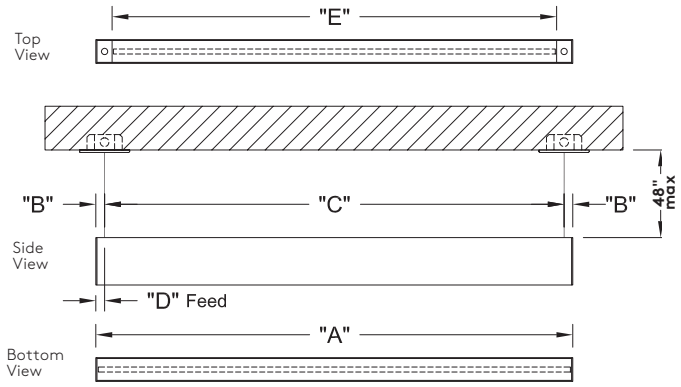
L60 Cable (C) Suspension Detail
(Feed location(s) only)



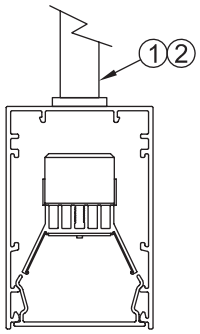
L60 Cable (C) Suspension Detail
(Non-Feed location(s) only)



Stem Mounting (S and RS)



Stem Mounting (S and RS)

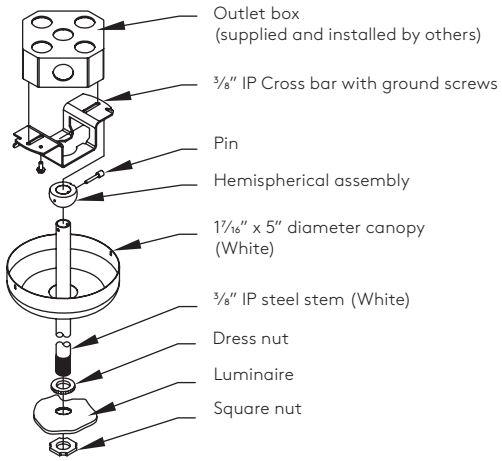


1. Ø ⅝" Swivel Stem provides 30° swivel and **can be cut in field** (48" max. from ceiling to luminaire).
2. Ø ⅝" Rigid Stem is fixed and is **not able to be cut/adjusted in field** (48" max. from ceiling to luminaire).

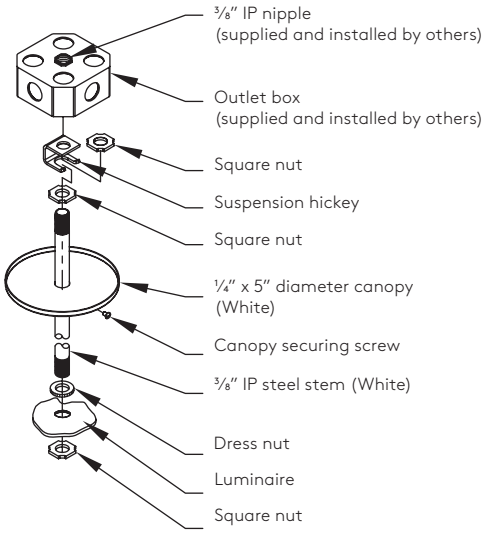
Swivel (S) & Rigid Stem (RS) Mountings - Dimensions								
Nominal Length	**"A" Housing Length**		*** "B" (Ref.) End Suspensions**		**"C" Mid. Suspension**		**"D" Feed Location**	
	Feet/Inch	**MM**	**Feet/Inch**	**MM**	**Feet/Inch**	**MM**	**Feet/Inch**	**MM**
01 (1ft.)	1' - ¼"	311	0' - 2 ⅛"	54	0' - 8"	203	0' - 2 ⅛"	54
02 (2ft.)	2' - ¼"	616	0' - 2 ⅛"	54	1' - 8"	508	0' - 2 ⅛"	54
03 (3ft.)	3' - ¼"	921	0' - 3 ⅛"	79	2' - 6"	762	0' - 3 ⅛"	79
04 (4ft.)	4' - ¼"	1226	0' - 3 ⅛"	79	3' - 6"	1067	0' - 3 ⅛"	79
05 (5ft.)	5' - ¼"	1530	0' - 3 ⅛"	79	4' - 6"	1372	0' - 3 ⅛"	79
06 (6ft.)	6' - ¼"	1835	0' - 3 ⅛"	79	5' - 6"	1676	0' - 3 ⅛"	79
07 (7ft.)	7' - ¼"	2140	0' - 3 ⅛"	79	6' - 6"	1981	0' - 3 ⅛"	79
08 (8ft.)	8' - ¼"	2445	0' - 3 ⅛"	79	7' - 6"	2286	0' - 3 ⅛"	79
09 (9ft.)	9' - ¼"	2750	0' - 3 ⅛"	79	8' - 6"	2591	0' - 3 ⅛"	79
10 (10ft.)	10' - ¼"	3054	0' - 3 ⅛"	79	9' - 6"	2896	0' - 3 ⅛"	79
11 (11ft.)	11' - ¼"	3359	0' - 3 ⅛"	79	10' - 6"	3200	0' - 3 ⅛"	79
12 (12ft.)	12' - ¼"	3664	0' - 3 ⅛"	79	11' - 6"	3505	0' - 3 ⅛"	79

*Dimension(s) rounded to the nearest 1⁄16" with a ± 1⁄16" (1mm) tolerance.

L60 Swivel Stem (S) Suspension Detail
(feed wires through stem supplied by Selux)

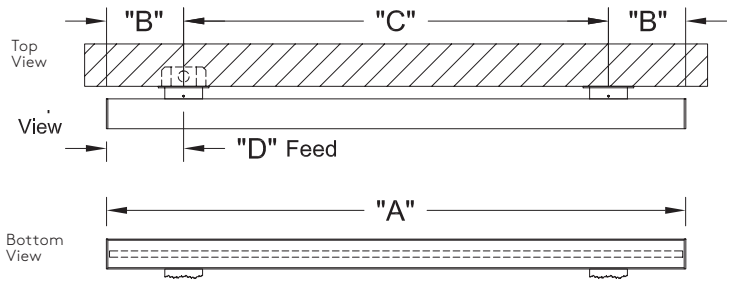


L60 Rigid Stem (RS) Suspension Detail
(feed wires through stem supplied by Selux)



Wall Mounting (W)

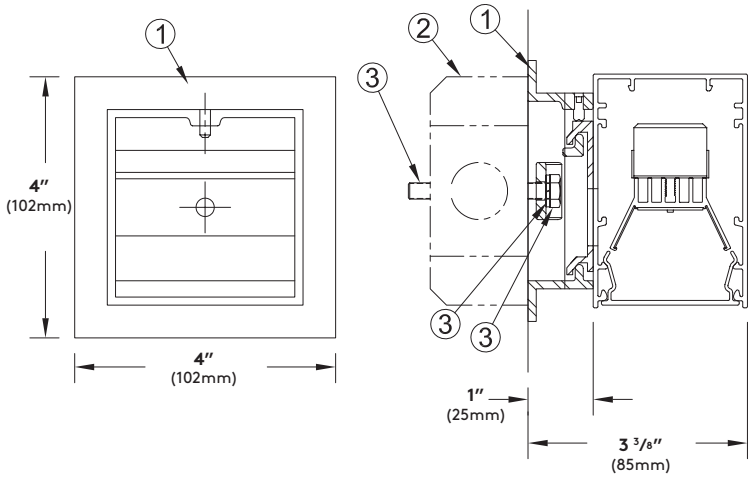
For patterns and configurations that include a wall mount, please see page 12 for details



Wall (W) Mount - Dimensions								
Nominal Length	**"A" Housing Length**		*** "B" (Ref.) End Suspensions**		**"C" Mid. Suspension**		**"D" Feed Location**	
	Feet/Inch	**MM**	**Feet/Inch**	**MM**	**Feet/Inch**	**MM**	**Feet/Inch**	**MM**
01 (1 ft.)	1' - ¼"	311	6⅛"	156	N/A		0 - 6⅛"	156
02 (2 ft.)	2' - ¼"	616	3⅛"	79	1' - 0"	458	0 - 3⅛"	79
03 (3 ft.)	3' - ¼"	921	6⅛"	156	2' - 6"	610	0 - 6⅛"	156
04 (4 ft.)	4' - ¼"	1226	6⅛"	156	3' - 0"	914	0 - 6⅛"	156
05 (5 ft.)	5' - ¼"	1530	6⅛"	156	4' - 0"	1219	0 - 6⅛"	156
06 (6 ft.)	6' - ¼"	1835	6⅛"	156	5' - 0"	1524	0 - 6⅛"	156
07 (7 ft.)	7' - ¼"	2140	6⅛"	156	6' - 0"	1829	0 - 6⅛"	156
08 (8 ft.)	8' - ¼"	2445	6⅛"	156	7' - 0"	2134	0 - 6⅛"	156
09 (9 ft.)	9' - ¼"	2750	6⅛"	156	8' - 0"	2438	0 - 6⅛"	156
10 (10 ft.)	10' - ¼"	3054	6⅛"	156	9' - 0"	2743	0 - 6⅛"	156
11 (11 ft.)	11' - ¼"	3359	6⅛"	156	10' - 0"	3048	0 - 6⅛"	156
12 (12 ft.)	12' - ¼"	3664	6⅛"	156	11' - 0"	3353	0 - 6⅛"	156

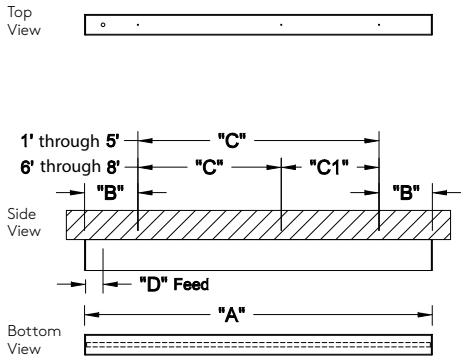
*Dimension(s) rounded to the nearest 1⁄16" with a ± 1⁄16" (1mm) tolerance.

Wall Mount (W)
(Covers a 4x4 or 2x4 J-Box)

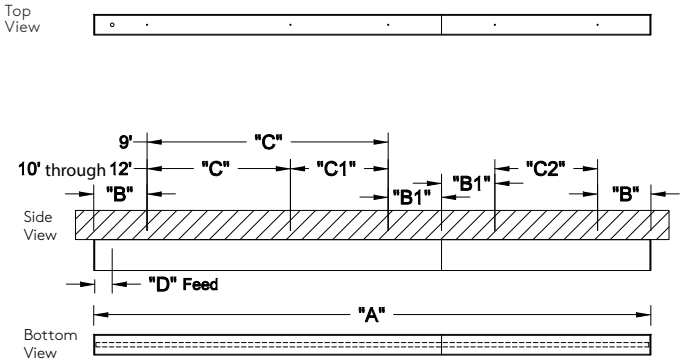


1. Aluminum wall bracket (by Selux).
2. 4"x4" or 2"x4" J-Box at feed location (supplied and installed by others).
3. ¼"-20 Threaded rod, ¼"-20 lock washer and ¼"-20 nut required to anchor the wall bracket. Mounting hardware supplied and installed to code by others.

Surface Mounting (F) - 1′ to 8′



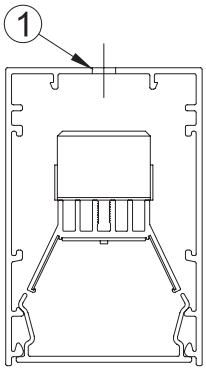
Surface Mounting (F) - Over 9′ to 12′



Surface Mount (FF, F2, & F4) - Dimensions														
Nominal Length	**"A" Housing Length**		*** "B" (Ref.) End Suspensions**		*** "B1" End Suspensions**		**"C" Mid. Suspension**		**"C1" Mid. Suspension**		**"C2" Mid. Suspension**		**"D" Feed Location**	
	Feet/Inch	**MM**	**Feet/Inch**	**MM**	**Feet/Inch**	**MM**	**Feet/Inch**	**MM**	**Feet/Inch**	**MM**	**Feet/Inch**	**MM**	**Feet/Inch**	**MM**
01 (1 ft.)	1' - ¼"	311	- 1⅝"	41	N/A		0' - 9"	229	N/A		N/A		0' - 4⅛"	105
02 (2 ft.)	2' - ¼"	616	0' - 1⅝"	41	N/A		1' - 9"	533	N/A		N/A		0' - 4⅛"	105
03 (3 ft.)	3' - ¼"	921	0' - 6⅛"	156	N/A		2' - 0"	610	N/A		N/A		0' - 2⅛"	54
04 (4 ft.)	4' - ¼"	1226	0' - 6⅛"	156	N/A		3' - 0"	914	N/A		N/A		0' - 2⅛"	54
05 (5 ft.)	5' - ¼"	1530	0' - 6⅛"	156	N/A		4' - 0"	1219	N/A		N/A		0' - 2⅛"	54
06 (6 ft.)	6' - ¼"	1835	0' - 6⅛"	156	N/A		3' - 0"	914	2' - 0"	610	N/A		0' - 2⅛"	54
07 (7 ft.)	7' - ¼"	2140	0' - 6⅛"	156	N/A		3' - 0"	914	3' - 0"	914	N/A		0' - 2⅛"	54
08 (8 ft.)	8' - ¼"	2445	0' - 6⅛"	156	N/A		3' - 0"	914	4' - 0"	1219	N/A		0' - 2⅛"	54
09 (9 ft.)	9' - ¼"	2750	0' - 6⅛"	156	0' - 6"	152	4' - 0"	1219	N/A		3' - 0"	914	0' - 2⅛"	54
10 (10 ft.)	10' - ¼"	3054	0' - 6⅛"	156	0' - 6"	152	3' - 0"	914	2' - 0"	610	3' - 0"	914	0' - 2⅛"	54
11 (11 ft.)	11' - ¼"	3359	0' - 6⅛"	156	0' - 6"	152	3' - 0"	914	3' - 0"	914	3' - 0"	914	0' - 2⅛"	54
12 (12 ft.)	12' - ¼"	3664	0' - 6⅛"	156	0' - 6"	152	3' - 0"	914	4' - 0"	1219	3' - 0"	914	0' - 2⅛"	54

*Dimension(s) rounded to the nearest 1/16" with a ± 1/16" (1mm) tolerance.

Surface Mount (F)



***Please note: Fixture does not cover a 4x4 J-box**

1. Ø 5/16" Mounting hole drilled at the factory (mounting hardware to code by others).

0-10V linear dimming (DIM)
Luminaires supplied with drivers offering the capability of either normal switched operation of 0-10V dimming for linear dimming curve. Fixtures ship wired for dimming. For on/off functionality, simply cap the dimming leads. Minimum dimming level preset at factory to 1%. (Due to size constraints, 1' luminaires are supplied with a driver from a different manufacturer than 2' and above luminaires. For details, please consult factory).

0-10V logarithmic eldoLED ECOdrive dimming (DIL)
Luminaires supplied with drivers offering the capability of either normal switched operation of 0-10V dimming for logarithmic dimming curve, Fixtures shipped wired for dimming. For on/off functionality, simply cap the dimming leades. Minimum dimming level preset at factory to 1%.

eldoLED ECOdrive DALI dimming (DED)
Luminaires supplied with ECOdrive DALI dimming driver with logarithmic dimming curve. Minimum dimming level preset at factory to 1%. For "dim to dark" (down to 0.1%), please consult factory.

eldoLED SOLOdrive 0-10V linear dimming (D01)
Luminaires supplied with SOLOdrive 0-10V dimming driver with linear dimming curve. Minimum dimming level preset at factory to 0.1% and "dim to dark".

eldoLED SOLOdrive 0-10V logarithmic dimming (DL01)
Luminaires supplied with SOLOdrive 0-10V dimming driver with logarithmic dimming curve. Minimum dimming level preset at factory to 0.1% and "dim to dark".

LUTRON 2-wire dimming (DC2)
Luminaires supplied with Hi-Lume 2-wire dimming driver (120V only) programmed for Constant Current Reduction (CCR). For Pulse Width Modulation (PWM) dimming, please consult factory. Minimum dimming level down to 1%.

LUTRON EcoSystem dimming (DE1/DC5)
Luminaires supplied with Hi-Lume EcoSystem (4 wire, digital link) dimming driver programmed for Constant Current Reduction (CCR). Minimum dimming level down to 1% (DE1) with SoftOn/FadeToBlack or 5% (DC5).

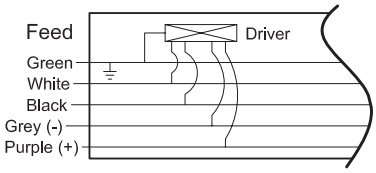
* For control recommendations, please contact driver manufacturer.

<table>
<tr><td colspan="13">Driver Quantity</td></tr>
<tr><td rowspan="2">Light Engine</td><td rowspan="2">Dimming Code</td><td colspan="11">Length</td></tr>
<tr><td>1ft</td><td>2ft</td><td>3ft</td><td>4ft</td><td>5ft</td><td>6ft</td><td>7ft</td><td>8ft</td><td>9ft</td><td>10ft</td><td>11ft</td><td>12ft</td></tr>
<tr><td rowspan="4">1C20</td><td>DIM/DIL</td><td rowspan="16">N/A</td><td colspan="7" rowspan="3">1</td><td rowspan="3">2</td><td colspan="2" rowspan="3">2</td><td rowspan="3">1</td></tr>
<tr><td>D01/DL01/DED</td></tr>
<tr><td>DE1/DC5</td></tr>
<tr><td>DC2</td><td>3</td><td colspan="2">3</td><td>2</td></tr>
<tr><td rowspan="4">1C25</td><td>DIM/DIL</td><td colspan="5" rowspan="3">1</td><td colspan="2" rowspan="2">1</td><td rowspan="3">2</td><td colspan="2" rowspan="3">2</td><td rowspan="3">1</td></tr>
<tr><td>D01/DL01/DED</td></tr>
<tr><td>DE1/DC5</td></tr>
<tr><td>DC2</td><td colspan="2">2</td><td>3</td><td colspan="2">3</td><td>2</td></tr>
<tr><td rowspan="4">1C30</td><td>DIM/DIL</td><td colspan="4" rowspan="3">1</td><td colspan="3" rowspan="2">1</td><td rowspan="3">2</td><td colspan="2" rowspan="3">2</td><td rowspan="3">2</td></tr>
<tr><td>D01/DL01/DED</td></tr>
<tr><td>DE1/DC5</td></tr>
<tr><td>DC2</td><td colspan="3">2</td><td>3</td><td colspan="2">3</td><td>3</td></tr>
<tr><td rowspan="4">1C35</td><td>DIM/DIL</td><td>1</td><td colspan="4" rowspan="3">1</td><td rowspan="3">1</td><td>2</td><td rowspan="3">1</td><td rowspan="3">2</td><td colspan="2" rowspan="3">2</td><td rowspan="3">2</td></tr>
<tr><td>D01/DL01/DED</td><td rowspan="15">N/A</td><td rowspan="2">1</td><td>1</td></tr>
<tr><td>DE1/DC5</td><td>2</td></tr>
<tr><td>DC2</td><td colspan="2">2</td><td>2</td><td>3</td><td colspan="2">3</td><td>3</td></tr>
<tr><td rowspan="4">1C40</td><td>DIM/DIL</td><td colspan="3" rowspan="2">1</td><td rowspan="2">1</td><td>2</td><td colspan="3" rowspan="2">2</td><td colspan="2" rowspan="2">3</td></tr>
<tr><td>D01/DL01/DED</td><td>1</td></tr>
<tr><td>DE1/DC5</td><td colspan="9">N/A</td></tr>
<tr><td>DC2</td></tr>
<tr><td rowspan="4">1C45</td><td>DIM/DIL</td><td colspan="3" rowspan="2">1</td><td>2</td><td rowspan="2">1</td><td colspan="2" rowspan="2">2</td><td rowspan="2">3</td><td rowspan="2">2</td><td colspan="2" rowspan="2">3</td></tr>
<tr><td>D01/DL01/DED</td><td>1</td></tr>
<tr><td>DE1/DC5</td><td colspan="9" rowspan="2">N/A</td></tr>
<tr><td>DC2</td></tr>
</table>

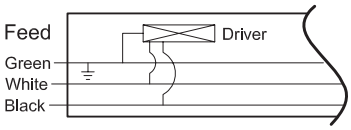
Wiring Diagrams

Standard Wiring supplied for all drivers.	Green = Ground White = Neutral Black = Hot
- The following wire(s) are in addition to the standard above -	
DIM, DIL, DED D01, DL01	Gray = (-) DALI or 0-10V Dimming Control Purple = (+) DALI or 0-10V Dimming Control
DC2	No additional wires
DE1, DC5	Violet = "E1" Digital Link Dimming Control Violet/White = "E2" Digital Link Dimming Control

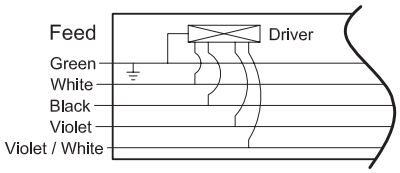
0-10V linear (DIM)
0-10V logarithmic eldoLED Ecodrive (DIL)
DALI logarithmic eldoLED ECOdrive (DED)
0-10V linear eldoLED SOLOdrive (D01)
0-10V logarithmic eldoLED SOLOdrive (DL01)



Lutron 2-Wire (DC2)

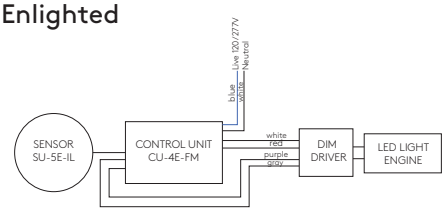


Lutron EcoSystem (DE1)
Lutron 5-Series (DC5)

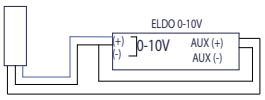


Sensor Wiring Diagrams

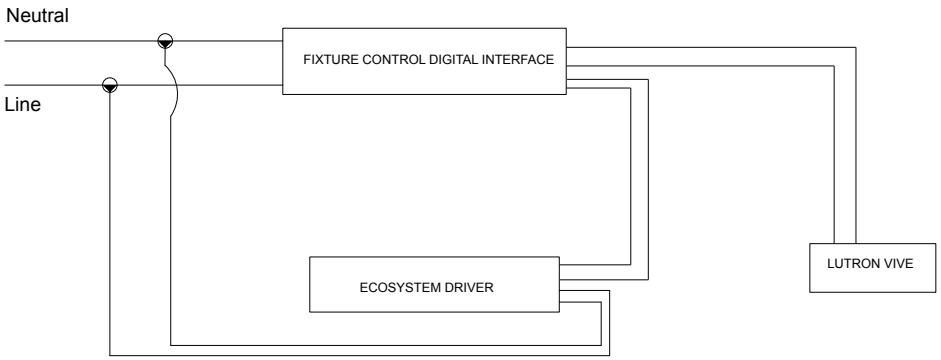
Enlighted



Sensor Switch



Lutron Vive



Driver power chart - use below values to determine the nominal watts per foot based on driver, light engine, and voltage.
* Driver losses increase the wattage for fixtures less than 4 foot.
** Values are nominal values determined based on multiple tested fixtures.

Driver Power Usage				
Driver	**Light Engine**	**Nominal W/ft**		
		120V	**277V**	**347V**
DIM, DIL, DED, D01, DL01	1C20	4.9	5.3	n/a
	1C25	6.1	6.5	
	1C30	7.3	7.7	
	1C35	8.7	8.9	
	1C40	9.9	10.1	
	1C45	11.1	11.3	
DC2, DE1, DCE, DC5, DC3	1C20	5.5	5.2	n/a
	1C25	6.7	6.3	
	1C30	8.0	7.6	
	1C35	9.3	8.8	
	1C40	10.6	10.0	
	1C45	11.6	11.3	
DIM @347V	1C20	n/a	n/a	5.4
	1C25			6.5
	1C30			7.7
	1C35			8.8
	1C40			10.0
	1C45			11.2
EM	all	6		n/a

Fuse (FS) - Fusing, luminaires supplied with a in-line fuse located on the hot wire for each feed (Supplied with an 8A slow burn fuse).

Damp Location (DL) - Luminaires are suitable for use in damp location(s). Examples of such locations include protected areas under canopies, marquees, roofed porches, and similar locations where the fixture(s) are protected from direct contact with rain, snow, or excessive moisture (such as ocean spray). Interior locations include areas subject to moderate degrees of moisture, such as basements and certain barns and cold storage buildings.

* For Damp Location with sensors, please consult factory.

Separate Switching (SS) - Luminaires available with separately switched 4' (nominal) sections starting at 7' and up. Luminaire is intended to be wired to the same panel/breaker (not intended for Emergency use).

* All separately switched (non-EM) circuits within an individual luminaire, linear run, or configuration must be connected to the same branch circuit on-site.

* To specify this option, the number of separately switched sections and locations of these sections must be provided at time of order.

* If the project requires different separate switching than outlined above please consult the factory.

* For Separate Switching with sensors, please consult factory.

Emergency Wiring (EC) - Luminaires with (EC) option are compliant to UL 924 listed emergency luminaire. EC luminaires are intended to be wired to separate panels/breakers for emergency use. See install instructions for proper wiring.

For 1' to 6' nominal luminaires, the entire fixture is wired for operation on emergency circuit.

For 7' and up nominal luminaires, the first 4' nominal length is wired for operation by a separate EM circuit by default to meet the required "Life Safety Code" (NFPA 101).

If a different configuration is needed, please consult factory.

Note: Wiring may vary slightly due to on-site conditions or local codes. Please follow all safety installation protocols contained within install instructions when installing luminaire.

Emergency Battery (EM) – Luminaires with emergency battery (EM) option are compliant to UL 924 listed emergency luminaire. The EM battery is located integral to fixture and is factory pre-wired. See install instructions for proper wiring.

In the event of an emergency, EM battery will illuminate a 4' section at 12W (constant) for 90 minutes at 25°C. Recharge time is 24 hours.

Direct fixtures are available for emergency battery (EM) use in 4' and ≥6. Due to size constraints, EM is not available in 5' fixtures.

For individual fixtures, emergency option will illuminate the first 4' section of fixture. For continuous runs, please consult factory to advise on 4' section intended for emergency use. For fixtures >12' or if a different configuration is needed, please consult factory.

Emergency test switch and plate is a non-illuminated 3" blank section located adjacent to the length of fixture wired for emergency.

* Emergency battery option is UNV for use with 120V or 277V and is not available for 347V.

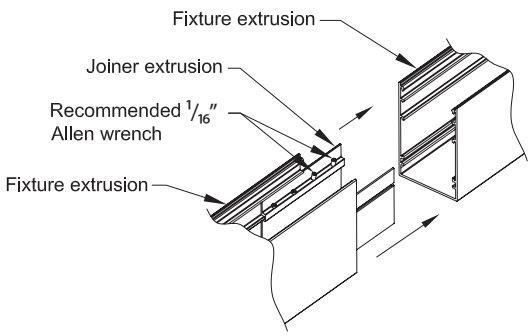
* Please note battery pack requires an unswitched hot.

* For EM with sensors, please consult factory.

* If a different configuration is needed, please consult factory.

Note: Wiring may vary slightly due to on-site conditions or local codes. Please follow all safety installation protocols contained within install instructions when installing luminaire.

Joiner System - standard for Runs and Configurations



Sensor Ordering Chart		
Quantity	**Sensor**	**Settings***
x Number of Sensors	**E** Enlighted SU-5E-IL **S** Sensor Switch MSD EZ **V** Lutron Vive DFCSJ	**1** Daylight **2** Occupancy/Vacancy **3** Daylight/Occupancy/Vacancy * Settings not available with Enlighted

Enlighted SU-5E-IL (E)
Enlighted Micro Sensor SU-5E-IL (Independent Lighting) provided as standard with an Enlighted CU-4E-FM Fixture Mount Control Unit integral to fixture. If SU-5E-CL (Connected Lighting) or SU-5E-IoT (Internet of Things) is desired, please contact factory. Occupancy/vacancy, thermal, daylight sensing plus Tunable White, Room & Zone control, Internet of Things (IoT) data collection and reporting control. For full details, please see SU-5E-(IoT/CL/IL) spec sheet on the Enlighted website. Must be paired with a 0-10V driver with auxiliary (DIM driver selection). Commissioning by Enlighted.

*Sensor can control up to 5 drivers. Please refer to driver quantity chart on page 7. Multiple sensors may be required for longer lengths.

Sensor Switch MSD EZ (S)
Occupancy/vacancy and daylight harvesting. For full functionality and programming options, select settings option 3. If a different settings option is selected, other settings may be unavailable. For full details, please see MSD EZ spec sheets on the Sensor Switch website. Must be paired with DIM driver selection. Manual control of dimming not available with MSD EZ sensor.

*Sensor can control up to 30 drivers. Please refer to driver quantity chart on page 7. Multiple sensors may be required for longer lengths.

Lutron Vive DFCSJ (V)
The DFCSJ-OEM-OCC provides the capabilities of daylight harvesting and occupancy/vacancy sensing. When integrated with the DFC-OEM-DBI (Fixture Contril Digital Link Interface), the sensor is wirelessly compatible with the DE1 Lutron EcoSystem driver. Commissioning bt certified Lutron technician.

*Vive DFCSJ sensor can control up to a maximum of five (5) drivers per sensor. Please refer to driver chart on page 7. Multiple sensors may be required for longer lengths.

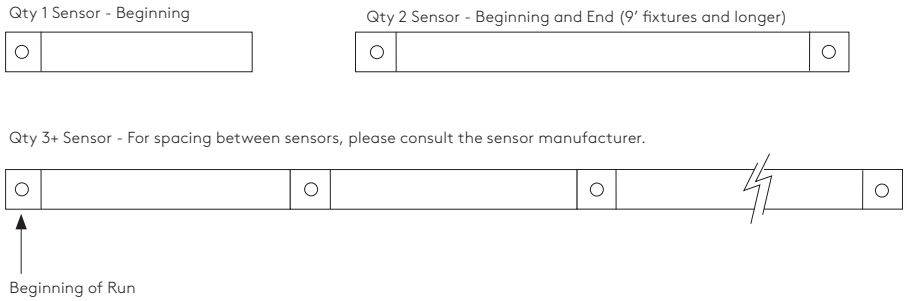
	Occupancy	Vacancy	Daylight Harvesting	Driver Compatibility
Enlighted SU-5E-IL (E)	√	√	√	DIM
Sensor Switch MSD EZ (S)	√	√	√	DIM
Lutron Vive DFCSJ (V)	√	√	√	DE1

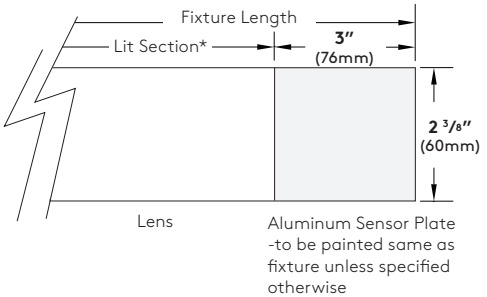
Please contact controls manufacturer for details prior to specifying.

Factory Presets - Sensors come from the sensor manufacturer with factory presets for each of the settings in above chart. Please see sensor manufacturers' spec sheets for details on presets and re-programming.

Commissioning - Commissioning of sensors and installation by others. Contact sensor manufacturer for details and costs associated with commissioning the system prior to specification of sensors.

Standard Sensor Placement - for other placement options, please consult factory. For functionality and limitations, please see sensor details above.





*Lit section will be the fixture length minus 3" for sensor plate.

Notes: 1. For spacing between sensors, please consult the sensor manufacturer.
2. Exact sensor placement and coverage will be defined by approved factory drawing.
3. Sections controlled by sensors may not be symmetrical - consult factory for layout.

Standard Direct shapes/configurations:

Listed below are the minimum lengths and details for standard shapes. These standard shapes can be combined with each other and/or the standard luminaire lengths, ensuring full even illumination. If you have any questions, please consult the factory.

The minimum standard lengths for "L" shapes:
- L9 or V9 open shapes is 4' x 4' nominal (example: leg, 90, leg)
- L9 or V9 closed shapes is 6' x 6' nominal (example: 90, leg, 90)
(Exception is that the L9 and V9's can be joined directly to provide a 4' x 4' nominal shape)

*For sensors in configurations, please consult factory.

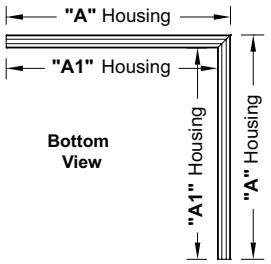
For patterns and configurations that are to include a wall mounted option, please consult the factory to identify location, on which side of housing and spacing of brackets required.

The minimum standard lengths for "T" and "X" shapes:
- T9 = 4' nominal on the short leg and 8' nominal on the long side
- X9 = 8' nominal for either direction

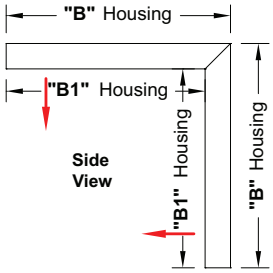
Project Specific Direct shapes/configurations:

Selux is capable of supplying a wide range of project solutions including different shapes, angles, and sizes to meet the project requirements. Due to the complex nature of these project specific layout(s) we ask that you please consult the factory with the project requirements for review.

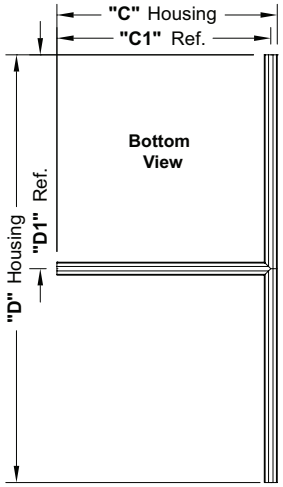
L9 - Lit Horizontal corner



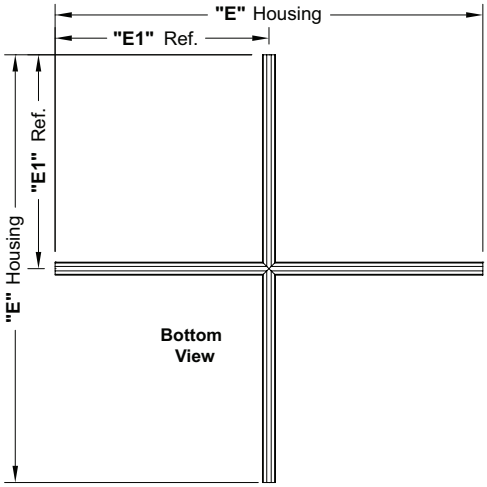
V9 - Lit Inside corner



T9 - Lit "T" section



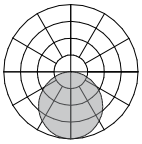
X9 - Lit "X" section



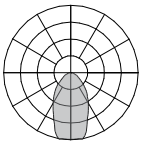
Direct Lit Corner and Section - Dimensions								
	L9		V9		T9		X9	
	Feet/Inch	MM	Feet/Inch	MM	Feet/Inch	MM	Feet/Inch	MM
"A" Housing (Outside)	2' - 1¼"	642						
"A1" Housing (Inside)	1' - 10 15/16"	582						
"B" Housing (Outside)			2' - 3 1/16"	688				
"B1" Housing (Inside)			1' - 11½"	597				
"C" Housing					2' - 1¼"	642		
* "C1" Ref.					2' - ⅛"	612		
"D" Housing					4' - 3/16"	1224		
* "D1" Ref.					2' - ⅛"	612		
"E" Housing							4' - 3/16"	1224
* "E1" Ref.							2' - ⅛"	612

*Dimension(s) rounded to the nearest 1/16" with a ± 1/16 (1mm) tolerance.

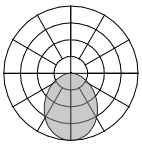
Photometry



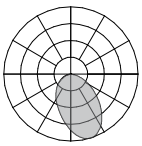
LW - LED Optimized White Lens				
Light Engine	Lumens per 4 foot	Lumens per foot	Input watts per foot	lm/W
1C35	2804	701	8.9	79



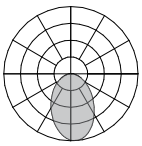
MI - Clear Lens with Microprism Inlay				
Light Engine	Lumens per 4 foot	Lumens per foot	Input watts per foot	lm/W
1C35	3251	813	8.9	92



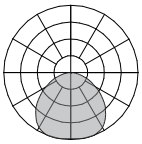
NB - LMO Symmetric				
Light Engine	Lumens per 4 foot	Lumens per foot	Input watts per foot	lm/W
1C35	3002	751	8.9	85



A2 - LMO Asymmetric 20° Wall Washer				
Light Engine	Lumens per 4 foot	Lumens per foot	Input watts per foot	lm/W
1C35	3032	758	8.9	86



A5 - LMO Asymmetric 5° Wall Grazer				
Light Engine	Lumens per 4 foot	Lumens per foot	Input watts per foot	lm/W
1C35	2807	702	8.9	79



BW - LMO Batwing				
Light Engine	Lumens per 4 foot	Lumens per foot	Input watts per foot	lm/W
1C35	3926	982	8.9	111

M60 Direct	
CCT Multiplier	
4000K	1.05
3500K	1.00
3000K	0.96
2700K	0.92
CRI Multiplier	
90+ CRI	1.00
80+ CRI	1.19
Lens Multiplier	
LW	1.00
MI	1.02
NB	1.22
A2	1.26
A5	1.26
BW	1.00

CCT and CRI multipliers apply to the photometry, IES files, and per foot values listed on page 1 (light engine).

Lens multipliers supplied for per foot values listed on page 1 (light engine).

Specification

LT-08

ADVANCED HIGH CEILING

Signum 8 - Standard

METEOR

8 inch aperture high lumen with lumen output 3230 – 4220lm.

Quantity		Type	
Project		Note	

Electrical System

- 4220lm (45W)
- Power Input: Universal (120-277V)
- Operating Temperature: -13°F~112°F
- Surge Protection: 4KV
- Power Factor Greater than 0.9
- Remote Emergency Pack: Bodine BSL20LV

LED Technology

- 2700K, 3000K, 3500K, 4000K, 5000K
- 85 CRI
- Beam Angle: 25°, 40°, 60°, 100°
- Rated Life > 60,000 Hours (L70)

Advanced Dimming

(Proprietary VX Driver is incorporated to all dimming options for video flicker-free lighting)

- **Standard 0-10V** dims to 10%
- **DMX:** high resolution dims to 0.1%
(Supports ANSI E1.20 RDM protocol)
- **Superior 0-10V:** dims to 1%
- **LTE: Hi-Lume 1% 2-wire LED Driver (120V forward phase only)**
- **LDE1: Hi-Lume 1% EcoSystem LED Driver with Soft-on, Fade-to-Black (UNV only)**

Housing

- Diameter: 8.26" (210mm)
- Height: 9.25" (235mm)
- Material: Steel, Aluminum
- Weight: 11.02 lbs

Mounting

- Surface Mount
- Stem 2ft, 4ft; 45° Swivel Canopy Included
- Adjustable Aircraft Cable 10ft
- Wall Mount
- Yoke Mount

Warranty

- 5 year limited warranty

Listing

- ETL Damp Location Listed
- CE

ADVANCED HIGH CEILING

Signum 8 - Standard

METEOR

How To Specify:

Ordering Example: SS8-45-358-UNV-SPV-40-BLK-AD10

4-5 weeks lead time on over 75% of specifications.

Model	Wattage	CCT / CRI	Voltage	Dimming
SS8			UNV	
SS8 Signum 8	**45** 45W	**278** 2700K / CRI85 **308** 3000K / CRI85 **358** 3500K / CRI85 **408** 4000K / CRI85 **508** 5000K / CRI85	**UNV** 120-277V	**STV** STV Standard 0-10V dims to 10% **SPV** Superior 0-10V dims to 1% **DMX** DMX dims to 0.1% (XLR Sockets) **DMX(RJ45)** DMX dims to 0.1% (RJ45 Sockets) **LTE** Hi-Lume 1% 2-wire LED Driver (120V forward phase only) **LDE1** Hi-Lume 1% EcoSystem LED Driver with Soft-on, Fade-to-Black (UNV only)

Beam Angle	Finish	Mounting	Accessories
25 25º **40** 40º **60** 60º **WD** 100º	**BLK** Black **WHT** White	**SUM** Surface Mount **ST2** Stem 2ft **ST4** Stem 4ft **AD10** Adjustable Aircraft Cable 10ft **WLM** Wall Mount **YKM** Yoke Mount	**SPD**[1] Surge Protector **EMP** Remote Emergency Pack [1] Surge protector for up to 10KV. Applicable for unstable mains or facilities using high power machineries

ADVANCED HIGH CEILING

Signum 8 - Standard

Delivered Lumens*

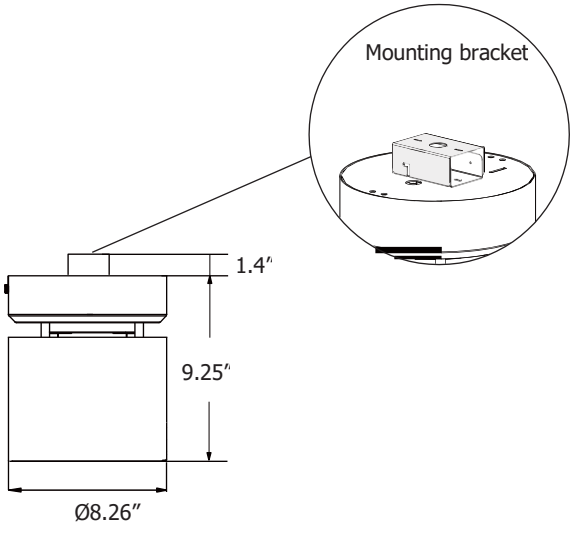
Wattage / CCT	SS8-45
	Beam Angle: 25°
5000K	4220 lm
4000K	3770 lm
3500K	3490 lm
3000K	3350 lm
2700K	3230 lm

*Tolerance±8%

Current Consumption

Volt / Wattage	120V	277V
45W	0.47A	0.20A

Dimensions

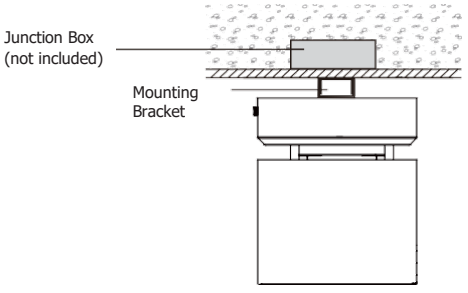


8-inch 45W

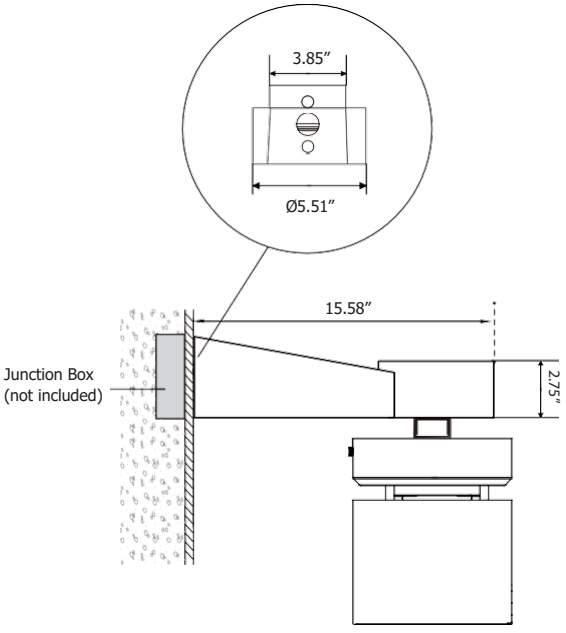
ADVANCED HIGH CEILING

Signum 8 - Standard

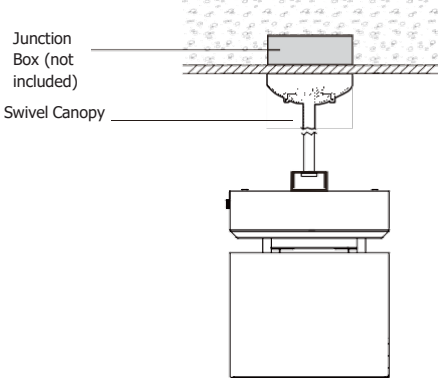
Mounting Options



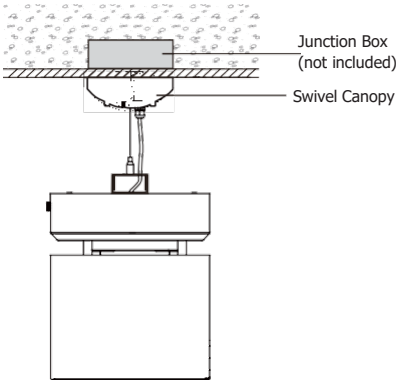
Surface Mount



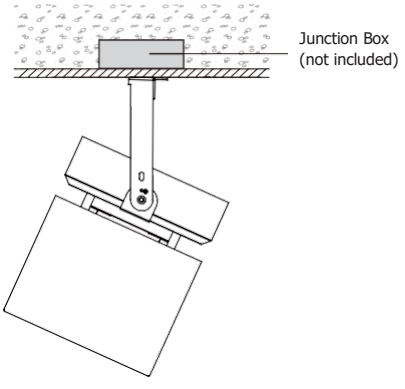
Wall Mount



Stem



Adjustable Aircraft Cable



Yoke Mount

ADVANCED HIGH CEILING

Signum 8 - Standard

DMX Requirements*

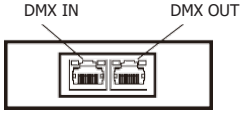
The Signum 8 LED fixture with DMX is a ONE CHANNEL DMX unit.

When placing order, please indicate DMX address. (The DMX address will be listed on the back of the fixture.)

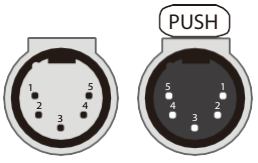
The LED fixture provide RJ45 Socket or XLR socket to connect. (DMX cable NOT included.)

The final fixture should be terminated by the use of DMX Terminator (by others).

RJ45 Sockets



XLR Sockets

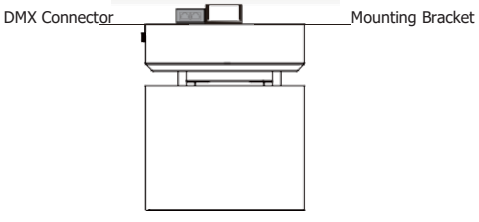


CONNECTION	RJ45 (CAT5e)	5-PIN XLR
Common	WHITE/BROWN(PIN7) & BROWN(PIN 8)	PIN 1
Signal -	ORANGE(PIN 2)	PIN 2
Signal +	WHITE/ORANGE(PIN 1)	PIN 3
Spare	-	PIN 4
Spare	-	PIN 5

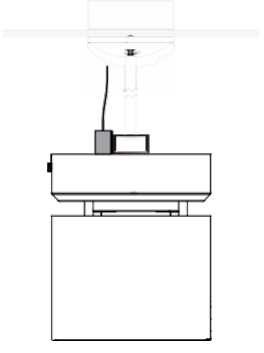
Compatible DMX Cabling List

DMX uses a cable consisting of two twisted pairs plus a shield to carry data. The cable must be specifically impedance matched for the digital DMX signal, meaning that microphone cable or other non-rated cable **must not be used to carry DMX**. Network cable (Cat5, 5e or 6 cable) may be used to carry DMX in an installation; however special consideration must be given to shielding and termination. Under no circumstances should solid core cable like Cat5 be terminated into a screw down connector.

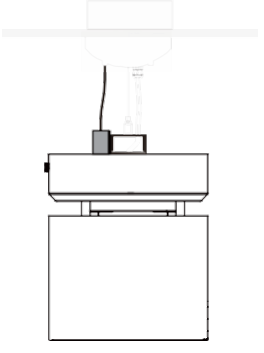
Meteor recommends the use of Belden 9729 for DMX installation. Belden 9729 is a two pair cable, which allows for a spare pair for 'out and back' type terminations if needed. Below is a list of other compatible Belden cables.



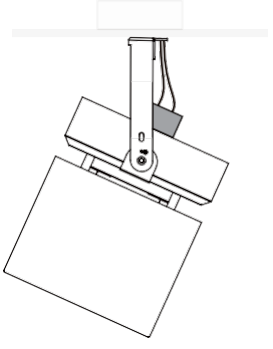
Surface Mount



Stem



Adjustable Aircraft Cable



Yoke Mount

Compatible LTE Dimmer List

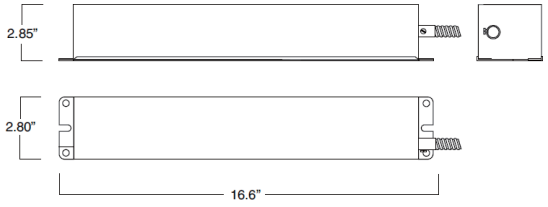
LUTRON PART NO.

RRD-6NA-	RRT-G5NEW-	RRT-GH	HQRD-10ND-	HQRT-GH	HQRD-HN	PD-10NXD-
RRD-6ND	RRT-G25LW-	HQRD-6NA-	MRF2-6ND-120-	HQRT-G25LW-	GT-250M-	PD-5NE-
RRD-10ND-	RRD-HN	HQRD-6ND-	MRF2S-6ND-120-	HQRT-G5NEW-	GTJ-250M-	

ADVANCED HIGH CEILING

Signum 8 - Standard

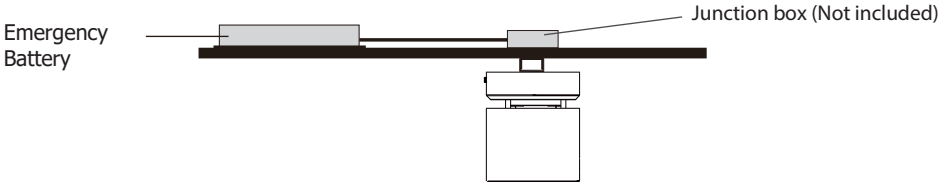
Remote Emergency Pack



Emergency Pack Lumen Output Table

CCT	2700K	3000K	4000K	5000K
Lumen	1640 lm	1760 lm	1890 lm	1950 lm

Mounting with standard celling recessed Junction BOX



Date: _____ Customer: _____

Project: _____

Type: _____ Qty: _____

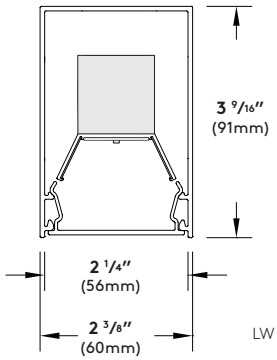
selux

M60
LED Direct

Order Code: L60 - _____ - _____ - _____ - _____ - _____ - _____ - _____ - _____ - _____ - _____ - _____ - _____

L60	Series	**L60** M60 LED Direct	
_____	Light Engine	**1C45**[1,2,3] 80CRI-1018lm 90CRI-855lm 11.1W per foot **1C40**[1,2,3] 80CRI-954lm 90CRI-802lm 9.9W per foot **1C35**[1] 80CRI-834lm 90CRI-701lm 8.7W per foot **1C30**[1,2] 80CRI-746lm 90CRI-627lm 7.3W per foot **1C25**[1,2] 80CRI-594lm 90CRI-500lm 6.1W per foot **1C20**[1,2] 80CRI-494lm 90CRI-415lm 4.9W per foot	[1] Values calculated from a 4' fixture at 3500K, 90+ CRI using LW shielding and DIM driver. For additional information please see page 2. [2] Available starting at 2' and up. [3] Not available with Lutron.
_____	CCT	**927** 2700K 90+ CRI **930** 3000K 90+ CRI **935** 3500K 90+ CRI **940** 4000K 90+ CRI **827**[4] 2700K 80+ CRI **830**[4] 3000K 80+ CRI **835**[4] 3500K 80+ CRI **840**[4] 4000K 80+ CRI **RGBW** (consult factory)	[4] Consult factory for lead times
_____	Shielding	**LW** LED Optimized White Lens **MI** Clear Lens with Microprism **NB** LMO Symmetric with Satine Lens **A2** LMO Asymmetric 20° Wall Washer with Satine Lens **A5** LMO Asymmetric 5° Wall Grazer with Satine Lens **BW** LMO Batwing with Satine Lens	
_____	Mounting	**C** Cable **S** Swivel Stem **RS** Rigid Stem **W**[5] Wall Mount **F**[6] Surface Mount	[5] Consult factory for lengths under 2' [6] Over 8' supplied with 2 or more housings that are joined in the field.
_____	Nominal Fixture Length	**01*** 1 ft. **02** 2 ft. **03** 3 ft. **04** 4 ft. **05** 5 ft. **06** 6 ft. **07** 7 ft. **08** 8 ft. **09** 9 ft. **10** 10 ft. **11** 11 ft. **12** 12 ft. **XX** Runs (over 12') and Configurations, round up to the nearest foot and replace the "xx" with the # (i.e. 13=13' nominal) **1' fixture only available with 1C35 light engine.* *Individual fixtures, Runs and Configurations are supplied in nominal lengths to ensure full, even, illumination. See pages 2 through 6 for additional details.*	
_____	Finish	**WH*** White **BL** Semi-Matte Black **SV** Silver **SP** Specify Premium Color	** Custom colors are available, please consult factory*
_____	Voltage	**1** 120V **2** 277V **U** 120V through 277V 50/60hz capable **3**[7] 347V (consult factory)	[7] 347V not available with EM integral battery option
_____	Driver	**DIM**[8] 0-10V 1% (Linear) **DIL**[8,9] eldoLED 1% ECOdrive 0-10V (Logarithmic) **DED**[8,9] eldoLED 1% ECOdrive DALI (Logarithmic) **D01**[8,9] eldoLED 0.1% SOLOdrive 0-10V (Linear) **DL01**[8,9] eldoLED 0.1% SOLOdrive 0-10V (Logarithmic) **DC2**[8,9,10] Lutron 1% 2-Wire **DE1**[8,9] Lutron 1% EcoSystem **DC5** Lutron 5% 5-Series (consult factory) **DC3** Lutron 1% 3-Wire (consult factory)	[8] See page 7 for full details [9] Not available for 1' length or with [10] 120V only
_____	Fixture Options	**DL** Damp Location Rated **FS** In-line Fuse **SS**[11] Separate Switching	[11] See page 10 for details
_____	Sensor Options	**xE**[12,13] Enlighted **xS1**[12,13] Sensor Switch Daylight **xS2**[12,13] Sensor Switch Occ/Vac **xS3**[12,13] Sensor Switch Occ/Vac/ Daylight **xSN** nLight enabled (consult factory) **xV** Lutron Vive (consult factory) Replace "x" with quantity	[12] Minimum fixture length 2'. See page 10 for full details and restrictions [13] Requires DIM driver (0-10V)
_____	Emergency Options	**EC**[14,15] Emergency Circuit Wiring **EMR** Remote Micro Inverter (consult factory) **EM**[14,15,16] Integral EM battery pack	[14] See page 8 for full details and restrictions [15] For emergency options with sensors, please consult factory. [16] For EM available in 4' and ≥ 6'. Please consult factory for 5'.
_____	Configuration Options	**L9** Lit Horizontal 90° Corner **V9** Lit Inverted 90° Corner **T9** Lit "T" section **X9** Lit "X" section	* See page 12 for full details and restrictions

All options indicated with the green truck symbol are available with 4-week ship time. Mixed orders will defer to the longest lead time.



LW lens shown for reference

Construction:

Housing - Continuous, low copper 6063-T6 extruded aluminum profile with aluminum endcaps, available as Individual fixtures (up to 12') or Runs.

Geartray - Low copper 6063-T6 extruded aluminum profile.

Shielding - Extruded, impact resistant acrylic lens:
- LED Optimized White Lens (LW)
- Clear Lens with Microprism (MI)

"LMO" refers to the Selux proprietary LED optical system - Light modulation optics. These lenses are offered in M60 behind a Satine Lens for even illumination and comfortable lit appearance.
- "LMO" Symmetric Lens (NB)
- "LMO" Asymmetric 20° Wall Washer (A2)
- "LMO" Asymmetric 5° Wall Grazer (A5)
- "LMO" Batwing (BW)

Mounting(s) - 1/16" Aircraft Cable, Ø5/8" Swivel or Rigid Steel Stem, Wall Bracket, Surface mounting (see pages 3 through 6 for details).
** Cable, Stem and Wall mountings may not be symmetrical for Runs and Configurations due to the use of modular housing lengths. If symmetrical suspensions are required please consult the factory.

Standard Luminaire lengths - All standard luminaires are supplied in nominal lengths to ensure full, even, illumination. Runs and Configurations are available in approximately 1/4" increments starting at the nominal 12' fixture length.
** Individual luminaires are not joinable in the field.

Exact length luminaires - Individual luminaires, Runs, and Configurations are available in exact lengths to meet your project needs. Please consult factory with your requirements.
** Lens luminance may soften at the very ends of the straight sections for exact length luminaire.

L60 Joiner(s) - Runs and Configurations are supplied in multiple housings that are joined together in the field using the supplied L60 Joiner System. This allows ease of installation and ensures a uniform appearance (see page 9 for detail).

Weight: 2.4 lb. per foot.

Electrical/Performance:

LED Light Engine - Brand-name mid-power LEDs create a high efficiency LED light engine able to provide a lumen maintenance of 95% at 25,000 hours and 90% at 60,000 hours at 25°C per TM-21 reports. Reported L70 greater than 60,000 hours.

Photometrics - Consult website or factory for IES Files. Independent photometric lumen measurement complies with IES LM-79-08 testing procedures. Due to the LED manufacturer's tolerances, the listed output has a ±5% tolerance. For outputs based on different optics or CCT, please see page 13 for details.

CCT - Available in 2700K, 3000K, 3500K and 4000K, tolerance within a 3-step MacAdam ellipse.

CRI - 90+ and 80+ CRI. Consult factory for lead times of 80 CRI.

All Drivers - High efficiency, constant current, soft start, Electronic Class 2 with a PFC>0.90. For more detailed information on the available drivers please see page 7.

Sensors - Selux offers a variety of integral sensor options. For details and specifications, please refer to page 10.

Emergency - There are multiple emergency options available - Emergency Circuit, Remote Micro Inverter, and Integral EM Battery Pack. All options compliant with UL 924 listed emergency luminaire. Please consult factory for use of sensors with emergency options. For more details on EC and EM options, see page 9.

Thermal Performance:

Ambient Operating Temperature - Luminaires suitable for maximum ambient temperature of 35°C (95°F) for all drivers.

Luminaires are suitable for minimum ambient temperatures of -40°C (-40°F) for DIM, DIL, DED, D01, and DL01 drivers; 0°C (32°F) for DC2 and DE1 drivers.

Luminaire Finish:

Powder Coat - All Selux luminaries are finished in high quality polyester powder coating in our Tiger Drylac certified facility and are tested in accordance with test specifications for coatings from ASTM and PCI.

All products undergo a five stage intensive pretreatment process where product is thoroughly cleaned, phosphated, and sealed. Selux powder coated products provide excellent salt and humidity resistance as well as ultra violet resistance for color retention.

Standard interior colors are White (WH), Semi-Matte Black (BL), and Silver (SV). Selux premium colors (SP) are available, please specify from your Selux color selection guide.

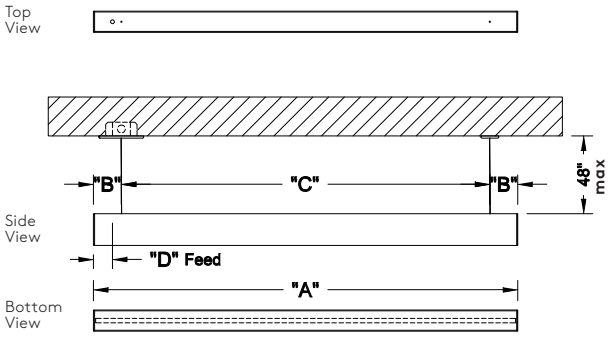
Warranty:

5 Year Limited LED Luminaire Warranty - Selux offers a 5 Year Limited Warranty to the original purchaser that the M60 series LED luminaire shall be free from defects in material and workmanship for up to five (5) years from date of shipment. This limited warranty covers the LED driver and LED light engine when installed according to Selux instructions and operated within the Ambient Temperature. For additional details and exclusions, see "Selux Terms and Condition of Sale."

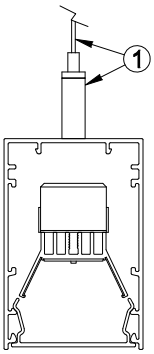
Certifications and Compliance:

NRTL - For Dry and Damp location
(I.E. cULus; cCSAus)
ADA Compliant
ARRA Compliant
RoHS Compliant

Cable Mounting (C)



Cable Mounting (C)

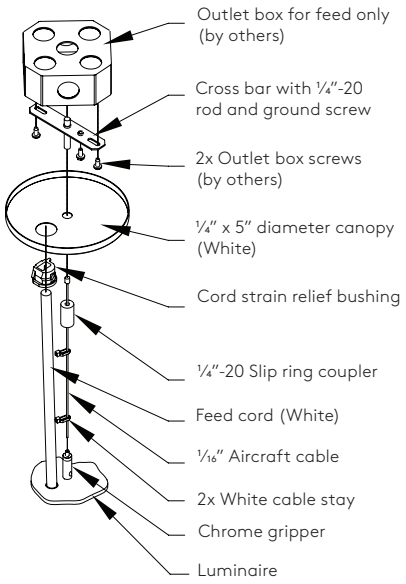


1. Ø 1⁄16" Aircraft Cable with chrome gripper for easy adjustment (48" max. from ceiling to luminaire).

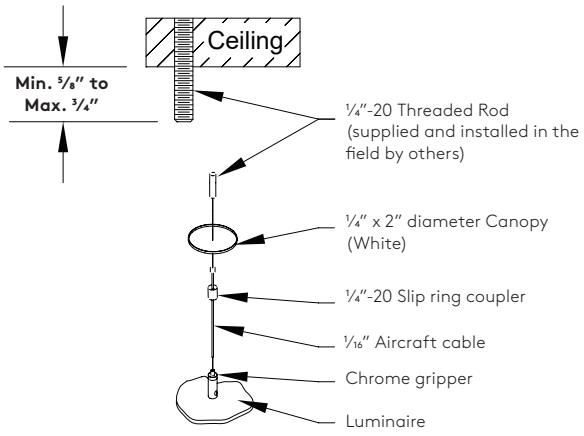
Cable Mounting (C) - Dimensions								
Nominal Length	**"A" Housing Length**		*** "B" (Ref.) End Suspensions**		**"C" Mid. Suspension**		**"D" Feed Location**	
	Feet/Inch	**MM**	**Feet/Inch**	**MM**	**Feet/Inch**	**MM**	**Feet/Inch**	**MM**
01 (1ft.)	1' - 1⁄4"	311	0' - 2 1⁄8"	54	0' - 8"	203	0' - 1 1⁄8"	29
02 (2ft.)	2' - 1⁄4"	616	0' - 2 1⁄8"	54	1' - 8"	508	0' - 1 1⁄8"	29
03 (3ft.)	3' - 1⁄4"	921	0' - 3 1⁄8"	79	2' - 6"	762	0' - 2 1⁄8"	54
04 (4ft.)	4' - 1⁄4"	1226	0' - 3 1⁄8"	79	3' - 6"	1067	0' - 2 1⁄8"	54
05 (5ft.)	5' - 1⁄4"	1530	0' - 3 1⁄8"	79	4' - 6"	1372	0' - 2 1⁄8"	54
06 (6ft.)	6' - 1⁄4"	1835	0' - 3 1⁄8"	79	5' - 6"	1676	0' - 2 1⁄8"	54
07 (7ft.)	7' - 1⁄4"	2140	0' - 3 1⁄8"	79	6' - 6"	1981	0' - 2 1⁄8"	54
08 (8ft.)	8' - 1⁄4"	2445	0' - 3 1⁄8"	79	7' - 6"	2286	0' - 2 1⁄8"	54
09 (9ft.)	9' - 1⁄4"	2750	0' - 3 1⁄8"	79	8' - 6"	2591	0' - 2 1⁄8"	54
10 (10ft.)	10' - 1⁄4"	3054	0' - 3 1⁄8"	79	9' - 6"	2896	0' - 2 1⁄8"	54
11 (11ft.)	11' - 1⁄4"	3359	0' - 3 1⁄8"	79	10' - 6"	3200	0' - 2 1⁄8"	54
12 (12ft.)	12' - 1⁄4"	3664	0' - 3 1⁄8"	79	11' - 6"	3505	0' - 2 1⁄8"	54

*Dimension(s) rounded to the nearest 1⁄16" with a ± 1⁄16" (1mm) tolerance.

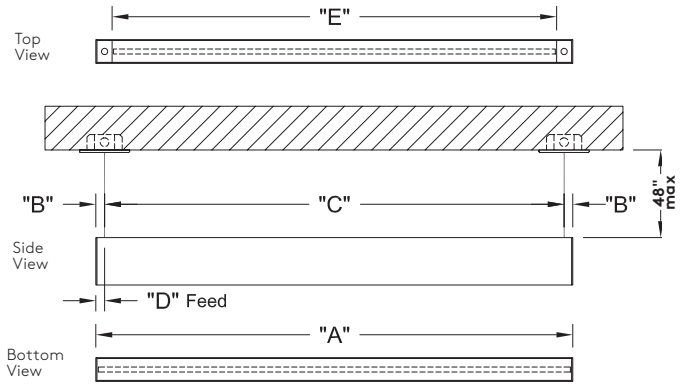
L60 Cable (C) Suspension Detail
(Feed location(s) only)



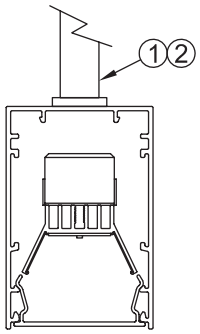
L60 Cable (C) Suspension Detail
(Non-Feed location(s) only)



Stem Mounting (S and RS)



Stem Mounting (S and RS)

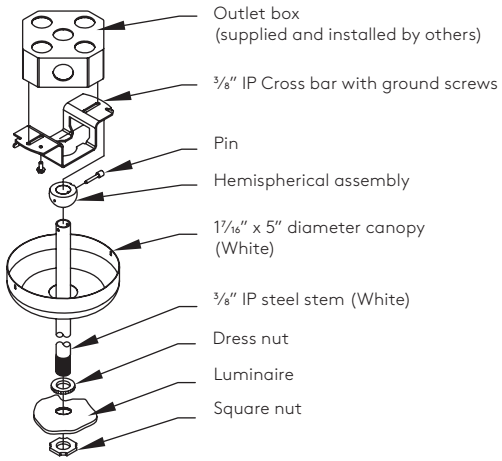


1. Ø ⅝" Swivel Stem provides 30° swivel and **can be cut in field** (48" max. from ceiling to luminaire).
2. Ø ⅝" Rigid Stem is fixed and is **not able to be cut/adjusted in field** (48" max. from ceiling to luminaire).

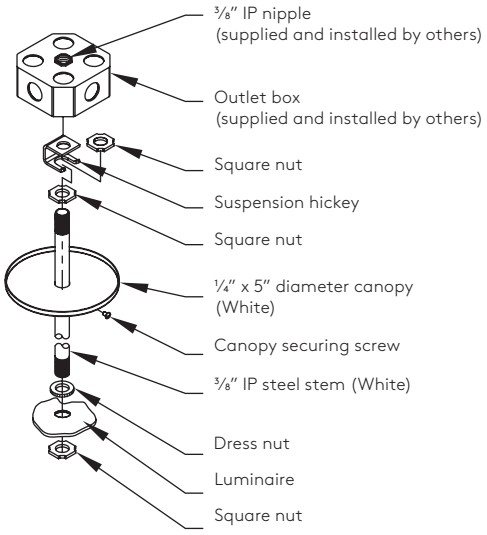
Swivel (S) & Rigid Stem (RS) Mountings - Dimensions								
Nominal Length	**"A" Housing Length**		*** "B" (Ref.) End Suspensions**		**"C" Mid. Suspension**		**"D" Feed Location**	
	Feet/Inch	**MM**	**Feet/Inch**	**MM**	**Feet/Inch**	**MM**	**Feet/Inch**	**MM**
01 (1ft.)	1' - ¼"	311	0' - 2 ⅛"	54	0' - 8"	203	0' - 2 ⅛"	54
02 (2ft.)	2' - ¼"	616	0' - 2 ⅛"	54	1' - 8"	508	0' - 2 ⅛"	54
03 (3ft.)	3' - ¼"	921	0' - 3 ⅛"	79	2' - 6"	762	0' - 3 ⅛"	79
04 (4ft.)	4' - ¼"	1226	0' - 3 ⅛"	79	3' - 6"	1067	0' - 3 ⅛"	79
05 (5ft.)	5' - ¼"	1530	0' - 3 ⅛"	79	4' - 6"	1372	0' - 3 ⅛"	79
06 (6ft.)	6' - ¼"	1835	0' - 3 ⅛"	79	5' - 6"	1676	0' - 3 ⅛"	79
07 (7ft.)	7' - ¼"	2140	0' - 3 ⅛"	79	6' - 6"	1981	0' - 3 ⅛"	79
08 (8ft.)	8' - ¼"	2445	0' - 3 ⅛"	79	7' - 6"	2286	0' - 3 ⅛"	79
09 (9ft.)	9' - ¼"	2750	0' - 3 ⅛"	79	8' - 6"	2591	0' - 3 ⅛"	79
10 (10ft.)	10' - ¼"	3054	0' - 3 ⅛"	79	9' - 6"	2896	0' - 3 ⅛"	79
11 (11ft.)	11' - ¼"	3359	0' - 3 ⅛"	79	10' - 6"	3200	0' - 3 ⅛"	79
12 (12ft.)	12' - ¼"	3664	0' - 3 ⅛"	79	11' - 6"	3505	0' - 3 ⅛"	79

*Dimension(s) rounded to the nearest 1⁄16" with a ± 1⁄16" (1mm) tolerance.

L60 Swivel Stem (S) Suspension Detail
(feed wires through stem supplied by Selux)

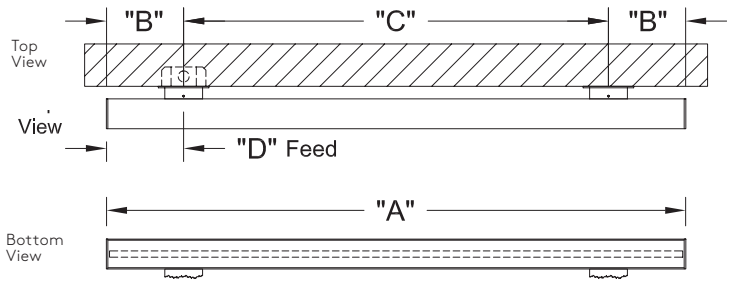


L60 Rigid Stem (RS) Suspension Detail
(feed wires through stem supplied by Selux)



Wall Mounting (W)

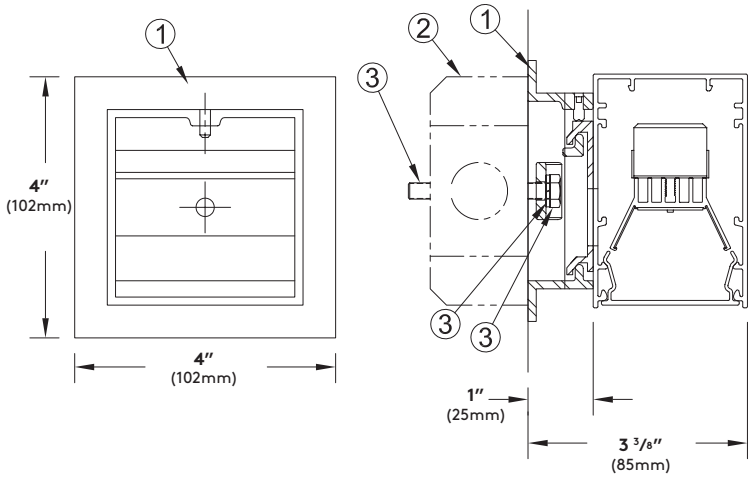
For patterns and configurations that include a wall mount, please see page 12 for details



Wall (W) Mount - Dimensions								
Nominal Length	**"A" Housing Length**		*** "B" (Ref.) End Suspensions**		**"C" Mid. Suspension**		**"D" Feed Location**	
	Feet/Inch	**MM**	**Feet/Inch**	**MM**	**Feet/Inch**	**MM**	**Feet/Inch**	**MM**
01 (1 ft.)	1' - ¼"	311	6⅛"	156	N/A		0 - 6⅛"	156
02 (2 ft.)	2' - ¼"	616	3⅛"	79	1' - 0"	458	0 - 3⅛"	79
03 (3 ft.)	3' - ¼"	921	6⅛"	156	2' - 6"	610	0 - 6⅛"	156
04 (4 ft.)	4' - ¼"	1226	6⅛"	156	3' - 0"	914	0 - 6⅛"	156
05 (5 ft.)	5' - ¼"	1530	6⅛"	156	4' - 0"	1219	0 - 6⅛"	156
06 (6 ft.)	6' - ¼"	1835	6⅛"	156	5' - 0"	1524	0 - 6⅛"	156
07 (7 ft.)	7' - ¼"	2140	6⅛"	156	6' - 0"	1829	0 - 6⅛"	156
08 (8 ft.)	8' - ¼"	2445	6⅛"	156	7' - 0"	2134	0 - 6⅛"	156
09 (9 ft.)	9' - ¼"	2750	6⅛"	156	8' - 0"	2438	0 - 6⅛"	156
10 (10 ft.)	10' - ¼"	3054	6⅛"	156	9' - 0"	2743	0 - 6⅛"	156
11 (11 ft.)	11' - ¼"	3359	6⅛"	156	10' - 0"	3048	0 - 6⅛"	156
12 (12 ft.)	12' - ¼"	3664	6⅛"	156	11' - 0"	3353	0 - 6⅛"	156

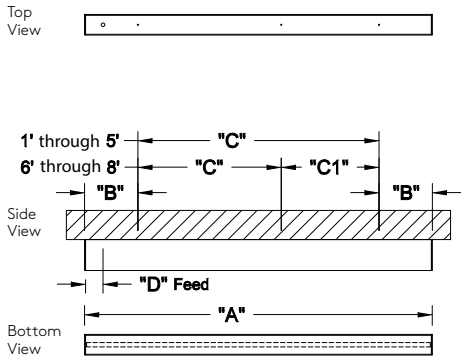
*Dimension(s) rounded to the nearest 1⁄16" with a ± 1⁄16" (1mm) tolerance.

Wall Mount (W)
(Covers a 4x4 or 2x4 J-Box)

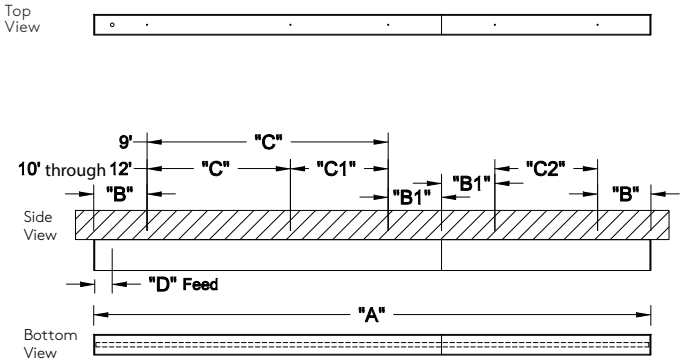


1. Aluminum wall bracket (by Selux).
2. 4"x4" or 2"x4" J-Box at feed location (supplied and installed by others).
3. ¼"-20 Threaded rod, ¼"-20 lock washer and ¼"-20 nut required to anchor the wall bracket. Mounting hardware supplied and installed to code by others.

Surface Mounting (F) - 1′ to 8′



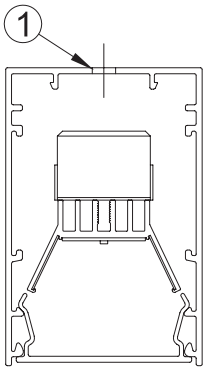
Surface Mounting (F) - Over 9′ to 12′



Surface Mount (FF, F2, & F4) - Dimensions														
Nominal Length	**"A" Housing Length**		*** "B" (Ref.) End Suspensions**		*** "B1" End Suspensions**		**"C" Mid. Suspension**		**"C1" Mid. Suspension**		**"C2" Mid. Suspension**		**"D" Feed Location**	
	Feet/Inch	**MM**	**Feet/Inch**	**MM**	**Feet/Inch**	**MM**	**Feet/Inch**	**MM**	**Feet/Inch**	**MM**	**Feet/Inch**	**MM**	**Feet/Inch**	**MM**
01 (1 ft.)	1' - ¼"	311	- 1⅝"	41	N/A		0' - 9"	229	N/A		N/A		0' - 4⅛"	105
02 (2 ft.)	2' - ¼"	616	0' - 1⅝"	41	N/A		1' - 9"	533	N/A		N/A		0' - 4⅛"	105
03 (3 ft.)	3' - ¼"	921	0' - 6⅛"	156	N/A		2' - 0"	610	N/A		N/A		0' - 2⅛"	54
04 (4 ft.)	4' - ¼"	1226	0' - 6⅛"	156	N/A		3' - 0"	914	N/A		N/A		0' - 2⅛"	54
05 (5 ft.)	5' - ¼"	1530	0' - 6⅛"	156	N/A		4' - 0"	1219	N/A		N/A		0' - 2⅛"	54
06 (6 ft.)	6' - ¼"	1835	0' - 6⅛"	156	N/A		3' - 0"	914	2' - 0"	610	N/A		0' - 2⅛"	54
07 (7 ft.)	7' - ¼"	2140	0' - 6⅛"	156	N/A		3' - 0"	914	3' - 0"	914	N/A		0' - 2⅛"	54
08 (8 ft.)	8' - ¼"	2445	0' - 6⅛"	156	N/A		3' - 0"	914	4' - 0"	1219	N/A		0' - 2⅛"	54
09 (9 ft.)	9' - ¼"	2750	0' - 6⅛"	156	0' - 6"	152	4' - 0"	1219	N/A		3' - 0"	914	0' - 2⅛"	54
10 (10 ft.)	10' - ¼"	3054	0' - 6⅛"	156	0' - 6"	152	3' - 0"	914	2' - 0"	610	3' - 0"	914	0' - 2⅛"	54
11 (11 ft.)	11' - ¼"	3359	0' - 6⅛"	156	0' - 6"	152	3' - 0"	914	3' - 0"	914	3' - 0"	914	0' - 2⅛"	54
12 (12 ft.)	12' - ¼"	3664	0' - 6⅛"	156	0' - 6"	152	3' - 0"	914	4' - 0"	1219	3' - 0"	914	0' - 2⅛"	54

*Dimension(s) rounded to the nearest 1/16" with a ± 1/16" (1mm) tolerance.

Surface Mount (F)



***Please note: Fixture does not cover a 4x4 J-box**

1. Ø 5/16" Mounting hole drilled at the factory (mounting hardware to code by others).

0-10V linear dimming (DIM)
Luminaires supplied with drivers offering the capability of either normal switched operation of 0-10V dimming for linear dimming curve. Fixtures ship wired for dimming. For on/off functionality, simply cap the dimming leads. Minimum dimming level preset at factory to 1%. (Due to size constraints, 1' luminaires are supplied with a driver from a different manufacturer than 2' and above luminaires. For details, please consult factory).

0-10V logarithmic eldoLED ECOdrive dimming (DIL)
Luminaires supplied with drivers offering the capability of either normal switched operation of 0-10V dimming for logarithmic dimming curve, Fixtures shipped wired for dimming. For on/off functionality, simply cap the dimming leades. Minimum dimming level preset at factory to 1%.

eldoLED ECOdrive DALI dimming (DED)
Luminaires supplied with ECOdrive DALI dimming driver with logarithmic dimming curve. Minimum dimming level preset at factory to 1%. For "dim to dark" (down to 0.1%), please consult factory.

eldoLED SOLOdrive 0-10V linear dimming (D01)
Luminaires supplied with SOLOdrive 0-10V dimming driver with linear dimming curve. Minimum dimming level preset at factory to 0.1% and "dim to dark".

eldoLED SOLOdrive 0-10V logarithmic dimming (DL01)
Luminaires supplied with SOLOdrive 0-10V dimming driver with logarithmic dimming curve. Minimum dimming level preset at factory to 0.1% and "dim to dark".

LUTRON 2-wire dimming (DC2)
Luminaires supplied with Hi-Lume 2-wire dimming driver (120V only) programmed for Constant Current Reduction (CCR). For Pulse Width Modulation (PWM) dimming, please consult factory. Minimum dimming level down to 1%.

LUTRON EcoSystem dimming (DE1/DC5)
Luminaires supplied with Hi-Lume EcoSystem (4 wire, digital link) dimming driver programmed for Constant Current Reduction (CCR). Minimum dimming level down to 1% (DE1) with SoftOn/FadeToBlack or 5% (DC5).

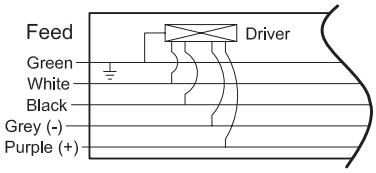
* For control recommendations, please contact driver manufacturer.

<table>
<tr><td colspan="13">Driver Quantity</td></tr>
<tr><td rowspan="2">Light Engine</td><td rowspan="2">Dimming Code</td><td colspan="11">Length</td></tr>
<tr><td>1ft</td><td>2ft</td><td>3ft</td><td>4ft</td><td>5ft</td><td>6ft</td><td>7ft</td><td>8ft</td><td>9ft</td><td>10ft</td><td>11ft</td><td>12ft</td></tr>
<tr><td rowspan="4">1C20</td><td>DIM/DIL</td><td rowspan="16">N/A</td><td colspan="7" rowspan="3">1</td><td rowspan="3">2</td><td colspan="2" rowspan="3">2</td><td rowspan="3">1</td></tr>
<tr><td>D01/DL01/DED</td></tr>
<tr><td>DE1/DC5</td></tr>
<tr><td>DC2</td><td>3</td><td colspan="2">3</td><td>2</td></tr>
<tr><td rowspan="4">1C25</td><td>DIM/DIL</td><td colspan="5" rowspan="3">1</td><td colspan="2" rowspan="2">1</td><td rowspan="3">2</td><td colspan="2" rowspan="3">2</td><td rowspan="3">1</td></tr>
<tr><td>D01/DL01/DED</td></tr>
<tr><td>DE1/DC5</td></tr>
<tr><td>DC2</td><td colspan="2">2</td><td>3</td><td colspan="2">3</td><td>2</td></tr>
<tr><td rowspan="4">1C30</td><td>DIM/DIL</td><td colspan="4" rowspan="3">1</td><td colspan="3" rowspan="2">1</td><td rowspan="3">2</td><td colspan="2" rowspan="3">2</td><td rowspan="3">2</td></tr>
<tr><td>D01/DL01/DED</td></tr>
<tr><td>DE1/DC5</td></tr>
<tr><td>DC2</td><td colspan="3">2</td><td>3</td><td colspan="2">3</td><td>3</td></tr>
<tr><td rowspan="4">1C35</td><td>DIM/DIL</td><td>1</td><td colspan="4" rowspan="3">1</td><td rowspan="3">1</td><td>2</td><td rowspan="3">1</td><td rowspan="3">2</td><td colspan="2" rowspan="3">2</td><td rowspan="3">2</td></tr>
<tr><td>D01/DL01/DED</td><td rowspan="15">N/A</td><td rowspan="2">1</td><td>1</td></tr>
<tr><td>DE1/DC5</td><td>2</td></tr>
<tr><td>DC2</td><td colspan="2">2</td><td>2</td><td>3</td><td colspan="2">3</td><td>3</td></tr>
<tr><td rowspan="4">1C40</td><td>DIM/DIL</td><td colspan="3" rowspan="2">1</td><td rowspan="2">1</td><td>2</td><td colspan="3" rowspan="2">2</td><td colspan="2" rowspan="2">3</td></tr>
<tr><td>D01/DL01/DED</td><td>1</td></tr>
<tr><td>DE1/DC5</td><td colspan="9">N/A</td></tr>
<tr><td>DC2</td></tr>
<tr><td rowspan="4">1C45</td><td>DIM/DIL</td><td colspan="3" rowspan="2">1</td><td>2</td><td rowspan="2">1</td><td colspan="2" rowspan="2">2</td><td rowspan="2">3</td><td rowspan="2">2</td><td colspan="2" rowspan="2">3</td></tr>
<tr><td>D01/DL01/DED</td><td>1</td></tr>
<tr><td>DE1/DC5</td><td colspan="9" rowspan="2">N/A</td></tr>
<tr><td>DC2</td></tr>
</table>

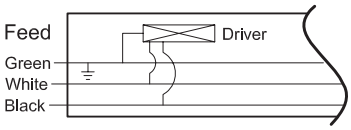
Wiring Diagrams

Standard Wiring supplied for all drivers.	Green = Ground White = Neutral Black = Hot
- The following wire(s) are in addition to the standard above -	
DIM, DIL, DED D01, DL01	Gray = (-) DALI or 0-10V Dimming Control Purple = (+) DALI or 0-10V Dimming Control
DC2	No additional wires
DE1, DC5	Violet = "E1" Digital Link Dimming Control Violet/White = "E2" Digital Link Dimming Control

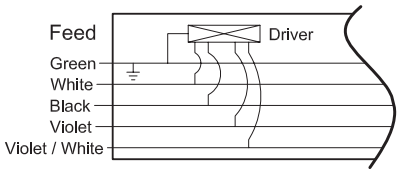
0-10V linear (DIM)
0-10V logarithmic eldoLED Ecodrive (DIL)
DALI logarithmic eldoLED ECOdrive (DED)
0-10V linear eldoLED SOLOdrive (D01)
0-10V logarithmic eldoLED SOLOdrive (DL01)



Lutron 2-Wire (DC2)

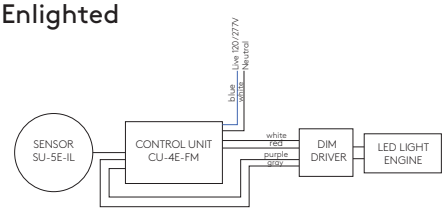


Lutron EcoSystem (DE1)
Lutron 5-Series (DC5)

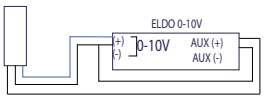


Sensor Wiring Diagrams

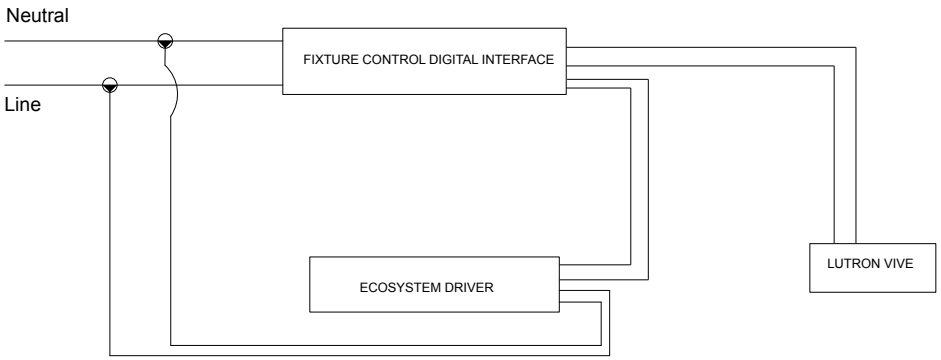
Enlighted



Sensor Switch



Lutron Vive



Driver power chart - use below values to determine the nominal watts per foot based on driver, light engine, and voltage.
* Driver losses increase the wattage for fixtures less than 4 foot.
** Values are nominal values determined based on multiple tested fixtures.

Driver Power Usage				
Driver	**Light Engine**	**Nominal W/ft**		
		120V	**277V**	**347V**
DIM, DIL, DED, D01, DL01	1C20	4.9	5.3	n/a
	1C25	6.1	6.5	
	1C30	7.3	7.7	
	1C35	8.7	8.9	
	1C40	9.9	10.1	
	1C45	11.1	11.3	
DC2, DE1, DCE, DC5, DC3	1C20	5.5	5.2	n/a
	1C25	6.7	6.3	
	1C30	8.0	7.6	
	1C35	9.3	8.8	
	1C40	10.6	10.0	
	1C45	11.6	11.3	
DIM @347V	1C20	n/a	n/a	5.4
	1C25			6.5
	1C30			7.7
	1C35			8.8
	1C40			10.0
	1C45			11.2
EM	all	6		n/a

Fuse (FS) - Fusing, luminaires supplied with a in-line fuse located on the hot wire for each feed (Supplied with an 8A slow burn fuse).

Damp Location (DL) - Luminaires are suitable for use in damp location(s). Examples of such locations include protected areas under canopies, marquees, roofed porches, and similar locations where the fixture(s) are protected from direct contact with rain, snow, or excessive moisture (such as ocean spray). Interior locations include areas subject to moderate degrees of moisture, such as basements and certain barns and cold storage buildings.

* For Damp Location with sensors, please consult factory.

Separate Switching (SS) - Luminaires available with separately switched 4' (nominal) sections starting at 7' and up. Luminaire is intended to be wired to the same panel/breaker (not intended for Emergency use).

* All separately switched (non-EM) circuits within an individual luminaire, linear run, or configuration must be connected to the same branch circuit on-site.

* To specify this option, the number of separately switched sections and locations of these sections must be provided at time of order.

* If the project requires different separate switching than outlined above please consult the factory.

* For Separate Switching with sensors, please consult factory.

Emergency Wiring (EC) - Luminaires with (EC) option are compliant to UL 924 listed emergency luminaire. EC luminaires are intended to be wired to separate panels/breakers for emergency use. See install instructions for proper wiring.

For 1' to 6' nominal luminaires, the entire fixture is wired for operation on emergency circuit.

For 7' and up nominal luminaires, the first 4' nominal length is wired for operation by a separate EM circuit by default to meet the required "Life Safety Code" (NFPA 101).

If a different configuration is needed, please consult factory.

Note: Wiring may vary slightly due to on-site conditions or local codes. Please follow all safety installation protocols contained within install instructions when installing luminaire.

Emergency Battery (EM) – Luminaires with emergency battery (EM) option are compliant to UL 924 listed emergency luminaire. The EM battery is located integral to fixture and is factory pre-wired. See install instructions for proper wiring.

In the event of an emergency, EM battery will illuminate a 4' section at 12W (constant) for 90 minutes at 25°C. Recharge time is 24 hours.

Direct fixtures are available for emergency battery (EM) use in 4' and ≥6. Due to size constraints, EM is not available in 5' fixtures.

For individual fixtures, emergency option will illuminate the first 4' section of fixture. For continuous runs, please consult factory to advise on 4' section intended for emergency use. For fixtures >12' or if a different configuration is needed, please consult factory.

Emergency test switch and plate is a non-illuminated 3" blank section located adjacent to the length of fixture wired for emergency.

* Emergency battery option is UNV for use with 120V or 277V and is not available for 347V.

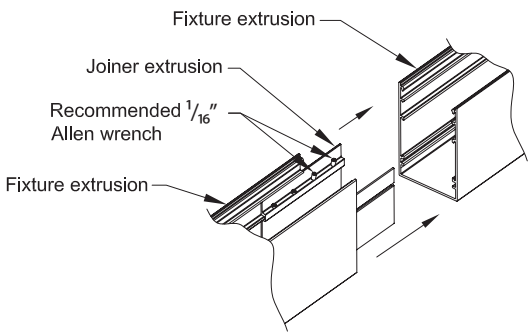
* Please note battery pack requires an unswitched hot.

* For EM with sensors, please consult factory.

* If a different configuration is needed, please consult factory.

Note: Wiring may vary slightly due to on-site conditions or local codes. Please follow all safety installation protocols contained within install instructions when installing luminaire.

Joiner System - standard for Runs and Configurations



Sensor Ordering Chart		
Quantity	**Sensor**	**Settings***
x Number of Sensors	**E** Enlighted SU-5E-IL **S** Sensor Switch MSD EZ **V** Lutron Vive DFCSJ	**1** Daylight **2** Occupancy/Vacancy **3** Daylight/Occupancy/Vacancy * Settings not available with Enlighted

Enlighted SU-5E-IL (E)
Enlighted Micro Sensor SU-5E-IL (Independent Lighting) provided as standard with an Enlighted CU-4E-FM Fixture Mount Control Unit integral to fixture. If SU-5E-CL (Connected Lighting) or SU-5E-IoT (Internet of Things) is desired, please contact factory. Occupancy/vacancy, thermal, daylight sensing plus Tunable White, Room & Zone control, Internet of Things (IoT) data collection and reporting control. For full details, please see SU-5E-(IoT/CL/IL) spec sheet on the Enlighted website. Must be paired with a 0-10V driver with auxiliary (DIM driver selection). Commissioning by Enlighted.

*Sensor can control up to 5 drivers. Please refer to driver quantity chart on page 7. Multiple sensors may be required for longer lengths.

Sensor Switch MSD EZ (S)
Occupancy/vacancy and daylight harvesting. For full functionality and programming options, select settings option 3. If a different settings option is selected, other settings may be unavailable. For full details, please see MSD EZ spec sheets on the Sensor Switch website. Must be paired with DIM driver selection. Manual control of dimming not available with MSD EZ sensor.

*Sensor can control up to 30 drivers. Please refer to driver quantity chart on page 7. Multiple sensors may be required for longer lengths.

Lutron Vive DFCSJ (V)
The DFCSJ-OEM-OCC provides the capabilities of daylight harvesting and occupancy/vacancy sensing. When integrated with the DFC-OEM-DBI (Fixture Contril Digital Link Interface), the sensor is wirelessly compatible with the DE1 Lutron EcoSystem driver. Commissioning bt certified Lutron technician.

*Vive DFCSJ sensor can control up to a maximum of five (5) drivers per sensor. Please refer to driver chart on page 7. Multiple sensors may be required for longer lengths.

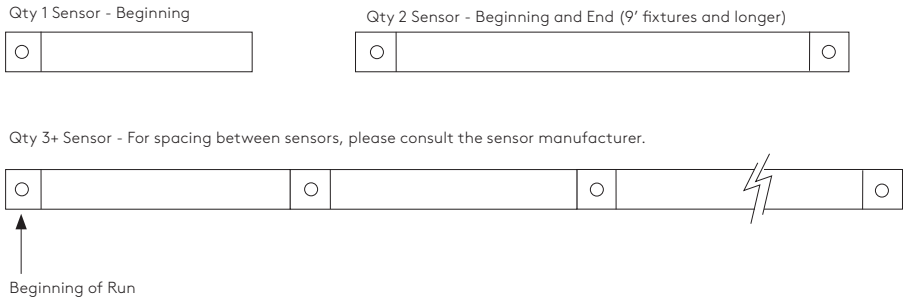
	Occupancy	Vacancy	Daylight Harvesting	Driver Compatibility
Enlighted SU-5E-IL (E)	√	√	√	DIM
Sensor Switch MSD EZ (S)	√	√	√	DIM
Lutron Vive DFCSJ (V)	√	√	√	DE1

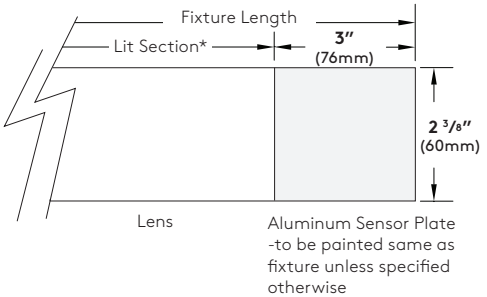
Please contact controls manufacturer for details prior to specifying.

Factory Presets - Sensors come from the sensor manufacturer with factory presets for each of the settings in above chart. Please see sensor manufacturers' spec sheets for details on presets and re-programming.

Commissioning - Commissioning of sensors and installation by others. Contact sensor manufacturer for details and costs associated with commissioning the system prior to specification of sensors.

Standard Sensor Placement - for other placement options, please consult factory. For functionality and limitations, please see sensor details above.





*Lit section will be the fixture length minus 3" for sensor plate.

Notes: 1. For spacing between sensors, please consult the sensor manufacturer.
2. Exact sensor placement and coverage will be defined by approved factory drawing.
3. Sections controlled by sensors may not be symmetrical - consult factory for layout.

Standard Direct shapes/configurations:

Listed below are the minimum lengths and details for standard shapes. These standard shapes can be combined with each other and/or the standard luminaire lengths, ensuring full even illumination. If you have any questions, please consult the factory.

The minimum standard lengths for "L" shapes:
- L9 or V9 open shapes is 4' x 4' nominal (example: leg, 90, leg)
- L9 or V9 closed shapes is 6' x 6' nominal (example: 90, leg, 90)
(Exception is that the L9 and V9's can be joined directly to provide a 4' x 4' nominal shape)

*For sensors in configurations, please consult factory.

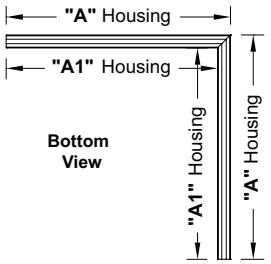
For patterns and configurations that are to include a wall mounted option, please consult the factory to identify location, on which side of housing and spacing of brackets required.

The minimum standard lengths for "T" and "X" shapes:
- T9 = 4' nominal on the short leg and 8' nominal on the long side
- X9 = 8' nominal for either direction

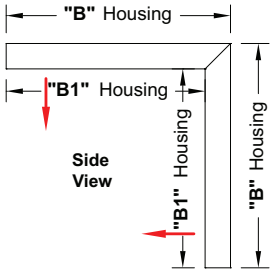
Project Specific Direct shapes/configurations:

Selux is capable of supplying a wide range of project solutions including different shapes, angles, and sizes to meet the project requirements. Due to the complex nature of these project specific layout(s) we ask that you please consult the factory with the project requirements for review.

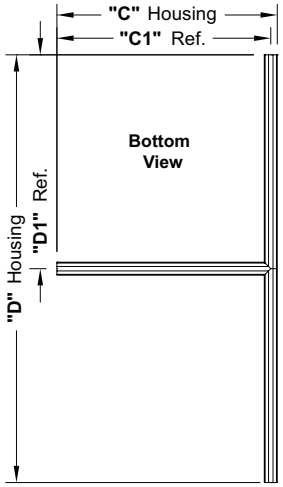
L9 - Lit Horizontal corner



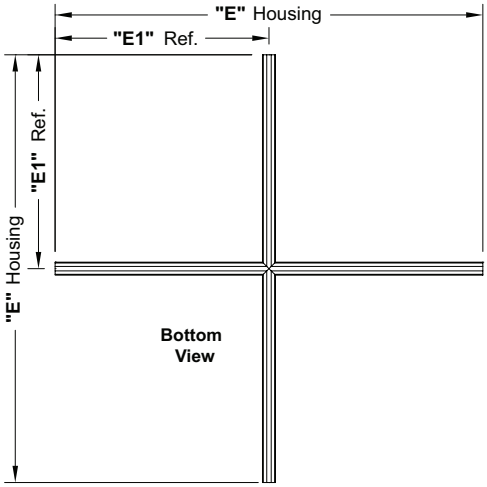
V9 - Lit Inside corner



T9 - Lit "T" section



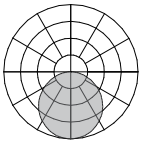
X9 - Lit "X" section



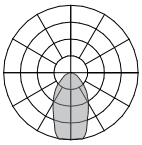
Direct Lit Corner and Section - Dimensions								
	L9		V9		T9		X9	
	Feet/Inch	MM	Feet/Inch	MM	Feet/Inch	MM	Feet/Inch	MM
"A" Housing (Outside)	2' - 1¼"	642						
"A1" Housing (Inside)	1' - 10 15/16"	582						
"B" Housing (Outside)			2' - 3 1/16"	688				
"B1" Housing (Inside)			1' - 11½"	597				
"C" Housing					2' - 1¼"	642		
* "C1" Ref.					2' - ⅛"	612		
"D" Housing					4' - 3/16"	1224		
* "D1" Ref.					2' - ⅛"	612		
"E" Housing							4' - 3/16"	1224
* "E1" Ref.							2' - ⅛"	612

*Dimension(s) rounded to the nearest 1/16" with a ± 1/16 (1mm) tolerance.

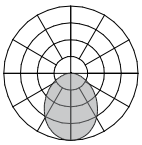
Photometry



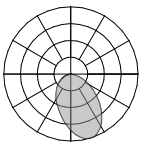
LW - LED Optimized White Lens				
Light Engine	Lumens per 4 foot	Lumens per foot	Input watts per foot	lm/W
1C35	2804	701	8.9	79



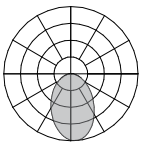
MI - Clear Lens with Microprism Inlay				
Light Engine	Lumens per 4 foot	Lumens per foot	Input watts per foot	lm/W
1C35	3251	813	8.9	92



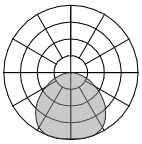
NB - LMO Symmetric				
Light Engine	Lumens per 4 foot	Lumens per foot	Input watts per foot	lm/W
1C35	3002	751	8.9	85



A2 - LMO Asymmetric 20° Wall Washer				
Light Engine	Lumens per 4 foot	Lumens per foot	Input watts per foot	lm/W
1C35	3032	758	8.9	86



A5 - LMO Asymmetric 5° Wall Grazer				
Light Engine	Lumens per 4 foot	Lumens per foot	Input watts per foot	lm/W
1C35	2807	702	8.9	79



BW - LMO Batwing				
Light Engine	Lumens per 4 foot	Lumens per foot	Input watts per foot	lm/W
1C35	3926	982	8.9	111

M60 Direct	
CCT Multiplier	
4000K	1.05
3500K	1.00
3000K	0.96
2700K	0.92
CRI Multiplier	
90+ CRI	1.00
80+ CRI	1.19
Lens Multiplier	
LW	1.00
MI	1.02
NB	1.22
A2	1.26
A5	1.26
BW	1.00

CCT and CRI multipliers apply to the photometry, IES files, and per foot values listed on page 1 (light engine).

Lens multipliers supplied for per foot values listed on page 1 (light engine).

LT-09A

CURVANO® 2.5"

Curved Linear Direct LED

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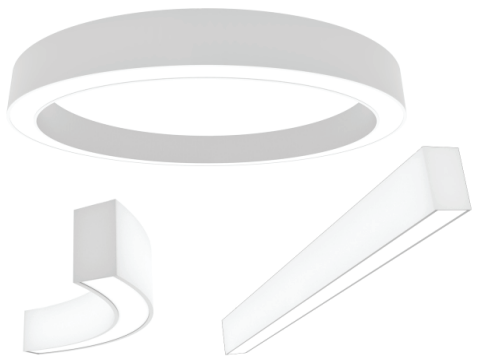
CURV2.5D Pendant Direct



Features

Curvano expands on the existing linear slot portfolio of Amerlux, further putting the "arch" in first-class architectural lighting. The 2.5" profile is available in 5 diameter options, as either a curved corner or full 360° circle. With the ability to fit in seamlessly anywhere on your project, from the simplest design to the most complex, Curvano provides infinite design and lighting patterns options: circular, serpentine and rounded-circle displays included. Trust Curvano to provide the freedom to create—and maintain—dynamic, head-turning spaces.

Product Overview

Type:	Pendant Direct
Wattage:	3W-10W/ft
Max Lumen Output:	3059 lm, 77.6 lm/W (10W, 4')
Color Temp:	2700K, 3000K, 3500K, 4000K
CRI:	83 or 90+ typ.
Dimming:	0-10V, 1% dimming (standard) Lutron Hi-lume® 2 wire (120V only) Lutron Hi-lume® EcoSystem, 1% dim, fade to off Lutron Hi-lume® 5 Series DALI dimming, 0.1% dim

PROJECT:

TYPE:

Fixture Summary *(see following pages for more information)*

Performance Chart

Watts Per Foot	Delivered Lumens	Lumens Per Foot	Lumens Per Watt
5	1672	418	84.6
10	3059	765	77.6

Lumen Output based on 4', 3500K-80 fixture.

Electrical Data

Wattage Per Foot	Volts	System Watts	Amps
5	120V	20	0.16
	277V	20.8	0.08
10	120V	39.7	0.33
	277V	39.7	0.15

4' fixture, electronic multi-volt (120V-277V), constant current LED driver

5 year limited warranty AMERLUX LED

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CURVANO® 2.5

Curved Linear Direct LED

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PROJECT: **TYPE:**

Ordering Information

CURV2.5D	.	DL	.		.		.		.		.	120/277
1		2		3		4		5		6		7

	.		.		.		.	
8		9		10		11		12

1 Model
CURV2.5D

2 Optic
DL - designer lens

3 Mounting
ASW10 - through ceiling tile or gyp board, white, 10'
ASW20 - through ceiling tile or gyp board, white, 20'
ASB10 - through ceiling tile or gyp board, black, 10'
ASB20 - through ceiling tile or gyp board, black, 20'
ASW10T - over ceiling tee, white, 10'
ASW20T - over ceiling tee, white, 20'
ASB10T - over ceiling tee, black, 10'
ASB20T - over ceiling tee, black, 20'

Mini Cable Suspension - required for **D22/D36/D43 ARC & CIR** configurations only
MASW10 - through ceiling tile or gyp board, white, 10'
MASB10 - through ceiling tile or gyp board, black, 10'
MASW10T - over ceiling tee, white, 10'
MASB10T - over ceiling tee, black, 10'

4 Wattage (per foot)
3
4
5
6
7
8
9
10

5 Color Temp-CRI
30 - 3000K-83
35 - 3500K-83
40 - 4000K-83
279 - 2700K-90+
309 - 3000K-90+
359 - 3500K-90+
409 - 4000K-90+

Consult factory for 90CRI lead time

6 Finish
HW - high reflectance matte white
BT - black texture
ST - silver texture
Consult factory for other options

7 Voltage
120/277

8 Length

_____ x	_____ x	_____
Length A	Length B	Length C
- all patterns - IND - CON - CUS	- all patterns	- PU - PZ

For CIR and ARC configurations, skip to "Diameter & Angle"

9 Diameter & Angle
D22 - 22" diameter
D36 - 36" diameter
D43 - 43" diameter
D72 - 72" diameter
D100 - 100" diameter
CD___ - custom diameter
A45 - 45° angle
A90 - 90° angle
A135 - 135° angle
A180 - 180° angle
CA___ - custom angle

_____ x	_____
(diameter)	(angle)
- ARC - CIR - PLL/PLR - PU - PR - PZ	- ARC - PLL/PLR - PU - PZ

See page 3 for more detail and restrictions. Patterns with multiple corners to have the same diameter and angle throughout. For IND/CON/CUS skip to "Configuration."
For jobs with architectural drawings, original CAD file (.DWG) is required to quote.

10 Configuration
IND - individual straight fixtures, 2' to 8' (in 1' increments)
CON - continuous run, > than 8', specify to nearest foot
CUS - custom made to measure, +/- 1/8" of customer supplied field dimensions
ARC - individual curved fixtures, see diameter and angle options above
CIR - circle (D22, D36, D43 ships assembled; D72, D100 ships in 45° sections)

Standard Patterns (see page 3 for details)
PLL - L left, (2) straight + (1) corner, leg right
PLR - L left, (2) straight + (1) corner, leg left
PU - U shape, (3) straight lengths + (2) corners
PR - Rectangle, (4) straight lengths + (4) corners
PZ - Z shape, (3) straight lengths + (2) corners

For custom patterns, submit EDR on amerlux.com
Minimum 10 pieces required for any custom diameter or angle.

11 Drivers
0-10V - 1% electronic dimming , multi-volt (120V-277V) constant current driver (standard).
DALI - DALI Dimming 120V-277V, 0.1% dim
HILUME-A-LTE - Lutron "A" Series, 1% dim, 2-wire, 120V only
HILUME-H-ECO - Lutron "H" Series, 1% dim, fade to off, EcoSystem
HILUME-5-ECO - Lutron "5" Series, EcoSystem

12 Options
ENLS - Enlighted Sensor (0-10V driver only and not available on 2' and 3' lenghts)
EMC-PF - emergency circuit requires power feed located in last fixture section (for other locations consult factory)
PF - extra power feed for additional circuiting
EMB - emergency battery pack (4'+ straight fixtures only)

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CURVANO® 2.5

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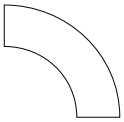
PROJECT: **TYPE:**

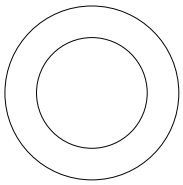
Diameter and Angle Options

Arc length is the center line length if the curve was straightened out.

45°	
Diameter	**Arc Length**
D43	16.89"
D72	28.08"
D100	39.27"



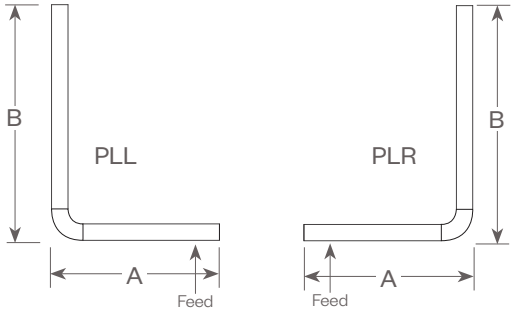
90°	
Diameter	**Arc Length**
D22	16.89"
D36	28.18"
D43	33.77"



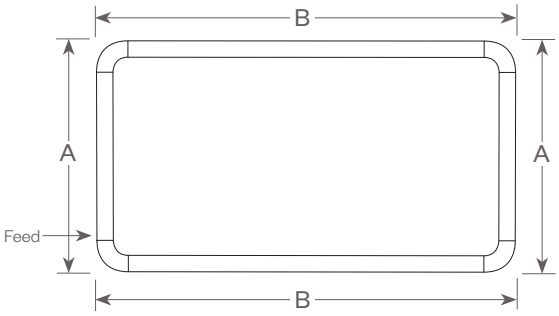
360°	
Diameter	**Arc Length**
D22	67.54"
D36	112.72"
D43	135.09"
D72*	224.62"
D100*	314.16"

* shipped as separate 45° fixtures

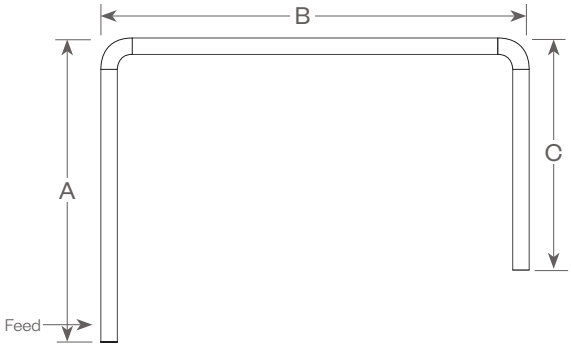
Standard Patterns



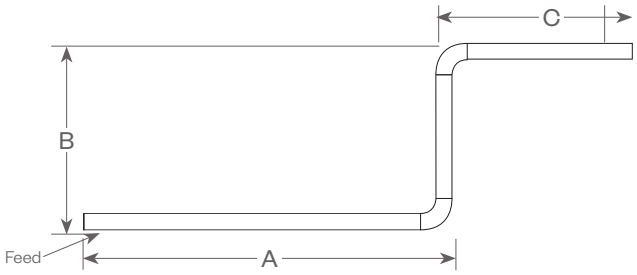
PLL - L Left, (2) straights + (1) corner, leg right
PLR - L Right, (2) straights + (1) corner, leg left
Provide overall lengths: A' & B'; Diameter & Angle of corner
Example: 4'x8'.D43xA90.PLL



PR - Closed Rectangle, (4) straight lengths + (4) 90˚ corners
Provide overall lengths: A' & B'; Diameter
Example: 12'x10'.D22.PR



PU - Open U, (3) straight lengths + (2) corners
Provide overall lengths: A', B' & C'; Diameter & Angle of corners
Example: 4'x10'.D72xA45.PU



PZ - Open Z, (3) straight lengths + (2) corners
Provide overall lengths: A', B' & C'; Diameter & Angle of corners
Example: 12'x6'x10'.D36XA90.PZ

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CURVANO® 2.5

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PROJECT: **TYPE:**

Specifications

Application

Retail and commercial ambient lighting that can be customized with a variety of diameters and angles to create any curved pattern or variety of illuminated circles.

Construction

Extruded aluminum housing. Die-cast End Plates match fixture body finish. Die-formed, cold-rolled steel internal components are protected against rust and corrosion.

Optical

Laser cut acrylic lens, with lift and shift lay-in design. Maximum length is 8' and maximum angle is 90° (ex. 180° curve will have 2 lenses; Circle will have 4 lenses). All lenses ship installed into fixture. Amerlux's proprietary acrylic lens provide excellent transmission while effectively concealing source image.

DL – Designer Lens provides flat even glow on lens

LED

Amerlux fixtures have excellent thermal management and offer a 5 year warranty. Our LED binning is within 3 MacAdam ellipse. Boards are configured for maximum flexibility resulting in even illumination no matter the fixture layout. LED boards are easily replaced in the field with just a Phillips screw driver.

Color Temperature Options: 2700K, 3000K, 3500K, 4000K
CRI: 83 or 90+ typical
R9: 16 @ CRI 83; >50 @ CRI 90+
Life: 50,000+ hr., > 70% of initial lumens (L70)

Electrical

Wiring: Individual and "Beginning of Run" (BOR) fixtures are prewired with power cord. All configurations have quick connect power harnesses for row connections.

Remote Driver Wiring (D22, D36 & D43 ARC or CIR only): Driver is supplied installed in remote driver box, (one driver per box), with 5' of low voltage plenum rated cable. Fixture supplied with 18/2 SJT power cord ready to be connected to J-Box (by others) over cable canopy. Amerlux recommends a maximum of 15' between the fixture and the remote driver box. Consult factory with job specific electrical spec if more than 15' is required. Feeds are added as required by specified wattage and driver maximums. See page 5 for wiring illustration

Standard Wattage: 3-10 W/ft (3W & 4W have a minimum length of 4').
Emergency circuit via remote invert or auxiliary emergency power supply (by others)

This product complies with IEEE C62.41 for surge endurance up to 2.5KV. Amerlux® recommends using additional surge protection with this unit (supplied by others), surge and over voltage damage is not covered under warranty.

ENLS - Enlighted Sensor (0-10V driver only, not available in 2' & 3' lengths, and can only be used on one circuit). Limited to straight fixtures only.

EMC-PF - Emergency circuit requires power feed to be located in last fixture section for continuous runs. For other locations consult factory. Not available for individual (IND) configuration.

PF - Extra power feed for additional circuiting. Not available for individual (IND) configuration.

EMB - Emergency battery pack - Bodine BSL10LST self-testing driver, 10W output power, 90 min of illumination time. Illuminated test-switch/charging indicator light is provided. Wattage consumption by EM: 2.5W/ft (4ft fixture), 1.66W/ft (6ft fixture), 1.25W/ft (8ft fixture). Request can be made to light up 4ft section on 8ft unit.

Drivers

0-10V - 1% electronic dimming, multi-volt (120V-277V) constant current driver (standard). Cap leads for non-dim applications.
HILUME-A-LTE - Lutron "A" Series, 1% dim, 2-wire, 120V only
HILUME-H-ECO - Lutron "H" Series, 1% dim, fade to off, EcoSystem
HILUME-5-ECO - Lutron "5" Series, EcoSystem
DALI - DALI Dimming 120-277VAC, 1% dim
For wiring diagrams & more information see pgs 9-10

Finish

All painted surfaces are premium powder coated baked on for maximum durability and color stability.
HW - High reflective matte White
BT - Black Texture
ST - Silver Texture
For special paint colors supply RAL and/or actual paint chip for factory consultation.

Configurations/Lengths

IND - Individual straights are standalone fixtures made of single lengths of 2' to 8' (in 1' increments). They are supplied with matching painted End Caps and the required mounting hardware. Lengths less than 4' may have restrictions based upon wattage, lengths, drivers or other options.

CON - Continuous runs are longer than 8', specified to the nearest whole foot. Continuous runs less than 16' are made of 2 lengths. Continuous runs longer than 16' start with a 8' Beginning of Row (BoR) wired with a power feed and fitted with an End Cap. The majority of the runs are made up of 8' Middle of Run (MoR) lengths. End of Run (EoR) units are made up of 2' to 8' units to the nearest whole foot or a combination of a last 4' MoR and a 5', 6' or 7' EoR. Runs longer than 60' may require a second power feed. Factory installed pins and splines simplify fixture alignment. Lengths are quickly joined with "catch and latch" mechanisms or screws and sturdy brackets. Quick connectors simplify field wiring.

CUS - Custom made to measure runs are made to nearest 1/8" of customer supplied field measurements. They can be a single custom length or runs configured as described above only EoR's are 2' to 8' cut to the nearest 1/8" exact length or a combination of a last 4' MoR with an EoR cut to exact length to the nearest 1/8".

ARC – Individual arcs are standalone fixtures made of single lengths using a diameter and an angle (ex. D43 x A90 is a 4' diameter, 90° individual fixture). They are supplied with matching painted End Caps and the required mounting hardware. D22, D36 & D43 utilize a remote mounted driver.

CIR – Circle fixtures made up of a single housing (D22, D36 & D43) or shipped in 45° segments (D72, D100). D22, D36 & D43 utilize a remote mounted driver.

PLL/PLR/PR/PU/PZ - Standard patterns consist of standard diameter & angle corners with standard lengths (3' to 8' in 1' increments) or custom lengths. Patterns with multiple corners will have the same diameter and angle utilized throughout the pattern. Depending upon complexity of the pattern, drawings may be required. When ordering please give overall lengths.
See page 3 for layouts.

PC - Custom patterns use standard or custom lengths, 90º or other corner angles with some limitations. Please provide drawings and consult factory

Mounting

CURV2.5D....ASW10 – Direct pendant installed in center of ceiling tile or gypsum board ceiling, (standard) i.e. ASW10. Or if canopy is installed on a grid Tee runner add, T i.e. ASW10T.

Cable Suspension: Cable is stranded stainless steel wire supplied with cable gripper and 5"x .250" steel die formed canopy. All components are protected against rust and corrosion. Power feeds are 16 gauge 3 or 5 conductor SJT cord supplies in same color as canopy. Amerlux supplies the required feed and non-feed suspension kits based upon length, electrical options and customer requirements. Suspension kit options include: color, length and mounting condition.

Mini Cable Suspension:
5" diameter by 0.25" canopy is used for both feed and non-feed Mini Cable Kits. The thinner Low Voltage power feeds are 22 gauge 2 conductor SJT cords supplied in same color as canopy. Amerlux supplies the required feed and non-feed suspension kits based upon length, electrical options and customer requirements. Suspension kit options include: color and mounting condition.

Certifications

Approved to UL standards as tested by CSA. Intended for indoor use only

Warranty

Amerlux's 5 year limited warranty. Please consult Amerlux website for details.

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CURVANO® 2.5

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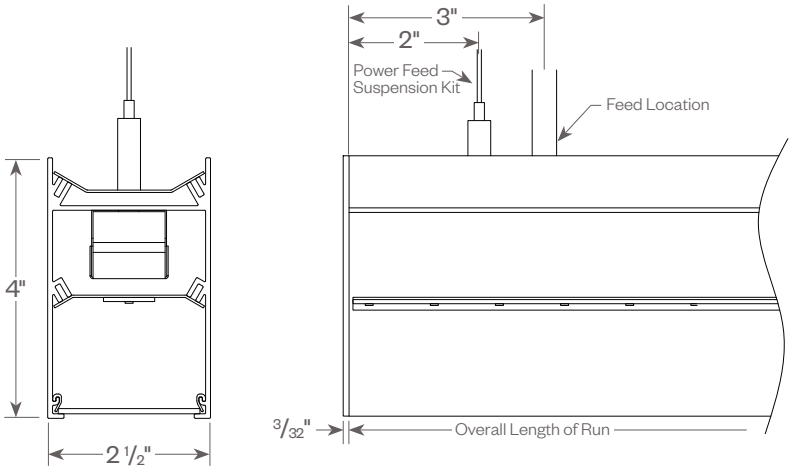
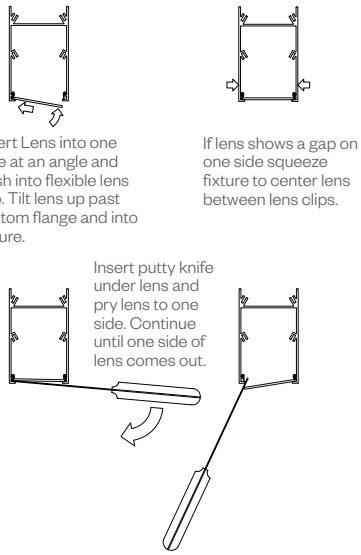
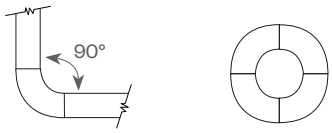
PROJECT: **TYPE:**

CROSS SECTION



LENS INSTALL/REMOVAL



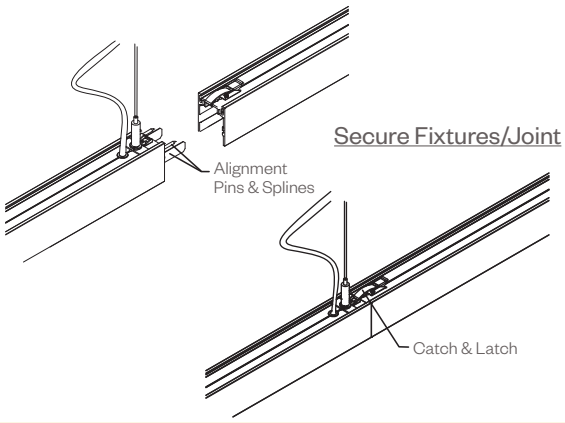


Rounded Corner Lens

Circle Lens

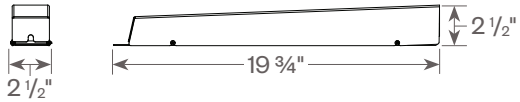
TOOLLESS JOINING

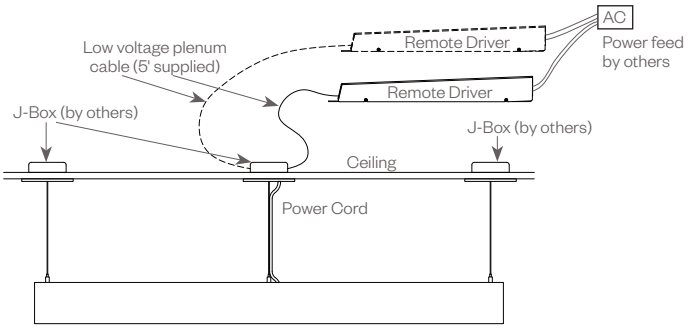
Line up the two housings by using the alignment pins & splines. Secure them together by using the Catch & Latch System on the top of or inside the extrusion.



REMOTE DRIVER

D22/36/43 ARC & CIR configurations only
Note: Driver required for every 4'. Remote drivers can be installed up to 15' max from fixture.





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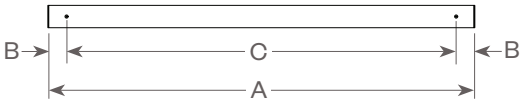
CURVANO® 2.5

Curved Linear Direct LED

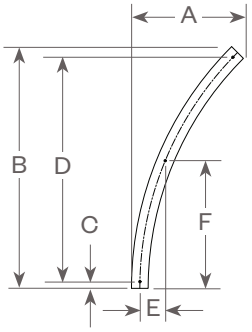
amerlux
A Delta Group Company

PROJECT: **TYPE:**

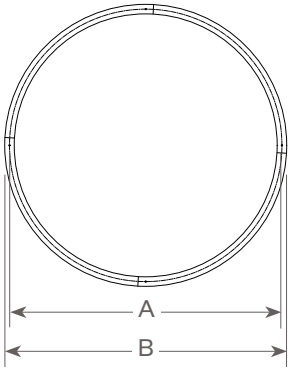
RUN LENGTHS AND DIMENSIONS (View from top of fixture. Black dots represent mounting points)



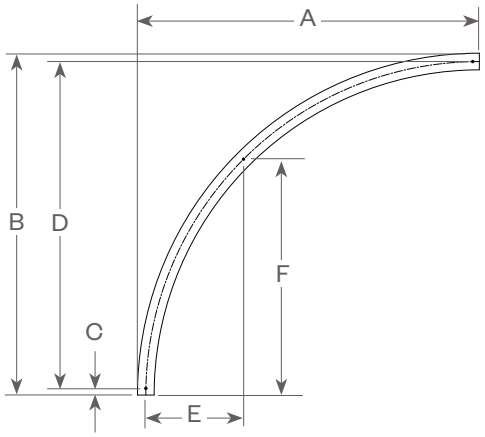
IND			
Length	**A**	**B**	**C**
2'	24"	2-3/32"	19-7/8"
3'	35-7/8"	2-3/32"	31-3/4"
4'	47-3/4"	2-3/32"	43-9/16"
5'	59-11/16"	2-3/32"	55-1/2"
6'	71-9/16"	2-3/32"	67-3/8"
7'	83-7/16"	2-3/32"	79-1/4"
8'	95-5/16"	2-3/32"	91-1/8"



45° ARC						
Diameter	**A**	**B**	**C**	**D**	**E**	**F**
D43	8-7/16"	16-1/16"	1"	14-1/2"	1-5/8"	8-1/4"
D72	12-5/8"	26-3/16"	1"	24-9/16"	2-3/4"	13-11/16"
D100	16-3/4"	36-1/4"	1"	34-5/8"	3-13/16"	19-1/8"



CIR		
Diameter	**A**	**B**
D22	21-5/8"	24-1/8"
D36	35-7/8"	38-3/8"
D43	43"	45-1/2"
D72	71-1/2"	74"
D100	100"	102-1/2"



90° ARC						
Diameter	**A**	**B**	**C**	**D**	**E**	**F**
D22	12-1/16"	12-1/16"	1"	10-3/4"	3-3/16"	7-5/8"
D36	19-3/16"	19-3/16"	1"	17-15/16"	5-1/4"	12-11/16"
D43	22-3/4"	22-3/4"	1"	21-/2"	6-5/16"	15-3/16"

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CURVANO® 2.5

Curved Linear Direct LED

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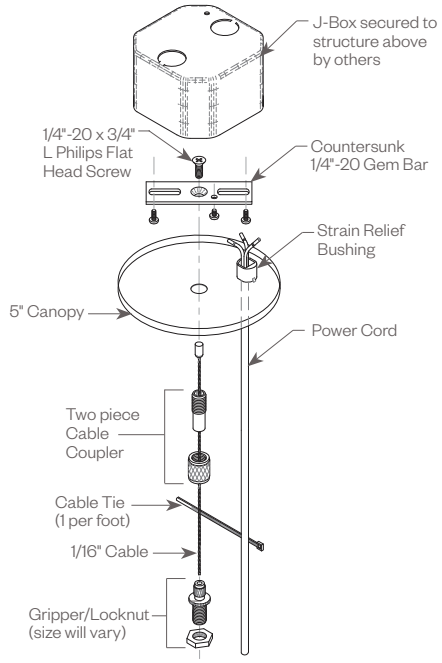
PROJECT: **TYPE:**

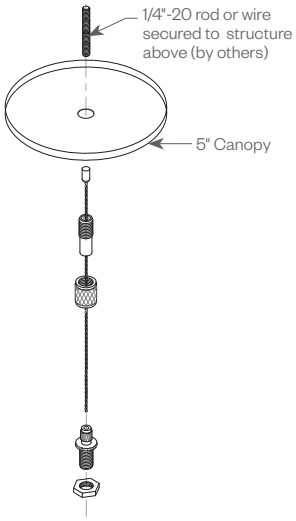
CABLE KIT SUSPENSION OPTIONS:

CEILING OR GYPSUM BOARD (ASW10, ASW20, ASB10, ASB20, MASW10, MASB10)

FEED



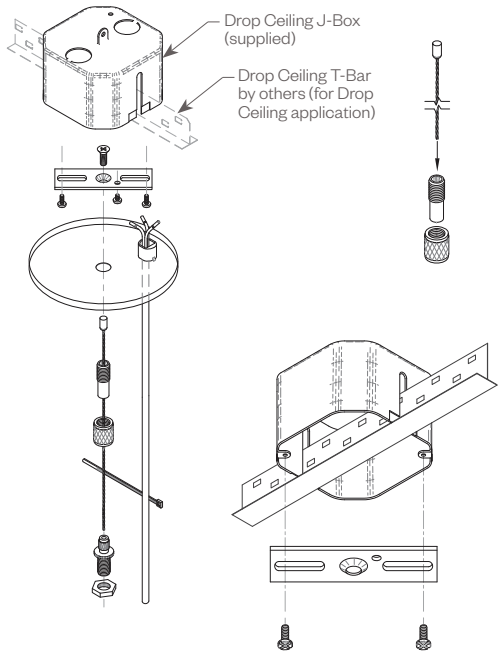
NON-FEED



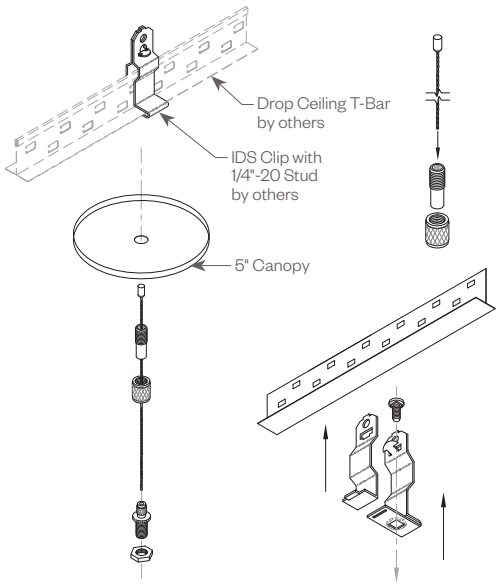
Cat#	Length	Cord/Canopy	Application
ASW10	10'	white/white	ceiling tile/gypsum
ASW20	20'	white/white	ceiling tile/gypsum
ASB10	10'	black/black	ceiling tile/gypsum
ASB20	20'	black/black	ceiling tile/gypsum
ASW10T	10'	white/white	ceiling tee
ASW20T	20'	white/white	ceiling tee
ASB10T	10'	black/black	ceiling tee
ASB20T	20'	black/black	ceiling tee
MASW10	10'	white/white	ceiling tile/gypsum
MASB10	10'	black/black	ceiling tile/gypsum
MASW10T	10'	white/white	ceiling tee
MASB10T	10'	black/black	ceiling tee

TEE GRID OR SCREW SLOT (ASW10T, ASW20T, ASB10T, ASB20T, MASW10T, MASB10T)

FEED



NON-FEED



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CURVANO® 2.5

Curved Linear Direct LED

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PROJECT: **TYPE:**

FIXTURE DATA: (Complete photometric data (.ies format) available upon request)

MULTIPLYING FACTORS: (Multiplying Factor is based on 3500K-83 120V IES file on website)

Wattage:	3W	4W	5W	6W	7W	8W	9W	10W
Factor:	0.67	0.83	**1.0**	1.17	1.33	1.5	1.66	1.83

CCT:	3000K-83	3500K-83	4000K-83
Factor:	0.97	1.0	1.01

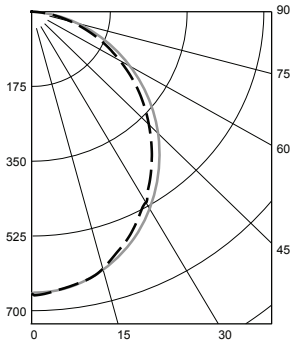
Wattage:	3W	4W	5W	6W	7W	8W	9W	10W
Factor:	0.37	0.46	0.55	0.64	0.73	0.82	0.91	**1.0**

CCT:	2700K-90+	3000K-90+	3500K-90+	4000K-90+
Factor:	0.90	0.93	0.96	0.97

CURV2.5D DL 5W 3500K 4FT

Total Watts: 20
Total Lumens: 1672
Source: 112 direct White LEDs

LTL# 13450111.01



ZONAL LUMEN SUMMARY

Zone	Lumens	%Fixt
0-40	790	47.3
0-60	1345	80.5
0-90	1672	100.0
90-180	0	0.0

Efficacy = 84.6 Lumens /Watt

COEFFICIENTS OF UTILIZATION

Effective Floor Cavity Reflectance 20%

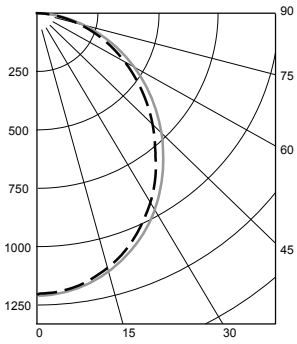
RC	80			
RW	70	50	30	10
RCR				
0	119	119	119	119
1	109	104	100	96
2	99	91	85	79
3	91	80	72	66
4	83	71	63	56
5	77	64	55	49
6	71	58	49	43
7	66	52	44	38
8	61	48	40	34
9	57	44	36	31
10	54	41	33	28

Values are expressed as percent of total lumen output delivered to the task surface.

CURV2.5D DL 10W 3500K 4FT

Total Watts: 39
Total Lumens: 3059
Source: 112 direct White LEDs

LTL# 13450111.04



ZONAL LUMEN SUMMARY

Zone	Lumens	%Fixt
0-40	1449	47.4
0-60	2452	80.2
0-90	3059	100.0
90-180	0	0.0

Efficacy = 77.6 Lumens /Watt

COEFFICIENTS OF UTILIZATION

Effective Floor Cavity Reflectance 20%

RC	80			
RW	70	50	30	10
RCR				
0	119	119	119	119
1	109	104	100	96
2	99	91	84	79
3	91	80	72	66
4	83	71	63	56
5	77	64	55	49
6	71	58	49	43
7	66	52	44	38
8	61	48	40	34
9	57	44	36	31
10	54	41	33	28

Values are expressed as percent of total lumen output delivered to the task surface.

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CURVANO® 2.5

Curved Linear Direct LED

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PROJECT: **TYPE:**

DIMMING COMPATIBILITY:

Amerlux® Curvano® fixtures are compatible with all major dimming protocols prevalent in the United States. Please see below for general compatibilities and wiring diagrams. Amerlux recommends testing your unique dimming configuration as the exact full configuration (Dimmer, Fixture Quantity, Voltage, etc) may affect dimming performance.

--- NOTE: INFORMATION BELOW IS FOR WIRED DIMMERS ONLY. FOR WIRELESS DIMMERS, CONSULT FACTORY ---

0-10V - DIMMING (Standard)

Integrates into a variety of building management and daylighting controls

Notes:

- 120V or 277V*
- Dims down to 1% light output
- Requires interface to turn off power to driver
- Consult Dimming manufacturer for installation instructions - DO NOT SHARE NEUTRALS!

Compatible Dimmers†:

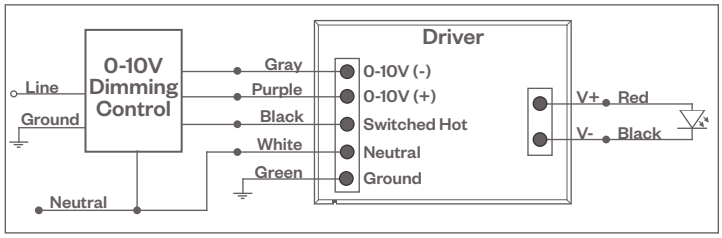
Wall Box

Lutron:	Wattstopper:	Leviton:
Diva - DVSTV	ADF-120277	Renoir II
Maestro - MS-Z101		
Nova-T - NTSTV-DV		

Center System

Lutron Grafixk Eye with GRX-TV1 Interface

0-10V Wiring Diagram



LUTRON HI-LUME DIMMING

Integrates into Lutron EcoSystem building management

Notes:

- 120V or 277V*
- Dims down to less than 5% light output
- EcoSystem Control
- Consult Dimming manufacturer for installation instructions - DO NOT SHARE NEUTRALS!

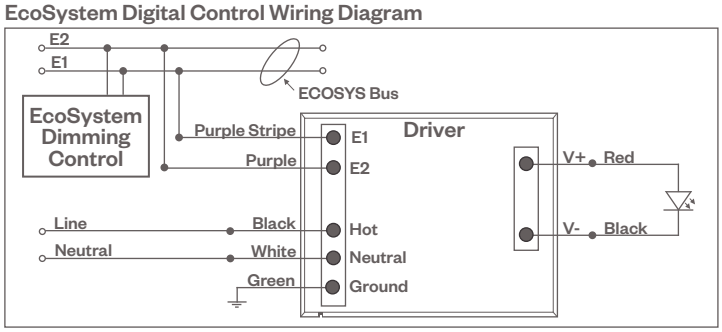
Compatible Dimmers†:

Wall Box

Lutron:
Diva
Maestro
Nova-T
Vareo

HILUME-H-ECO, HILUME-5-ECO

EcoSystem Digital Control Wiring Diagram



Center System

Lutron EcoSystem compatible controls

Notes:

* Driver is 277V dimmable with appropriate dimmer (by others). All provided wiring diagrams show 120V wiring colors and method. Please refer to 277V dimmer installation instructions for 277V wiring diagrams.

† The absence of a dimmer from the lists above does not imply incompatibility. Please consult factory for compatibility inquiries.

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CURVANO® 2.5

Curved Linear Direct LED

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A Delta Group Company

PROJECT: **TYPE:**

DIMMING COMPATIBILITY:
Amerlux® Curvano® fixtures are compatible with all major dimming protocols prevalent in the United States. Please see below for general compatibilities and wiring diagrams. Amerlux recommends testing your unique dimming configuration as the exact full configuration (Dimmer, Fixture Quantity, Voltage, etc) may affect dimming performance.

--- NOTE: INFORMATION BELOW IS FOR WIRED DIMMERS ONLY. FOR WIRELESS DIMMERS, CONSULT FACTORY ---

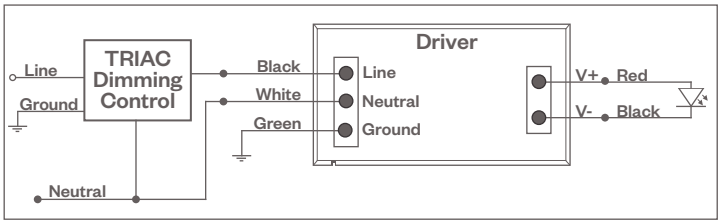
LUTRON HILUME-A-LTE DIMMING

Utilizes "Standard" incandescent dimmers that are in wide use in installations across the US. Best for retrofit applications where TRIAC dimmers are installed.

Notes:

- 120V only
- Dims down to less than 1% light output (most cases)
- Consult Dimming manufacturer for installation instructions - DO NOT SHARE NEUTRALS!
- Must meet dimmer Minimum Load Requirements per dimming manufacturer

Lutron HILUME-A-LTE Wiring Diagram



Compatible Dimmers†:

Wall Box (Incandescent Style, Wattage as required)

Lutron:
Diva
Maestro
Nova-T
Vareo
Skylark

Center System

Lutron "GP" Panel
Lutron Grafik Eye QS

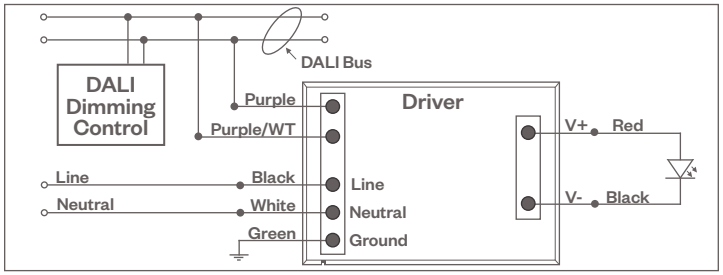
DALI - DALI DIMMING 120V-277V

Digital control protocol allows individual fixture control

Notes:

- 120V - 277V*
- Dims down to 0.1% light output in most cases

DALI Wiring Diagram



Compatible Dimmers†:

Wall Box

Leviton CD250 Controller

Center System

Dynalite
Fifth Light

Notes:

* Driver is 277V dimmable with appropriate dimmer (by others). All provided wiring diagrams show 120V wiring colors and method. Please refer to 277V dimmer installation instructions for 277V wiring diagrams.

† The absence of a dimmer from the lists above does not imply incompatibility. Please consult factory for compatibility inquiries.

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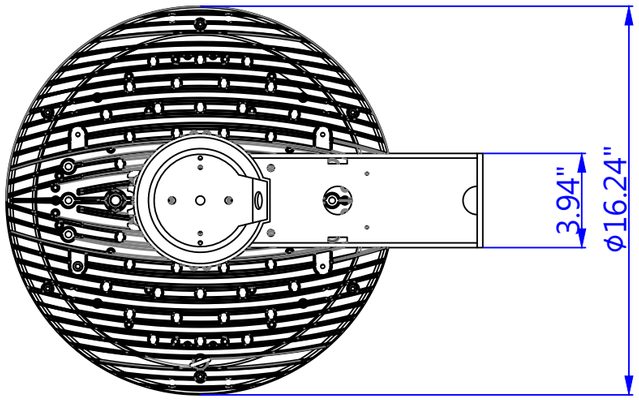
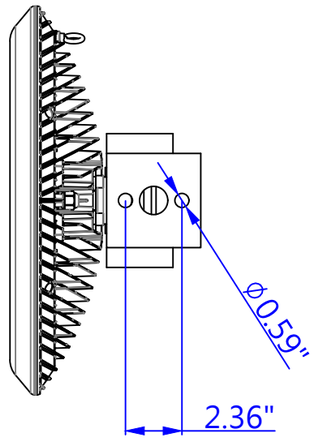
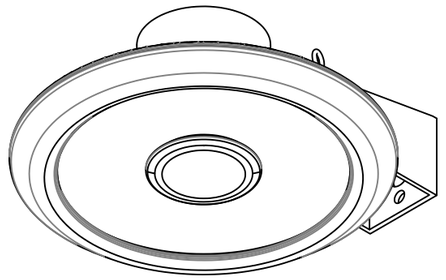
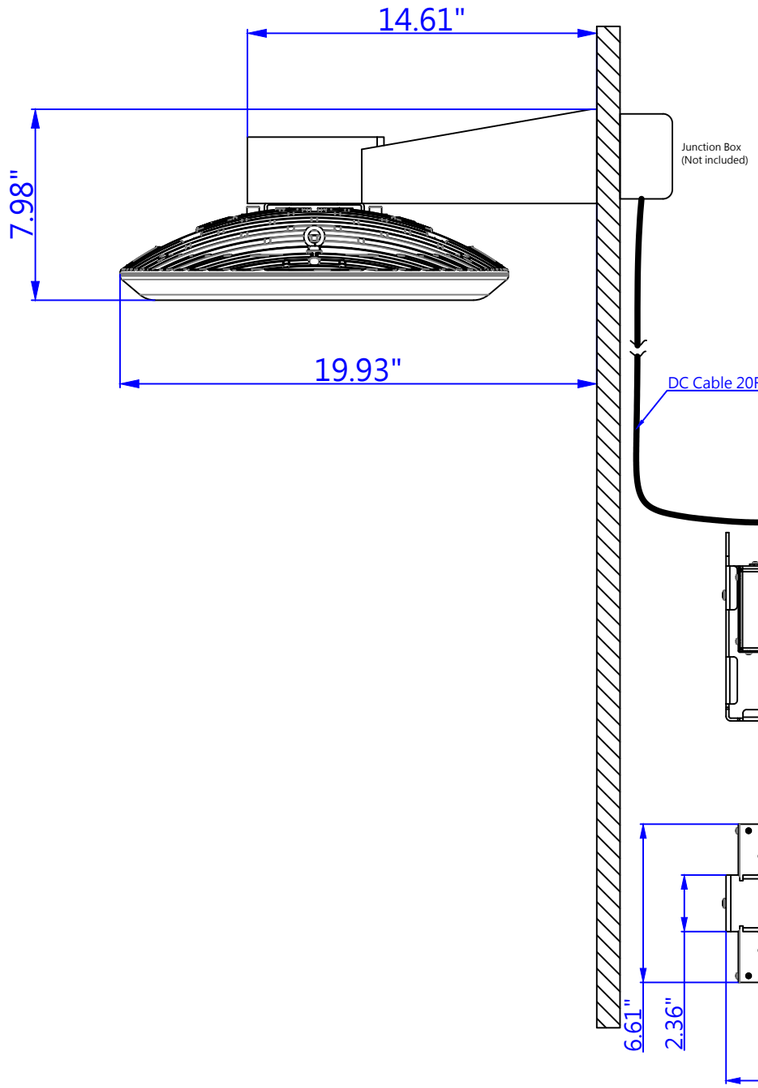
WS 2.0 Wall Mount Remote power box

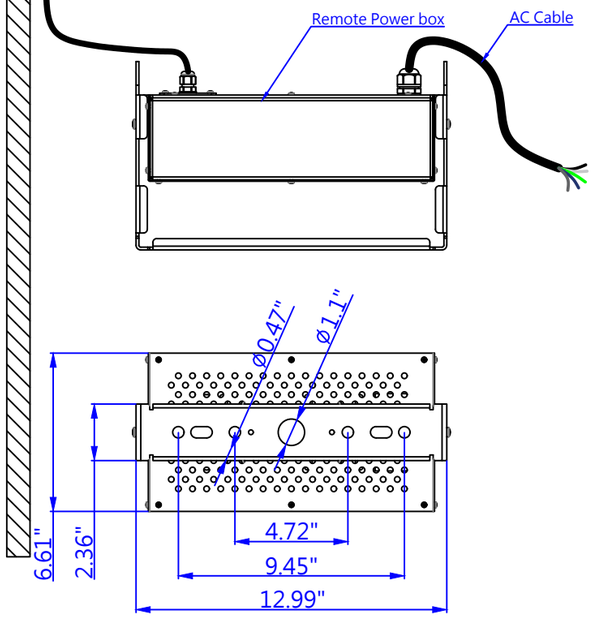
METEOR











Order code: **WALLMOUNTARM**

METEOR LIGHTING P: 213.255.2060 F: 213.596.3704 www.meteor-lighting.com

2021-04-09

1300 John Reed Court, Unit B, City of Industry, aCalifornia 91745

LT-10

ADVANCED HIGH CEILING

Whiz 2.0 - Standard

METEOR

High lumen compact luminaire with lumen output 12400 – 35400lm. Additional features include IP65 and outdoor/Natatorium rating.

Quantity		Type	
Project		Note	

Electrical System

- 13900lm (120W)
  19600lm (170W)
  26700lm (240W)
  35400lm (300W)
- Power Input: Universal (120-277V); 347-480V
- Operating Temperature: -40°F~112°F
- Surge Protection: 4KV
- Power Factor Greater than 0.9

LED Technology

- 3000K, 3500K, 4000K, 5000K
- 75 CRI, 85 CRI
- Beam Angle: 25°, 40°, 60° and 100° (with diffuser)
- Rated Life > 100,000 hours (L70)
- Lumen Maintenance > 0.90 at 60,000 hours

Advanced Dimming

(Proprietary VX Driver is incorporated to all dimming options for video flicker-free lighting)

- Standard 0-10V: dims to 10%
- Superior 0-10V: dims to 1%
- LDE1: Hi-Lume 1% EcoSystem (UNV only)
- LTE: Hi-Lume 1% 2-Wire TRIAC (120V only)
- DALI: dims to 10%
- DMX: high resolution dims to 0.1%
  (Supports ANSI E1.20 RDM protocol)

Housing

- Diameter: 16.24” (420mm)
- Material: Die-Cast Aluminum, Tempered Glass
- Weight: 33lbs

Mounting

- Stem 2ft, 4ft
- Adjustable Aircraft Cable 10ft
- Uplight 2ft, 4ft
- Adjustable Uplight 2ft, 4ft

Warranty

- 5 years limited warranty.

Listing

- ETL Damp Location Listed
- DLC Listed
- UL924

UL 924 ETL Intertek DLC QPL LISTED

Not all Whiz 2.0 are DLC qualified.
For all qualified products.
Please visit: www.designlights.org/qpl

ADVANCED HIGH CEILING

Whiz 2.0 - Standard

METEOR

How To Specify:
Ordering Example: WS2-240-507-UNV-DMX-60-BLK-ST2-EMP

Model	Wattage	CCT / CRI	Voltage	Dimming
WS2			UNV	
WS2 **Whiz 2.0 Series**	**120** 120W **170** 170W **240** 240W **300** 300W	**507** 5000K / CRI75 **308** 3000K / CRI85 **358** 3500K / CRI85 **408** 4000K / CRI85	**UNV** 120-277V **HVT** 347-480V **120** 120V	**NOD** Non-Dimming **STV** Standard 0-10V dims to 10% **SPV** Superior 0-10V dims to 1% **DMX** DMX dims to 0.1% (XLR Sockets) **DMX(RJ45)** DMX dims to 0.1% (RJ45 Sockets) **LTE**[1] Hi-Lume 1% 2-Wire TRIAC (120V only) **LDE1**[1] Hi-Lume 1% EcoSystem (UNV only) **DALI** DALI dims to 10% [1]Option only compatible with 120W, 170W.

Beam Angle	Finish	Mounting	Accessories
25 25º **40** 40º **60** 60º **WD*** 100º (with diffuser) *Please factor in change in lumen output with diffuser (-20% with WD; -12% with other degrees).	**BLK** Black **WHT** White	**ST2** Stem 2ft **ST4** Stem 4ft **AD10*** Adjustable Cable 10ft **UP2*** Uplight Stem 2ft **UP4*** Uplight Stem 4ft **AUP2*** Adjustable Uplight 2ft **AUP4*** Adjustable Uplight 4ft *Option is not compatible with OCC.	**OCC**[1] Occupancy Sensor **EMP** Remote Emergency Pack **DF**[2] Diffuser **WG**[3] Wire Guard **SNT**[4] Snoot **GSV**[5] Glare Shield Visor [1] Option is ONLY compatible with NOD, MUST order with Wire Guard. Not available for 300W. Occupancy sensor is a mesh network-controlled device. [2]Please factor in change in lumen output with diffuser (-20% with WD; -12% with other degrees). [3]Please factor in change in lumen output of -14%. [4]Please factor in change in lumen output of -30%. [5]Please factor in change in lumen output of -25%.

DesignLights Consortium™ Qualified Luminaires:

DLC QPL Model Number : WS2-300-408
Not all product variations listed on this page are DLC qualified.
To ensure that a specific model is qualified, visit www.designlights.org/search.

ADVANCED HIGH CEILING

Whiz 2.0 - Standard

METEOR

Delivered Lumens*

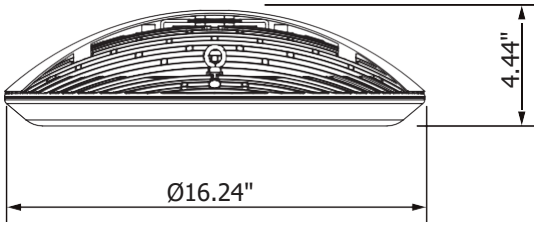
Wattage / CCT	120W	170W	240W	300W
	Beam Angle: 40°			
5000K	13900 lm	19600 lm	26700 lm	35400 lm
4000K	13300 lm	18900 lm	22100 lm	29700 lm
3500K	12500 lm	17700 lm	21400 lm	28800 lm
3000K	12400 lm	17510 lm	21200 lm	28500 lm

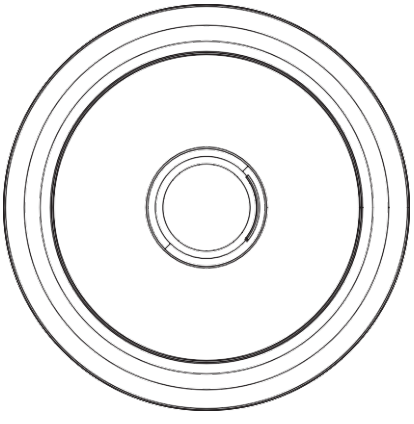
*Tolerance±8%

Current Consumption

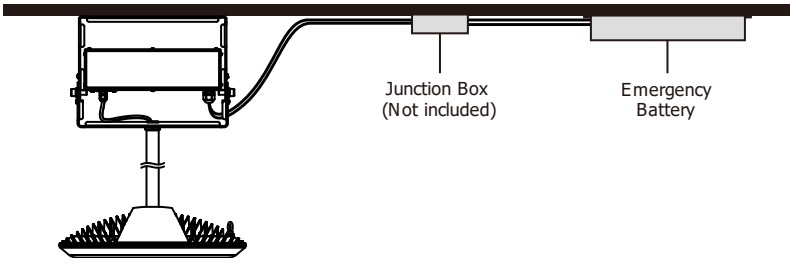
Volt / Wattage	120V	277V
120W	1.1A	0.48A
170W	1.56A	0.68A
240W	2.02A	0.87A
300W	2.75A	1.19A

Dimensions

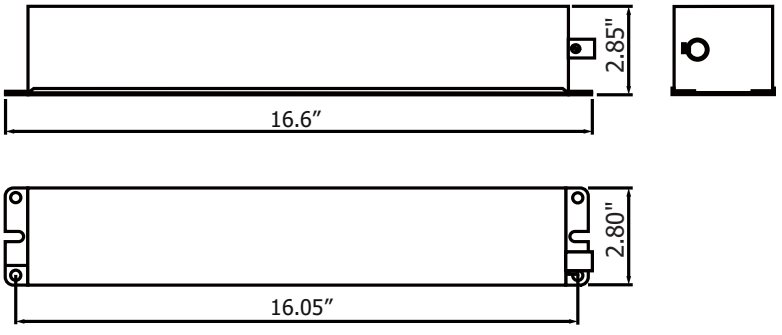




Remote Emergency Pack



16.6" x 2.8" x 2.85" (mounting center - 16.05")



Emergency Pack Lumen Output Table

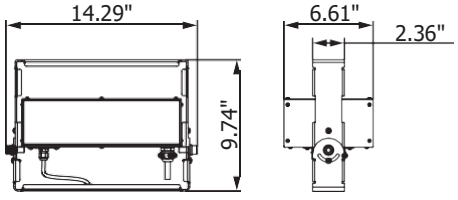
CCT	3000K	3500K	4000K	5000K
Lumen	1900 lm	1920 lm	1980 lm	2360 lm

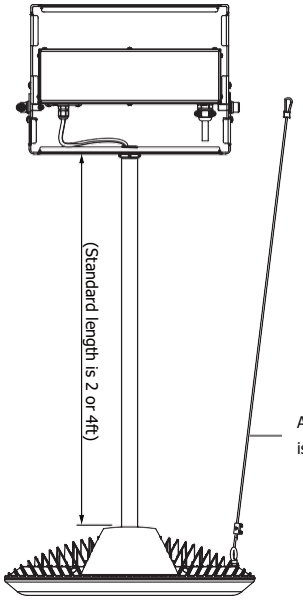
ADVANCED HIGH CEILING

Whiz 2.0 - Standard

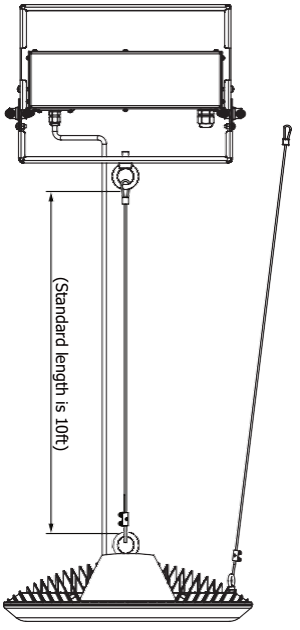
METEOR

Mounting Options

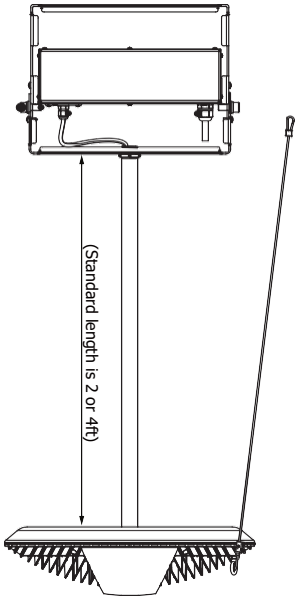




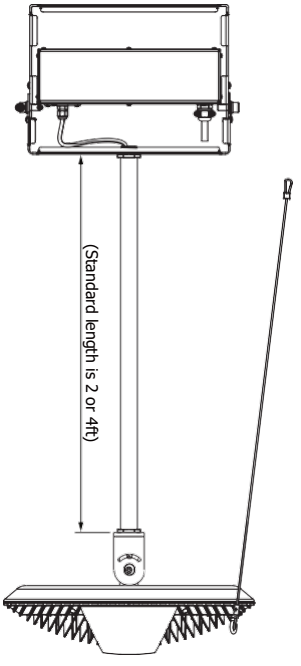
Stem



Adjustable
Aircraft Cable



Uplight



Adjustable Uplight

ADVANCED HIGH CEILING

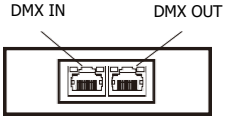
Whiz 2.0 - Standard

METEOR

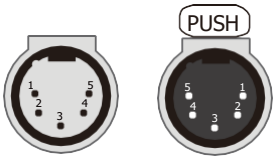
DMX Requirements*

The Whiz 2.0 LED fixture with DMX is a ONE CHANNEL DMX unit.
When placing order, please indicate DMX address. (The DMX address will be listed on the back of the fixture.)
The LED fixture provide RJ45 Socket or XLR socket to connect. (DMX cable NOT included.)
The final fixture should be terminated by the use of DMX Terminator (by others).

RJ45 Sockets



RJ45 Sockets

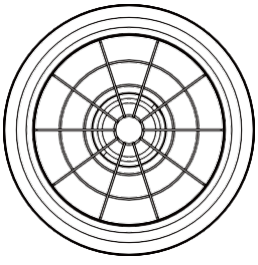


CONNECTION	RJ45 (CAT5e)	5-PIN XLR
Common	WHITE/BROWN(PIN7) & BROWN(PIN 8)	PIN 1
Signal -	ORANGE(PIN 2)	PIN 2
Signal +	WHITE/ORANGE(PIN 1)	PIN 3
Spare	-	PIN 4
Spare	-	PIN 5

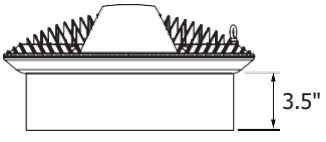
Compatible DMX Cabling List

DMX uses a cable consisting of two twisted pairs plus a shield to carry data. The cable must be specifically impedance matched for the digital DMX signal, meaning that microphone cable or other non-rated cable **must not be used to carry DMX**. Network cable (Cat5, 5e or 6 cable) may be used to carry DMX in an installation; however special consideration must be given to shielding and termination. Under no circumstances should solid core cable like Cat5 be terminated into a screw down connector.
Meteor recommends the use of Belden 9729 for DMX installation. Belden 9729 is a two pair cable, which allows for a spare pair for 'out and back' type terminations if needed. Below is a list of other compatible Belden cables.

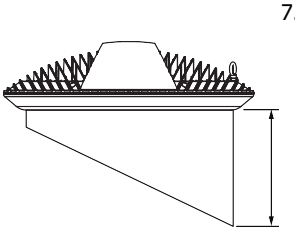
Accessory



Wire Guard



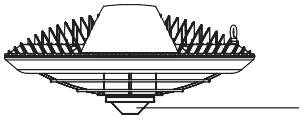
Snoot



Glare Shield Visor

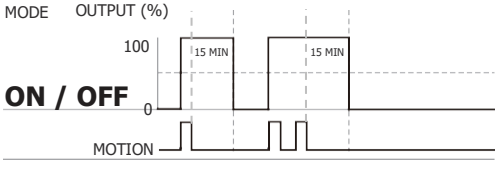
Occupancy Sensor

* Not available with any dimming option.
* Mesh network-controlled device.



Occupancy Sensor

Occupancy Sensor Operation



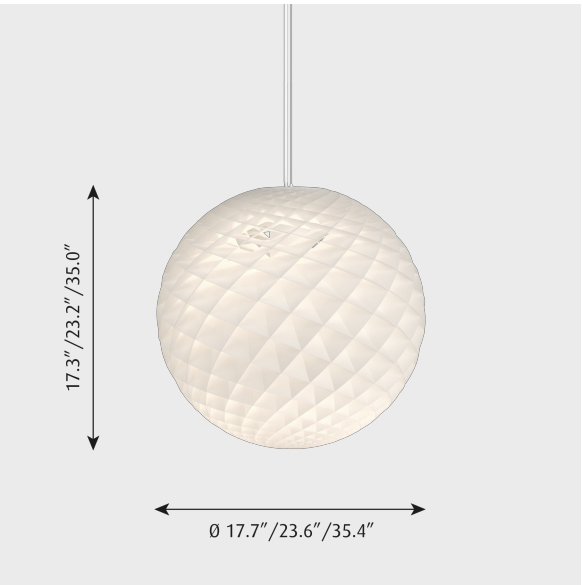
LT-11B

Patera

Project name:

Project type:

Notes:



Design

Øivind Slaatto

Product description

Patera is a modern pendant with a vibrant and beautiful light. From a distance it is the same shape as the source of all light and life, a sun or sphere. As you move closer the sphere comes to life, it is constructed of a structure that is ever present in nature, inspired from the Fibonacci mathematical sequence. It is a glowing sphere built up of small diamond-shaped cells formed by the weaving of ribbons of material. Each cell is carefully designed to capture light and to shield the light source from the viewing angles above 45 degrees. Available in three sizes: 17.7", 23.6", 35.4". Traditional sockets available for use with the customer's preferred lamping. Dedicated LED variants are available.

Variant options

Dimension	Light source	Lumen	Voltage frequency	Lighting control
17.7 IN	1x100W A-19/IF medium	-	120-277V/60HZ	-
23.6 IN	1x200W A-23W/IF medium	2307	120V	Dim 0-10v
35.4 IN	42W LED/2700K	2411		
	42W LED/3000K	3731		
	65W LED/2700K	3907		
	65W LED/3000K	4291		
	97W LED/2700K	4470		
	97W LED/3000K			

Specification notes

a. 17.7 IN available in 1/100W/A-19 or 44W LED. b. 23.6" variants available in 1/200W/A-19 or 65W LED. c. 35.4" variants available in 1/200W/A-19 or 97W LED. d. Incandescent variants available only in 120V. e.

Light description

Spherical light distribution. The light source is shielded with viewing angles above 45 degrees to minimize glare. At lower angles, the fields are open to direct light downwards. A small amount of upward light illuminates the ceiling. The shade is self-illuminating as a glowing sphere.

Mounting

Mounts over a 4 inch octagonal outlet box. The two larger LED variants include a single stainless steel aircraft wire to support the weight. Cord type is white, 2 or 3-conductors, 18 AWG PVC power cord. Cord length: 12'. Canopy color: white. Traditional socket variants of all sizes have a canopy of flat cone profile, 5.3 IN diameter x 1 IN tall. Canopy for 17.7 IN in LED is contoured cone profile, 6.8 IN diameter x 2.8 IN tall. Canopy for 23.6 IN and 35.4 IN sizes in LED is dome profile, 9.4 IN diameter x 4.3 IN tall. LED variants have an electronic, constant current, class II driver for 120-277V power supply housed inside canopy.

Information

Electrical:
System Wattage: 42W, 65W or 97W (LED)
100W or 200W (INC)
LED Wattage: 40W, 62W, or 89 W
Delivered lumens: 2,307 - 4,291 (LED)
Efficacy: 44 lm/W - 60 lm/W (LED)
Certifications:
cULus, Dry Location
Protection class IP20
Controllability: 0-10V Dimming (LED variants); Phase dimming (incandescent variants)
Color Rendering: Ra≥90 for LED variants.
Performance dependent upon screw-base lamp used in socketed variants.

Other functions

Longer cord lengths. LED in 3500K or 4000K. Alternative dimming controls.

Specification notes

a. 17.7 IN available in 1/100W/A-19 or 44W LED.
b. 23.6" variants available in 1/200W/A-19 or 65W LED.
c. 35.4" variants available in 1/200W/A-19 or 97W LED.
d. Incandescent variants available only in 120V.
e. LED variants available only in 120-277V with 0-10V dimming.

Material

Silver, Wht

Weight

Min: 12.562 lbs Max: 8.915 lbs

Dimensions

17.7 IN, 23.6 IN, 35.4 IN

Finish

White

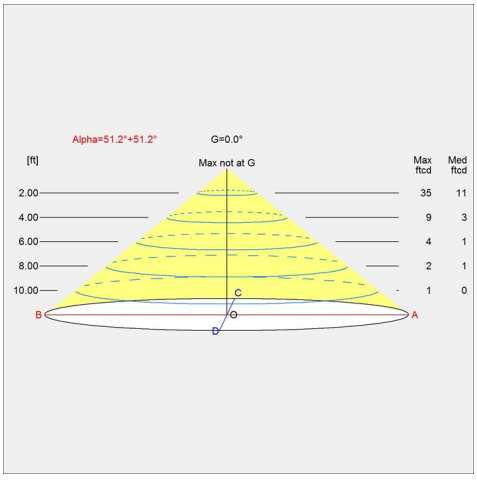
Voltage

120-277V/60HZ, 120V

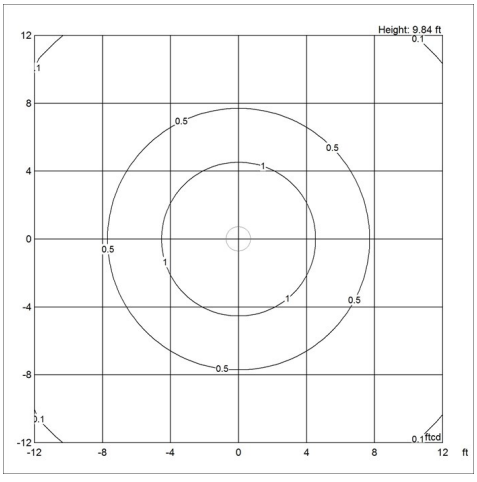
Light distribution diagrams

For the full data set on all variants, see louispoulsen.com.

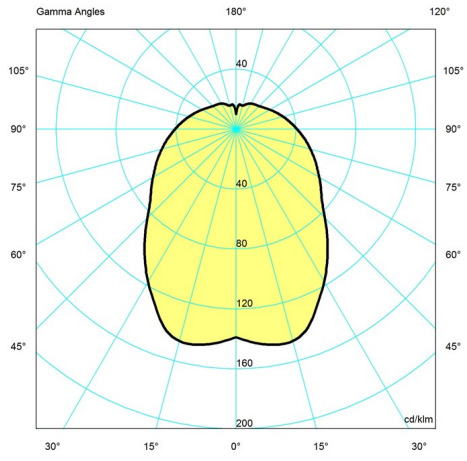
Cartesian



Isolux



Polar



Variant options

Dimension	Light source	Lumen	Voltage frequency	Lighting control	Variant number
17.7 IN	1x100W A-19/IF medium	-	120V	-	5741925151
17.7 IN	42W LED/2700K	2307	120-277V/60HZ	Dim 0-10v	5741925164
17.7 IN	42W LED/3000K	2411	120-277V/60HZ	Dim 0-10v	5741925177
23.6 IN	65W LED/2700K	3731	120-277V/60HZ	Dim 0-10v	5741925229
23.6 IN	65W LED/3000K	3907	120-277V/60HZ	Dim 0-10v	5741925232
23.6 IN	1x200W A-23W/IF medium	-	120V	-	5741925216
35.4 IN	97W LED/2700K	4291	120-277V/60HZ	Dim 0-10v	10000149264
35.4 IN	97W LED/3000K	4470	120-277V/60HZ	Dim 0-10v	10000149362
35.4 IN	1x200W A-23W/IF medium	-	120V	-	10000149361

Date: _____ Customer: _____

Project: _____

Type: _____ Qty: _____

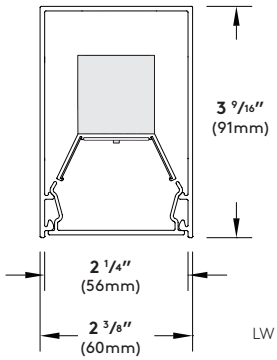
selux

M60
LED Direct

Order Code: L60 - _____ - _____ - _____ - _____ - _____ - _____ - _____ - _____ - _____ - _____ - _____ - _____

L60	Series	**L60** M60 LED Direct	
_____	Light Engine	**1C45**[1,2,3] 80CRI-1018lm 90CRI-855lm 11.1W per foot **1C40**[1,2,3] 80CRI-954lm 90CRI-802lm 9.9W per foot **1C35**[1] 80CRI-834lm 90CRI-701lm 8.7W per foot **1C30**[1,2] 80CRI-746lm 90CRI-627lm 7.3W per foot **1C25**[1,2] 80CRI-594lm 90CRI-500lm 6.1W per foot **1C20**[1,2] 80CRI-494lm 90CRI-415lm 4.9W per foot	[1] Values calculated from a 4' fixture at 3500K, 90+ CRI using LW shielding and DIM driver. For additional information please see page 2. [2] Available starting at 2' and up. [3] Not available with Lutron.
_____	CCT	**927** 2700K 90+ CRI **930** 3000K 90+ CRI **935** 3500K 90+ CRI **940** 4000K 90+ CRI **827**[4] 2700K 80+ CRI **830**[4] 3000K 80+ CRI **835**[4] 3500K 80+ CRI **840**[4] 4000K 80+ CRI **RGBW** (consult factory)	[4] Consult factory for lead times
_____	Shielding	**LW** LED Optimized White Lens **MI** Clear Lens with Microprism **NB** LMO Symmetric with Satine Lens **A2** LMO Asymmetric 20° Wall Washer with Satine Lens **A5** LMO Asymmetric 5° Wall Grazer with Satine Lens **BW** LMO Batwing with Satine Lens	
_____	Mounting	**C** Cable **S** Swivel Stem **RS** Rigid Stem **W**[5] Wall Mount **F**[6] Surface Mount	[5] Consult factory for lengths under 2' [6] Over 8' supplied with 2 or more housings that are joined in the field.
_____	Nominal Fixture Length	**01*** 1 ft. **02** 2 ft. **03** 3 ft. **04** 4 ft. **05** 5 ft. **06** 6 ft. **07** 7 ft. **08** 8 ft. **09** 9 ft. **10** 10 ft. **11** 11 ft. **12** 12 ft. **XX** Runs (over 12') and Configurations, round up to the nearest foot and replace the "xx" with the # (i.e. 13=13' nominal) **1' fixture only available with 1C35 light engine.* *Individual fixtures, Runs and Configurations are supplied in nominal lengths to ensure full, even, illumination. See pages 2 through 6 for additional details.*	
_____	Finish	**WH*** White **BL** Semi-Matte Black **SV** Silver **SP** Specify Premium Color	** Custom colors are available, please consult factory*
_____	Voltage	**1** 120V **2** 277V **U** 120V through 277V 50/60hz capable **3**[7] 347V (consult factory)	[7] 347V not available with EM integral battery option
_____	Driver	**DIM**[8] 0-10V 1% (Linear) **DIL**[8,9] eldoLED 1% ECOdrive 0-10V (Logarithmic) **DED**[8,9] eldoLED 1% ECOdrive DALI (Logarithmic) **D01**[8,9] eldoLED 0.1% SOLOdrive 0-10V (Linear) **DL01**[8,9] eldoLED 0.1% SOLOdrive 0-10V (Logarithmic) **DC2**[8,9,10] Lutron 1% 2-Wire **DE1**[8,9] Lutron 1% EcoSystem **DC5** Lutron 5% 5-Series (consult factory) **DC3** Lutron 1% 3-Wire (consult factory)	[8] See page 7 for full details [9] Not available for 1' length or with [10] 120V only
_____	Fixture Options	**DL** Damp Location Rated **FS** In-line Fuse **SS**[11] Separate Switching	[11] See page 10 for details
_____	Sensor Options	**xE**[12,13] Enlighted **xS1**[12,13] Sensor Switch Daylight **xS2**[12,13] Sensor Switch Occ/Vac **xS3**[12,13] Sensor Switch Occ/Vac/ Daylight **xSN** nLight enabled (consult factory) **xV** Lutron Vive (consult factory) Replace "x" with quantity	[12] Minimum fixture length 2'. See page 10 for full details and restrictions [13] Requires DIM driver (0-10V)
_____	Emergency Options	**EC**[14,15] Emergency Circuit Wiring **EMR** Remote Micro Inverter (consult factory) **EM**[14,15,16] Integral EM battery pack	[14] See page 8 for full details and restrictions [15] For emergency options with sensors, please consult factory. [16] For EM available in 4' and ≥ 6'. Please consult factory for 5'.
_____	Configuration Options	**L9** Lit Horizontal 90° Corner **V9** Lit Inverted 90° Corner **T9** Lit "T" section **X9** Lit "X" section	* See page 12 for full details and restrictions

All options indicated with the green truck symbol are available with 4-week ship time. Mixed orders will defer to the longest lead time.



LW lens shown for reference

Construction:

Housing - Continuous, low copper 6063-T6 extruded aluminum profile with aluminum endcaps, available as Individual fixtures (up to 12') or Runs.

Geartray - Low copper 6063-T6 extruded aluminum profile.

Shielding - Extruded, impact resistant acrylic lens:
- LED Optimized White Lens (LW)
- Clear Lens with Microprism (MI)

"LMO" refers to the Selux proprietary LED optical system - Light modulation optics. These lenses are offered in M60 behind a Satine Lens for even illumination and comfortable lit appearance.
- "LMO" Symmetric Lens (NB)
- "LMO" Asymmetric 20° Wall Washer (A2)
- "LMO" Asymmetric 5° Wall Grazer (A5)
- "LMO" Batwing (BW)

Mounting(s) - 1/16" Aircraft Cable, Ø5/8" Swivel or Rigid Steel Stem, Wall Bracket, Surface mounting (see pages 3 through 6 for details).
** Cable, Stem and Wall mountings may not be symmetrical for Runs and Configurations due to the use of modular housing lengths. If symmetrical suspensions are required please consult the factory.

Standard Luminaire lengths - All standard luminaires are supplied in nominal lengths to ensure full, even, illumination. Runs and Configurations are available in approximately 1/4" increments starting at the nominal 12' fixture length.
** Individual luminaires are not joinable in the field.

Exact length luminaires - Individual luminaires, Runs, and Configurations are available in exact lengths to meet your project needs. Please consult factory with your requirements.
** Lens luminance may soften at the very ends of the straight sections for exact length luminaire.

L60 Joiner(s) - Runs and Configurations are supplied in multiple housings that are joined together in the field using the supplied L60 Joiner System. This allows ease of installation and ensures a uniform appearance (see page 9 for detail).

Weight: 2.4 lb. per foot.

Electrical/Performance:

LED Light Engine - Brand-name mid-power LEDs create a high efficiency LED light engine able to provide a lumen maintenance of 95% at 25,000 hours and 90% at 60,000 hours at 25°C per TM-21 reports. Reported L70 greater than 60,000 hours.

Photometrics - Consult website or factory for IES Files. Independent photometric lumen measurement complies with IES LM-79-08 testing procedures. Due to the LED manufacturer's tolerances, the listed output has a ±5% tolerance. For outputs based on different optics or CCT, please see page 13 for details.

CCT - Available in 2700K, 3000K, 3500K and 4000K, tolerance within a 3-step MacAdam ellipse.

CRI - 90+ and 80+ CRI. Consult factory for lead times of 80 CRI.

All Drivers - High efficiency, constant current, soft start, Electronic Class 2 with a PFC>0.90. For more detailed information on the available drivers please see page 7.

Sensors - Selux offers a variety of integral sensor options. For details and specifications, please refer to page 10.

Emergency - There are multiple emergency options available - Emergency Circuit, Remote Micro Inverter, and Integral EM Battery Pack. All options compliant with UL 924 listed emergency luminaire. Please consult factory for use of sensors with emergency options. For more details on EC and EM options, see page 9.

Thermal Performance:

Ambient Operating Temperature - Luminaires suitable for maximum ambient temperature of 35°C (95°F) for all drivers.

Luminaires are suitable for minimum ambient temperatures of -40°C (-40°F) for DIM, DIL, DED, D01, and DL01 drivers; 0°C (32°F) for DC2 and DE1 drivers.

Luminaire Finish:

Powder Coat - All Selux luminaries are finished in high quality polyester powder coating in our Tiger Drylac certified facility and are tested in accordance with test specifications for coatings from ASTM and PCI.

All products undergo a five stage intensive pretreatment process where product is thoroughly cleaned, phosphated, and sealed. Selux powder coated products provide excellent salt and humidity resistance as well as ultra violet resistance for color retention.

Standard interior colors are White (WH), Semi-Matte Black (BL), and Silver (SV). Selux premium colors (SP) are available, please specify from your Selux color selection guide.

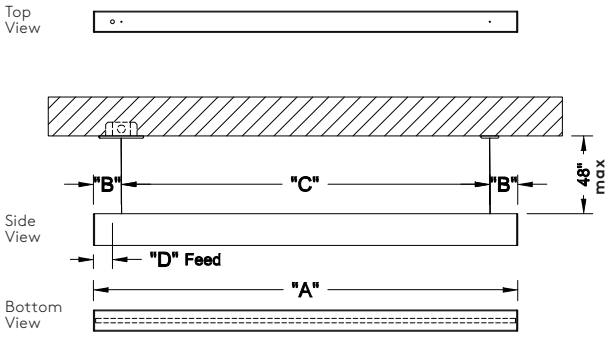
Warranty:

5 Year Limited LED Luminaire Warranty - Selux offers a 5 Year Limited Warranty to the original purchaser that the M60 series LED luminaire shall be free from defects in material and workmanship for up to five (5) years from date of shipment. This limited warranty covers the LED driver and LED light engine when installed according to Selux instructions and operated within the Ambient Temperature. For additional details and exclusions, see "Selux Terms and Condition of Sale."

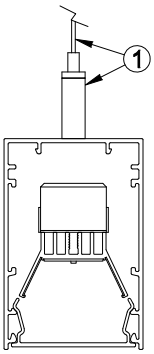
Certifications and Compliance:

NRTL - For Dry and Damp location
(I.E. cULus; cCSAus)
ADA Compliant
ARRA Compliant
RoHS Compliant

Cable Mounting (C)



Cable Mounting (C)

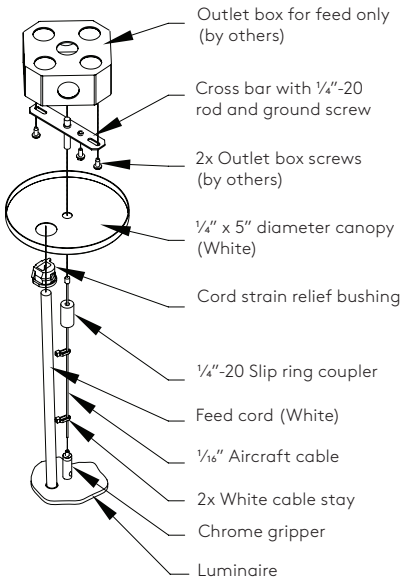


1. Ø 1⁄16" Aircraft Cable with chrome gripper for easy adjustment (48" max. from ceiling to luminaire).

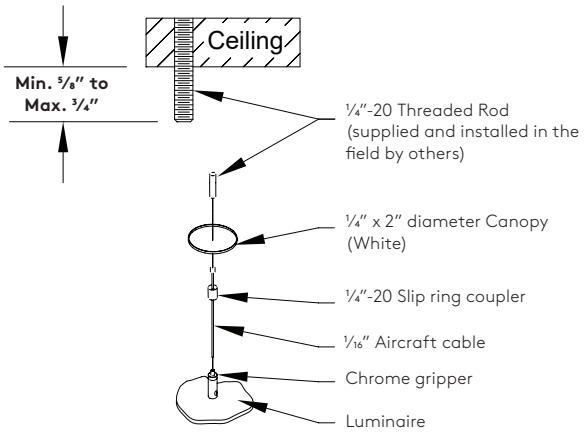
Cable Mounting (C) - Dimensions								
Nominal Length	**"A" Housing Length**		*** "B" (Ref.) End Suspensions**		**"C" Mid. Suspension**		**"D" Feed Location**	
	Feet/Inch	**MM**	**Feet/Inch**	**MM**	**Feet/Inch**	**MM**	**Feet/Inch**	**MM**
01 (1ft.)	1' - 1⁄4"	311	0' - 2 1⁄8"	54	0' - 8"	203	0' - 1 1⁄8"	29
02 (2ft.)	2' - 1⁄4"	616	0' - 2 1⁄8"	54	1' - 8"	508	0' - 1 1⁄8"	29
03 (3ft.)	3' - 1⁄4"	921	0' - 3 1⁄8"	79	2' - 6"	762	0' - 2 1⁄8"	54
04 (4ft.)	4' - 1⁄4"	1226	0' - 3 1⁄8"	79	3' - 6"	1067	0' - 2 1⁄8"	54
05 (5ft.)	5' - 1⁄4"	1530	0' - 3 1⁄8"	79	4' - 6"	1372	0' - 2 1⁄8"	54
06 (6ft.)	6' - 1⁄4"	1835	0' - 3 1⁄8"	79	5' - 6"	1676	0' - 2 1⁄8"	54
07 (7ft.)	7' - 1⁄4"	2140	0' - 3 1⁄8"	79	6' - 6"	1981	0' - 2 1⁄8"	54
08 (8ft.)	8' - 1⁄4"	2445	0' - 3 1⁄8"	79	7' - 6"	2286	0' - 2 1⁄8"	54
09 (9ft.)	9' - 1⁄4"	2750	0' - 3 1⁄8"	79	8' - 6"	2591	0' - 2 1⁄8"	54
10 (10ft.)	10' - 1⁄4"	3054	0' - 3 1⁄8"	79	9' - 6"	2896	0' - 2 1⁄8"	54
11 (11ft.)	11' - 1⁄4"	3359	0' - 3 1⁄8"	79	10' - 6"	3200	0' - 2 1⁄8"	54
12 (12ft.)	12' - 1⁄4"	3664	0' - 3 1⁄8"	79	11' - 6"	3505	0' - 2 1⁄8"	54

*Dimension(s) rounded to the nearest 1⁄16" with a ± 1⁄16" (1mm) tolerance.

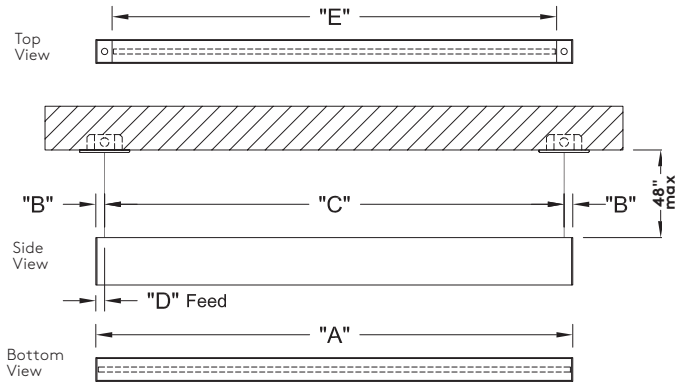
L60 Cable (C) Suspension Detail
(Feed location(s) only)



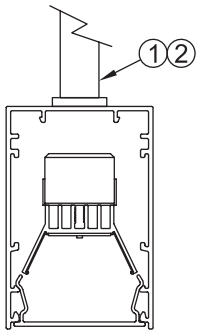
L60 Cable (C) Suspension Detail
(Non-Feed location(s) only)



Stem Mounting (S and RS)



Stem Mounting (S and RS)

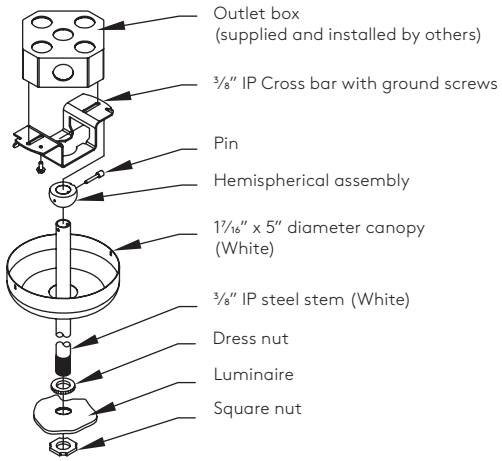


1. Ø ⅝" Swivel Stem provides 30° swivel and **can be cut in field** (48" max. from ceiling to luminaire).
2. Ø ⅝" Rigid Stem is fixed and is **not able to be cut/adjusted in field** (48" max. from ceiling to luminaire).

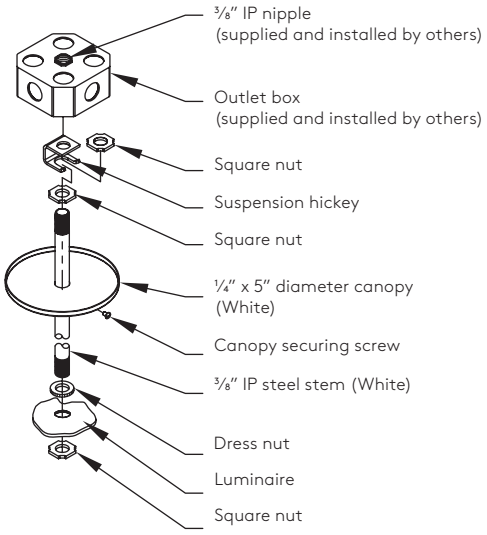
Swivel (S) & Rigid Stem (RS) Mountings - Dimensions								
Nominal Length	**"A" Housing Length**		*** "B" (Ref.) End Suspensions**		**"C" Mid. Suspension**		**"D" Feed Location**	
	Feet/Inch	**MM**	**Feet/Inch**	**MM**	**Feet/Inch**	**MM**	**Feet/Inch**	**MM**
01 (1ft.)	1' - ¼"	311	0' - 2 ⅛"	54	0' - 8"	203	0' - 2 ⅛"	54
02 (2ft.)	2' - ¼"	616	0' - 2 ⅛"	54	1' - 8"	508	0' - 2 ⅛"	54
03 (3ft.)	3' - ¼"	921	0' - 3 ⅛"	79	2' - 6"	762	0' - 3 ⅛"	79
04 (4ft.)	4' - ¼"	1226	0' - 3 ⅛"	79	3' - 6"	1067	0' - 3 ⅛"	79
05 (5ft.)	5' - ¼"	1530	0' - 3 ⅛"	79	4' - 6"	1372	0' - 3 ⅛"	79
06 (6ft.)	6' - ¼"	1835	0' - 3 ⅛"	79	5' - 6"	1676	0' - 3 ⅛"	79
07 (7ft.)	7' - ¼"	2140	0' - 3 ⅛"	79	6' - 6"	1981	0' - 3 ⅛"	79
08 (8ft.)	8' - ¼"	2445	0' - 3 ⅛"	79	7' - 6"	2286	0' - 3 ⅛"	79
09 (9ft.)	9' - ¼"	2750	0' - 3 ⅛"	79	8' - 6"	2591	0' - 3 ⅛"	79
10 (10ft.)	10' - ¼"	3054	0' - 3 ⅛"	79	9' - 6"	2896	0' - 3 ⅛"	79
11 (11ft.)	11' - ¼"	3359	0' - 3 ⅛"	79	10' - 6"	3200	0' - 3 ⅛"	79
12 (12ft.)	12' - ¼"	3664	0' - 3 ⅛"	79	11' - 6"	3505	0' - 3 ⅛"	79

*Dimension(s) rounded to the nearest 1⁄16" with a ± 1⁄16" (1mm) tolerance.

L60 Swivel Stem (S) Suspension Detail
(feed wires through stem supplied by Selux)

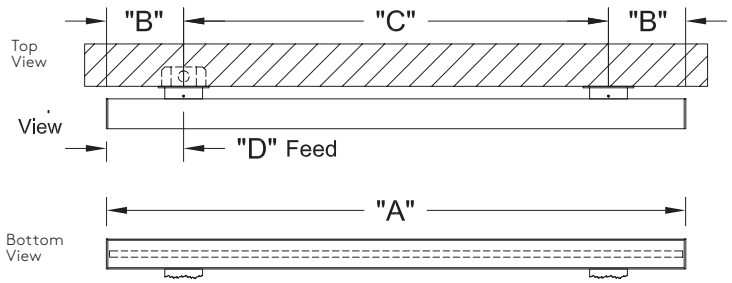


L60 Rigid Stem (RS) Suspension Detail
(feed wires through stem supplied by Selux)



Wall Mounting (W)

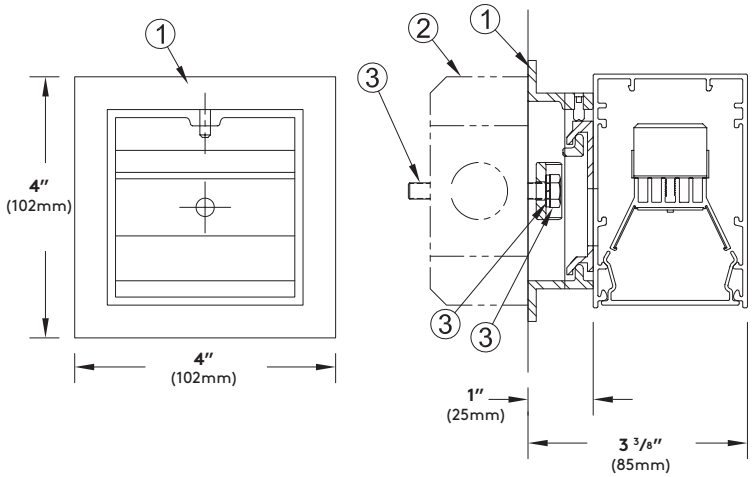
For patterns and configurations that include a wall mount, please see page 12 for details



Wall (W) Mount - Dimensions								
Nominal Length	**"A" Housing Length**		*** "B" (Ref.) End Suspensions**		**"C" Mid. Suspension**		**"D" Feed Location**	
	Feet/Inch	**MM**	**Feet/Inch**	**MM**	**Feet/Inch**	**MM**	**Feet/Inch**	**MM**
01 (1 ft.)	1' - ¼"	311	6⅛"	156	N/A		0 - 6⅛"	156
02 (2 ft.)	2' - ¼"	616	3⅛"	79	1' - 0"	458	0 - 3⅛"	79
03 (3 ft.)	3' - ¼"	921	6⅛"	156	2' - 6"	610	0 - 6⅛"	156
04 (4 ft.)	4' - ¼"	1226	6⅛"	156	3' - 0"	914	0 - 6⅛"	156
05 (5 ft.)	5' - ¼"	1530	6⅛"	156	4' - 0"	1219	0 - 6⅛"	156
06 (6 ft.)	6' - ¼"	1835	6⅛"	156	5' - 0"	1524	0 - 6⅛"	156
07 (7 ft.)	7' - ¼"	2140	6⅛"	156	6' - 0"	1829	0 - 6⅛"	156
08 (8 ft.)	8' - ¼"	2445	6⅛"	156	7' - 0"	2134	0 - 6⅛"	156
09 (9 ft.)	9' - ¼"	2750	6⅛"	156	8' - 0"	2438	0 - 6⅛"	156
10 (10 ft.)	10' - ¼"	3054	6⅛"	156	9' - 0"	2743	0 - 6⅛"	156
11 (11 ft.)	11' - ¼"	3359	6⅛"	156	10' - 0"	3048	0 - 6⅛"	156
12 (12 ft.)	12' - ¼"	3664	6⅛"	156	11' - 0"	3353	0 - 6⅛"	156

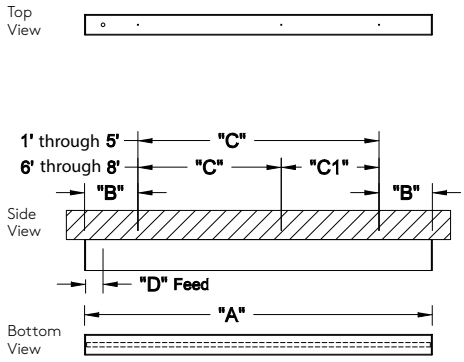
*Dimension(s) rounded to the nearest 1⁄16" with a ± 1⁄16" (1mm) tolerance.

Wall Mount (W)
(Covers a 4x4 or 2x4 J-Box)

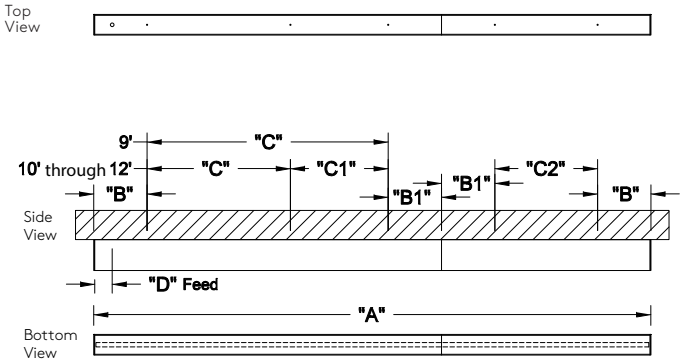


1. Aluminum wall bracket (by Selux).
2. 4"x4" or 2"x4" J-Box at feed location (supplied and installed by others).
3. ¼"-20 Threaded rod, ¼"-20 lock washer and ¼"-20 nut required to anchor the wall bracket. Mounting hardware supplied and installed to code by others.

Surface Mounting (F) - 1′ to 8′



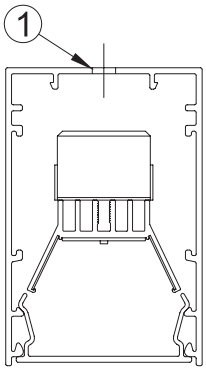
Surface Mounting (F) - Over 9′ to 12′



Surface Mount (FF, F2, & F4) - Dimensions														
Nominal Length	**"A" Housing Length**		*** "B" (Ref.) End Suspensions**		*** "B1" End Suspensions**		**"C" Mid. Suspension**		**"C1" Mid. Suspension**		**"C2" Mid. Suspension**		**"D" Feed Location**	
	Feet/Inch	**MM**	**Feet/Inch**	**MM**	**Feet/Inch**	**MM**	**Feet/Inch**	**MM**	**Feet/Inch**	**MM**	**Feet/Inch**	**MM**	**Feet/Inch**	**MM**
01 (1 ft.)	1' - ¼"	311	- 1⅝"	41	N/A		0' - 9"	229	N/A		N/A		0' - 4⅛"	105
02 (2 ft.)	2' - ¼"	616	0' - 1⅝"	41	N/A		1' - 9"	533	N/A		N/A		0' - 4⅛"	105
03 (3 ft.)	3' - ¼"	921	0' - 6⅛"	156	N/A		2' - 0"	610	N/A		N/A		0' - 2⅛"	54
04 (4 ft.)	4' - ¼"	1226	0' - 6⅛"	156	N/A		3' - 0"	914	N/A		N/A		0' - 2⅛"	54
05 (5 ft.)	5' - ¼"	1530	0' - 6⅛"	156	N/A		4' - 0"	1219	N/A		N/A		0' - 2⅛"	54
06 (6 ft.)	6' - ¼"	1835	0' - 6⅛"	156	N/A		3' - 0"	914	2' - 0"	610	N/A		0' - 2⅛"	54
07 (7 ft.)	7' - ¼"	2140	0' - 6⅛"	156	N/A		3' - 0"	914	3' - 0"	914	N/A		0' - 2⅛"	54
08 (8 ft.)	8' - ¼"	2445	0' - 6⅛"	156	N/A		3' - 0"	914	4' - 0"	1219	N/A		0' - 2⅛"	54
09 (9 ft.)	9' - ¼"	2750	0' - 6⅛"	156	0' - 6"	152	4' - 0"	1219	N/A		3' - 0"	914	0' - 2⅛"	54
10 (10 ft.)	10' - ¼"	3054	0' - 6⅛"	156	0' - 6"	152	3' - 0"	914	2' - 0"	610	3' - 0"	914	0' - 2⅛"	54
11 (11 ft.)	11' - ¼"	3359	0' - 6⅛"	156	0' - 6"	152	3' - 0"	914	3' - 0"	914	3' - 0"	914	0' - 2⅛"	54
12 (12 ft.)	12' - ¼"	3664	0' - 6⅛"	156	0' - 6"	152	3' - 0"	914	4' - 0"	1219	3' - 0"	914	0' - 2⅛"	54

*Dimension(s) rounded to the nearest 1/16" with a ± 1/16" (1mm) tolerance.

Surface Mount (F)



***Please note: Fixture does not cover a 4x4 J-box**

1. Ø 5/16" Mounting hole drilled at the factory (mounting hardware to code by others).

0-10V linear dimming (DIM)
Luminaires supplied with drivers offering the capability of either normal switched operation of 0-10V dimming for linear dimming curve. Fixtures ship wired for dimming. For on/off functionality, simply cap the dimming leads. Minimum dimming level preset at factory to 1%. (Due to size constraints, 1' luminaires are supplied with a driver from a different manufacturer than 2' and above luminaires. For details, please consult factory).

0-10V logarithmic eldoLED ECOdrive dimming (DIL)
Luminaires supplied with drivers offering the capability of either normal switched operation of 0-10V dimming for logarithmic dimming curve, Fixtures shipped wired for dimming. For on/off functionality, simply cap the dimming leades. Minimum dimming level preset at factory to 1%.

eldoLED ECOdrive DALI dimming (DED)
Luminaires supplied with ECOdrive DALI dimming driver with logarithmic dimming curve. Minimum dimming level preset at factory to 1%. For "dim to dark" (down to 0.1%), please consult factory.

eldoLED SOLOdrive 0-10V linear dimming (D01)
Luminaires supplied with SOLOdrive 0-10V dimming driver with linear dimming curve. Minimum dimming level preset at factory to 0.1% and "dim to dark".

eldoLED SOLOdrive 0-10V logarithmic dimming (DL01)
Luminaires supplied with SOLOdrive 0-10V dimming driver with logarithmic dimming curve. Minimum dimming level preset at factory to 0.1% and "dim to dark".

LUTRON 2-wire dimming (DC2)
Luminaires supplied with Hi-Lume 2-wire dimming driver (120V only) programmed for Constant Current Reduction (CCR). For Pulse Width Modulation (PWM) dimming, please consult factory. Minimum dimming level down to 1%.

LUTRON EcoSystem dimming (DE1/DC5)
Luminaires supplied with Hi-Lume EcoSystem (4 wire, digital link) dimming driver programmed for Constant Current Reduction (CCR). Minimum dimming level down to 1% (DE1) with SoftOn/FadeToBlack or 5% (DC5).

* For control recommendations, please contact driver manufacturer.

<table>
<tr><td colspan="13">Driver Quantity</td></tr>
<tr><td rowspan="2">Light Engine</td><td rowspan="2">Dimming Code</td><td colspan="11">Length</td></tr>
<tr><td>1ft</td><td>2ft</td><td>3ft</td><td>4ft</td><td>5ft</td><td>6ft</td><td>7ft</td><td>8ft</td><td>9ft</td><td>10ft</td><td>11ft</td><td>12ft</td></tr>
<tr><td rowspan="4">1C20</td><td>DIM/DIL</td><td rowspan="16">N/A</td><td colspan="7" rowspan="3">1</td><td rowspan="3">2</td><td colspan="2" rowspan="3">2</td><td rowspan="3">1</td></tr>
<tr><td>D01/DL01/DED</td></tr>
<tr><td>DE1/DC5</td></tr>
<tr><td>DC2</td><td>3</td><td colspan="2">3</td><td>2</td></tr>
<tr><td rowspan="4">1C25</td><td>DIM/DIL</td><td colspan="5" rowspan="3">1</td><td colspan="2" rowspan="2">1</td><td rowspan="3">2</td><td colspan="2" rowspan="3">2</td><td rowspan="3">1</td></tr>
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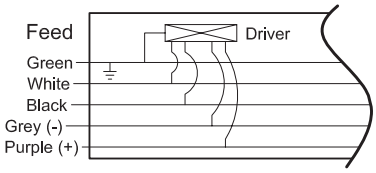
<tr><td>D01/DL01/DED</td></tr>
<tr><td>DE1/DC5</td></tr>
<tr><td>DC2</td><td colspan="3">2</td><td>3</td><td colspan="2">3</td><td>3</td></tr>
<tr><td rowspan="4">1C35</td><td>DIM/DIL</td><td>1</td><td colspan="4" rowspan="3">1</td><td rowspan="3">1</td><td>2</td><td rowspan="3">1</td><td rowspan="3">2</td><td colspan="2" rowspan="3">2</td><td rowspan="3">2</td></tr>
<tr><td>D01/DL01/DED</td><td rowspan="15">N/A</td><td rowspan="2">1</td><td>1</td></tr>
<tr><td>DE1/DC5</td><td>2</td></tr>
<tr><td>DC2</td><td colspan="2">2</td><td>2</td><td>3</td><td colspan="2">3</td><td>3</td></tr>
<tr><td rowspan="4">1C40</td><td>DIM/DIL</td><td colspan="3" rowspan="2">1</td><td rowspan="2">1</td><td>2</td><td colspan="3" rowspan="2">2</td><td colspan="2" rowspan="2">3</td></tr>
<tr><td>D01/DL01/DED</td><td>1</td></tr>
<tr><td>DE1/DC5</td><td colspan="9">N/A</td></tr>
<tr><td>DC2</td></tr>
<tr><td rowspan="4">1C45</td><td>DIM/DIL</td><td colspan="3" rowspan="2">1</td><td>2</td><td rowspan="2">1</td><td colspan="2" rowspan="2">2</td><td rowspan="2">3</td><td rowspan="2">2</td><td colspan="2" rowspan="2">3</td></tr>
<tr><td>D01/DL01/DED</td><td>1</td></tr>
<tr><td>DE1/DC5</td><td colspan="9" rowspan="2">N/A</td></tr>
<tr><td>DC2</td></tr>
</table>

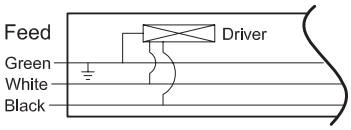
Wiring Diagrams

Standard Wiring supplied for all drivers.	Green = Ground White = Neutral Black = Hot
- The following wire(s) are in addition to the standard above -	
DIM, DIL, DED D01, DL01	Gray = (-) DALI or 0-10V Dimming Control Purple = (+) DALI or 0-10V Dimming Control
DC2	No additional wires
DE1, DC5	Violet = "E1" Digital Link Dimming Control Violet/White = "E2" Digital Link Dimming Control

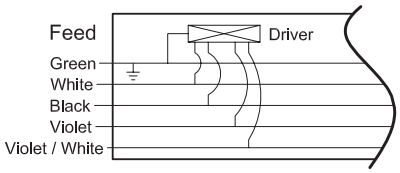
0-10V linear (DIM)
0-10V logarithmic eldoLED Ecodrive (DIL)
DALI logarithmic eldoLED ECOdrive (DED)
0-10V linear eldoLED SOLOdrive (D01)
0-10V logarithmic eldoLED SOLOdrive (DL01)



Lutron 2-Wire (DC2)

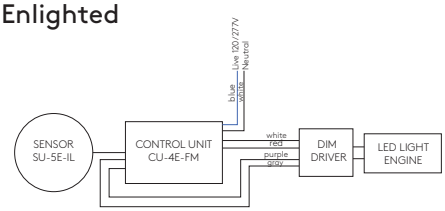


Lutron EcoSystem (DE1)
Lutron 5-Series (DC5)

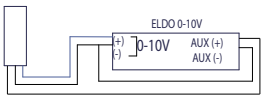


Sensor Wiring Diagrams

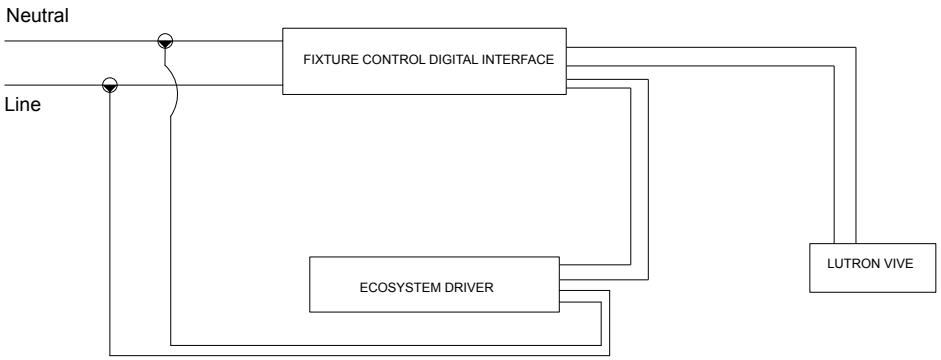
Enlighted



Sensor Switch



Lutron Vive



Driver power chart - use below values to determine the nominal watts per foot based on driver, light engine, and voltage.
* Driver losses increase the wattage for fixtures less than 4 foot.
** Values are nominal values determined based on multiple tested fixtures.

Driver Power Usage				
Driver	**Light Engine**	**Nominal W/ft**		
		120V	**277V**	**347V**
DIM, DIL, DED, D01, DL01	1C20	4.9	5.3	n/a
	1C25	6.1	6.5	
	1C30	7.3	7.7	
	1C35	8.7	8.9	
	1C40	9.9	10.1	
	1C45	11.1	11.3	
DC2, DE1, DCE, DC5, DC3	1C20	5.5	5.2	n/a
	1C25	6.7	6.3	
	1C30	8.0	7.6	
	1C35	9.3	8.8	
	1C40	10.6	10.0	
	1C45	11.6	11.3	
DIM @347V	1C20	n/a	n/a	5.4
	1C25			6.5
	1C30			7.7
	1C35			8.8
	1C40			10.0
	1C45			11.2
EM	all	6		n/a

Fuse (FS) - Fusing, luminaires supplied with a in-line fuse located on the hot wire for each feed (Supplied with an 8A slow burn fuse).

Damp Location (DL) - Luminaires are suitable for use in damp location(s). Examples of such locations include protected areas under canopies, marquees, roofed porches, and similar locations where the fixture(s) are protected from direct contact with rain, snow, or excessive moisture (such as ocean spray). Interior locations include areas subject to moderate degrees of moisture, such as basements and certain barns and cold storage buildings.

* For Damp Location with sensors, please consult factory.

Separate Switching (SS) - Luminaires available with separately switched 4' (nominal) sections starting at 7' and up. Luminaire is intended to be wired to the same panel/breaker (not intended for Emergency use).

* All separately switched (non-EM) circuits within an individual luminaire, linear run, or configuration must be connected to the same branch circuit on-site.

* To specify this option, the number of separately switched sections and locations of these sections must be provided at time of order.

* If the project requires different separate switching than outlined above please consult the factory.

* For Separate Switching with sensors, please consult factory.

Emergency Wiring (EC) - Luminaires with (EC) option are compliant to UL 924 listed emergency luminaire. EC luminaires are intended to be wired to separate panels/breakers for emergency use. See install instructions for proper wiring.

For 1' to 6' nominal luminaires, the entire fixture is wired for operation on emergency circuit.

For 7' and up nominal luminaires, the first 4' nominal length is wired for operation by a separate EM circuit by default to meet the required "Life Safety Code" (NFPA 101).

If a different configuration is needed, please consult factory.

Note: Wiring may vary slightly due to on-site conditions or local codes. Please follow all safety installation protocols contained within install instructions when installing luminaire.

Emergency Battery (EM) – Luminaires with emergency battery (EM) option are compliant to UL 924 listed emergency luminaire. The EM battery is located integral to fixture and is factory pre-wired. See install instructions for proper wiring.

In the event of an emergency, EM battery will illuminate a 4' section at 12W (constant) for 90 minutes at 25°C. Recharge time is 24 hours.

Direct fixtures are available for emergency battery (EM) use in 4' and ≥6. Due to size constraints, EM is not available in 5' fixtures.

For individual fixtures, emergency option will illuminate the first 4' section of fixture. For continuous runs, please consult factory to advise on 4' section intended for emergency use. For fixtures >12' or if a different configuration is needed, please consult factory.

Emergency test switch and plate is a non-illuminated 3" blank section located adjacent to the length of fixture wired for emergency.

* Emergency battery option is UNV for use with 120V or 277V and is not available for 347V.

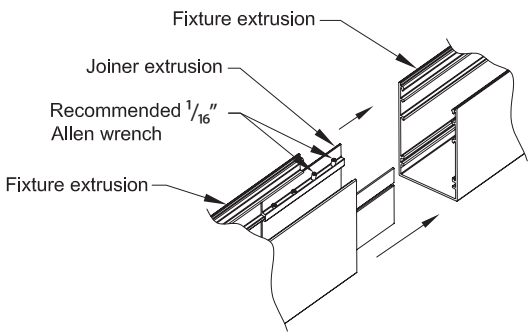
* Please note battery pack requires an unswitched hot.

* For EM with sensors, please consult factory.

* If a different configuration is needed, please consult factory.

Note: Wiring may vary slightly due to on-site conditions or local codes. Please follow all safety installation protocols contained within install instructions when installing luminaire.

Joiner System - standard for Runs and Configurations



Sensor Ordering Chart		
Quantity	**Sensor**	**Settings***
x Number of Sensors	**E** Enlighted SU-5E-IL **S** Sensor Switch MSD EZ **V** Lutron Vive DFCSJ	**1** Daylight **2** Occupancy/Vacancy **3** Daylight/Occupancy/Vacancy * Settings not available with Enlighted

Enlighted SU-5E-IL (E)
Enlighted Micro Sensor SU-5E-IL (Independent Lighting) provided as standard with an Enlighted CU-4E-FM Fixture Mount Control Unit integral to fixture. If SU-5E-CL (Connected Lighting) or SU-5E-IoT (Internet of Things) is desired, please contact factory. Occupancy/vacancy, thermal, daylight sensing plus Tunable White, Room & Zone control, Internet of Things (IoT) data collection and reporting control. For full details, please see SU-5E-(IoT/CL/IL) spec sheet on the Enlighted website. Must be paired with a 0-10V driver with auxiliary (DIM driver selection). Commissioning by Enlighted.

*Sensor can control up to 5 drivers. Please refer to driver quantity chart on page 7. Multiple sensors may be required for longer lengths.

Sensor Switch MSD EZ (S)
Occupancy/vacancy and daylight harvesting. For full functionality and programming options, select settings option 3. If a different settings option is selected, other settings may be unavailable. For full details, please see MSD EZ spec sheets on the Sensor Switch website. Must be paired with DIM driver selection. Manual control of dimming not available with MSD EZ sensor.

*Sensor can control up to 30 drivers. Please refer to driver quantity chart on page 7. Multiple sensors may be required for longer lengths.

Lutron Vive DFCSJ (V)
The DFCSJ-OEM-OCC provides the capabilities of daylight harvesting and occupancy/vacancy sensing. When integrated with the DFC-OEM-DBI (Fixture Contril Digital Link Interface), the sensor is wirelessly compatible with the DE1 Lutron EcoSystem driver. Commissioning bt certified Lutron technician.

*Vive DFCSJ sensor can control up to a maximum of five (5) drivers per sensor. Please refer to driver chart on page 7. Multiple sensors may be required for longer lengths.

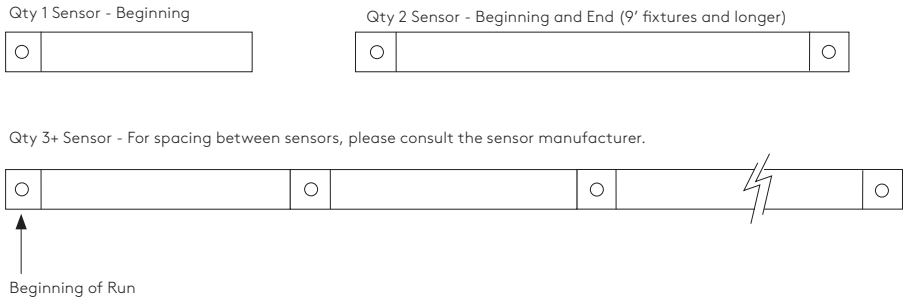
	Occupancy	Vacancy	Daylight Harvesting	Driver Compatibility
Enlighted SU-5E-IL (E)	√	√	√	DIM
Sensor Switch MSD EZ (S)	√	√	√	DIM
Lutron Vive DFCSJ (V)	√	√	√	DE1

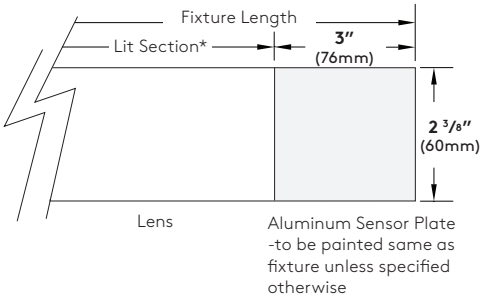
Please contact controls manufacturer for details prior to specifying.

Factory Presets - Sensors come from the sensor manufacturer with factory presets for each of the settings in above chart. Please see sensor manufacturers' spec sheets for details on presets and re-programming.

Commissioning - Commissioning of sensors and installation by others. Contact sensor manufacturer for details and costs associated with commissioning the system prior to specification of sensors.

Standard Sensor Placement - for other placement options, please consult factory. For functionality and limitations, please see sensor details above.





*Lit section will be the fixture length minus 3" for sensor plate.

Notes: 1. For spacing between sensors, please consult the sensor manufacturer.
2. Exact sensor placement and coverage will be defined by approved factory drawing.
3. Sections controlled by sensors may not be symmetrical - consult factory for layout.

Standard Direct shapes/configurations:

Listed below are the minimum lengths and details for standard shapes. These standard shapes can be combined with each other and/or the standard luminaire lengths, ensuring full even illumination. If you have any questions, please consult the factory.

The minimum standard lengths for "L" shapes:
- L9 or V9 open shapes is 4' x 4' nominal (example: leg, 90, leg)
- L9 or V9 closed shapes is 6' x 6' nominal (example: 90, leg, 90)
(Exception is that the L9 and V9's can be joined directly to provide a 4' x 4' nominal shape)

*For sensors in configurations, please consult factory.

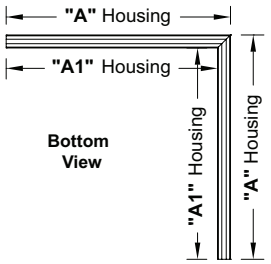
For patterns and configurations that are to include a wall mounted option, please consult the factory to identify location, on which side of housing and spacing of brackets required.

The minimum standard lengths for "T" and "X" shapes:
- T9 = 4' nominal on the short leg and 8' nominal on the long side
- X9 = 8' nominal for either direction

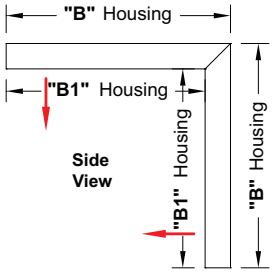
Project Specific Direct shapes/configurations:

Selux is capable of supplying a wide range of project solutions including different shapes, angles, and sizes to meet the project requirements. Due to the complex nature of these project specific layout(s) we ask that you please consult the factory with the project requirements for review.

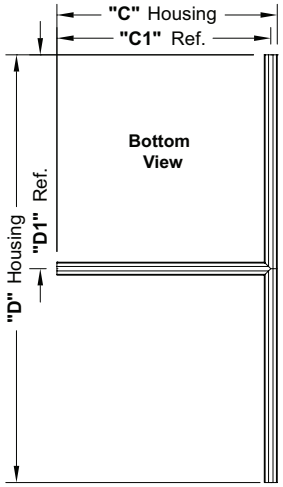
L9 - Lit Horizontal corner



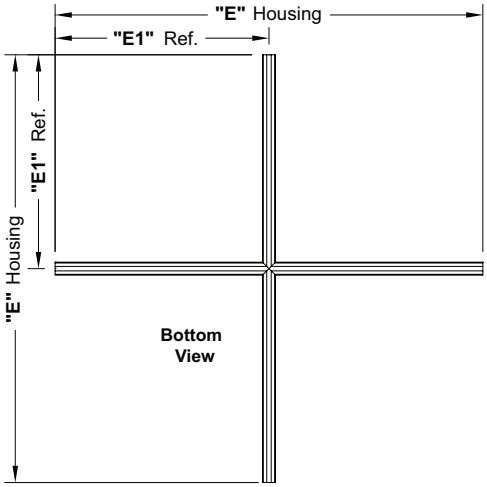
V9 - Lit Inside corner



T9 - Lit "T" section



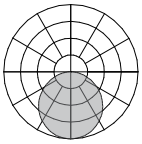
X9 - Lit "X" section



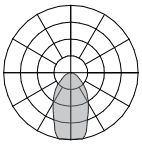
Direct Lit Corner and Section - Dimensions								
	L9		V9		T9		X9	
	Feet/Inch	MM	Feet/Inch	MM	Feet/Inch	MM	Feet/Inch	MM
"A" Housing (Outside)	2' - 1¼"	642						
"A1" Housing (Inside)	1' - 10 15/16"	582						
"B" Housing (Outside)			2' - 3 1/16"	688				
"B1" Housing (Inside)			1' - 11½"	597				
"C" Housing					2' - 1¼"	642		
* "C1" Ref.					2' - ⅛"	612		
"D" Housing					4' - 3/16"	1224		
* "D1" Ref.					2' - ⅛"	612		
"E" Housing							4' - 3/16"	1224
* "E1" Ref.							2' - ⅛"	612

*Dimension(s) rounded to the nearest 1/16" with a ± 1/16 (1mm) tolerance.

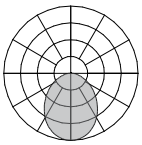
Photometry



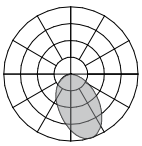
LW - LED Optimized White Lens				
Light Engine	Lumens per 4 foot	Lumens per foot	Input watts per foot	lm/W
1C35	2804	701	8.9	79



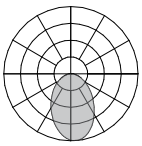
MI - Clear Lens with Microprism Inlay				
Light Engine	Lumens per 4 foot	Lumens per foot	Input watts per foot	lm/W
1C35	3251	813	8.9	92



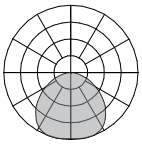
NB - LMO Symmetric				
Light Engine	Lumens per 4 foot	Lumens per foot	Input watts per foot	lm/W
1C35	3002	751	8.9	85



A2 - LMO Asymmetric 20° Wall Washer				
Light Engine	Lumens per 4 foot	Lumens per foot	Input watts per foot	lm/W
1C35	3032	758	8.9	86



A5 - LMO Asymmetric 5° Wall Grazer				
Light Engine	Lumens per 4 foot	Lumens per foot	Input watts per foot	lm/W
1C35	2807	702	8.9	79



BW - LMO Batwing				
Light Engine	Lumens per 4 foot	Lumens per foot	Input watts per foot	lm/W
1C35	3926	982	8.9	111

M60 Direct	
CCT Multiplier	
4000K	1.05
3500K	1.00
3000K	0.96
2700K	0.92
CRI Multiplier	
90+ CRI	1.00
80+ CRI	1.19
Lens Multiplier	
LW	1.00
MI	1.02
NB	1.22
A2	1.26
A5	1.26
BW	1.00

CCT and CRI multipliers apply to the photometry, IES files, and per foot values listed on page 1 (light engine).

Lens multipliers supplied for per foot values listed on page 1 (light engine).

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LT-13A

2L-W-D

MOD™ 2 LED Wall Direct

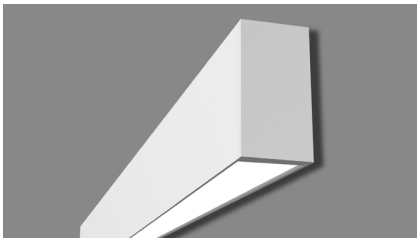
Fixture Type:

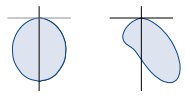
Project Name:

Ordering Guide

Feature	Code	Options	Description
Series		2L	MOD
Mounting		W	Wall
Fixture distribution		D AD	Direct Asymmetric Direct
Row length (in feet)		___'	Enter in foot increments. Note fixture lengths below.
Max length in row		02 03 04 05 06 08	2', 609mm 3', 914mm 4', 1219mm 5', 1524mm 6', 1829mm 8', 2438mm
Downlight diffuser		SOF REG BWO ASYM DRP	Soft Diffuse Lens Regressed Diffuse Lens* Blade Baffle with Overlay* Asymmetric Diffuser Lens*/** Drop Lens*+ *Not Available with Patterns **Must be ordered with AD
Finish/Color		C1 C2 C3 C4 C5 C6 CC	Matte White (Default) Textured Matte White Light Silver Machined Aluminum Carbon Black Textured Camera Black Custom Color
Color temperature		27K 30K 35K 40K 50K 27K9 30K9 35K9 40K9 50K9 2230TD 2750T 2765T	2700K + 3000K 3500K 4000K 5000K+ 2700K, 90 CRI+ 3000K, 90 CRI 3500K, 90 CRI 4000K, 90 CRI 5000K, 90 CRI+ 2200K-3000K SpectraSync™ Dim-to-Warm* 2700K-5000K SpectraSync™ Tunable White* 2700K-6500K SpectraSync™ Tunable White* *Must be ordered with D05 Driver option; excludes 2' lengths and patterns
Direct output/ft *(specifiable in 50 lumens/ft increments)*		D030 D100	300 1000
Driver		NDM D05 D01 DS1 D00 DS0 LEC DALI DALIP	Non Dimming 5% Dimming, 0-10V 1% Dimming, 0-10V Soft-Start 1% Dimming, 0-10V Dim-to-off (1%), 0-10V Soft-Start Dim-to-off (1%), 0-10V Hi-lume 1% EcoSystem LED driver DALI+ Powered DALI (2.0)+ *Must be ordered with 2230TD, 2750T or 2765T Option

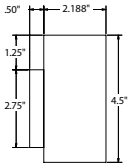
+ Additional lead time may be applicable. Contact factory.





SOF/REG/
BWO/DRP

ASYM



Key Features

- Variable Intensity technology provides specifiable lumen output/wattage
- End cap design eliminates visible diffuser seams/gaps
- 2 SDCM color variation

Performance

Nomenclature	Lumens/ft	W/ft	Efficacy
D030 (min)	300	2.9	102
D050	500	5.2	96
D085	850	8.6	99
D100 (max)	1000	12.1	91
(wattage may vary up to 5% from published)			

+ Additional lead time may be applicable. Contact factory.

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HUBBELL Lighting

Ordering Guide (continued)

Circuiting		1C	1 Circuit
Voltage		UNV 347	Universal Voltage (120V through 277V 347 Volt*+ *Excludes Emergency Battery Pack 'EF' Option. Excludes DALI, DALIP and Lutron (LEC) Dimming Drivers
Optional Features	**Code**	**Options**	**Description**
Nightlight		NL	Nightlight Circuit Required. Enter quantity. 2NL = 2 nightlight circuits/row
Emergency		EF	10W Emergency Battery Backup Enter quantity. 2EF=F Emergency batteries/row. See Details for restrictions.
Thru-wiring		W1 W2 W3	No Thru Wire Provide Normal and Emergency/Nightlight Thru Wiring* Provide Normal Thru Wiring Only *Only applicable when specified with Emergency/Nightlight
Patterns+*		C90L C120L C135L	Illuminated 90° corner Illuminated 120° corner Illuminated 135° corner *Contact Factory for pattern configurations. Approval drawings required. See page 5.
Control Options	**Code**	**Options**	**Description**
NX*+		NXE NXWE NXES NXS NXSW NXWD NXSWD	NX Enabled, Dual SmartPorts NX Wireless Enabled NX Enabled, Dual SmartPorts, PIR Occupancy Sensor, Dimming Daylight Harvesting NX, PIR Occupancy Sensor, Dimming Daylight Harvesting (standalone) NX Wireless, PIR Occupancy Sensor, Dimming Daylight Harvesting NX Wireless Enabled, Dual SmartPORTs NX Wireless, PIR Occupancy Sensor, Dimming Daylight Harvesting, Dual SmartPORTs *Not available for row mounting; Only available with 0-10V Driver options; Contact factory for Length restrictions *Only available in 4'+
Sensors*+		SD1 SO1	Daylight Sensor Required. Enter quantity. 2SD1= 2 daylight sensors/row Occupancy Sensor Required. Enter quantity. 2SO1= 2 occupancy sensors/row *Only available in 4'+

+ Additional lead time may be applicable. Contact factory.

2L-W-D
MOD™ 2 LED Wall Direct

Output Restrictions

Driver options listed below are not available for the output and length as shown

Restrictions-Direct		Output						
		300	350	400	450	500	950	1000
Length (feet)	2	LEC, DALI, 347V	LEC, DALI, 347V	DALI, 347V	DALI, 347V	DALI, 347V	LEC	LEC
	3	DALI, 347V	DALI, 347V				LEC	LEC
	4						LEC	LEC
	5						LEC	LEC
	6						LEC	LEC
	8						LEC	LEC

2L-W-D
MOD™ 2 LED Wall Direct

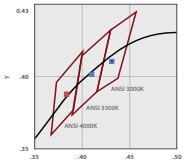
Details

Construction:
Housing- Extruded aluminum with extruded aluminum end headers/row joining brackets.
End caps- Die cast aluminum with magnetic interface. Overlaps diffuser at each fixture end to eliminate gaps/LED visibility.

Downlight diffuser:
SOF-Soft diffuse acrylic lens.
REG- ½" regressed softglo lens with painted steel inserts. Output multiplier (.77)
BWO- White blade baffle with softglo lens overlay. Output multiplier (.70)
ASYM- Highly transmissive diffuse acrylic lens with linear prisms.
DRP- ½" protruding soft diffuse lens.
Please see the installation instruction sheets for more details.

Finish/Color:
Visit www.litecontrol.com/finishes for details.

CCT:
27K-2700K output multiplier (0.95)
30K-3000K output multiplier (0.98)
35K-3500K output multiplier (1.00)*
40K-4000K output multiplier (1.03)
50K-5000K output multiplier (1.05)
27K9-2700K 90 CRI output multiplier (0.83)
30K9-3000K 90 CRI output multiplier (0.85)
35K9-3500K 90 CRI output multiplier (0.88)
40K9-4000K 90 CRI output multiplier (0.90)
50K9-5000K 90 CRI output multiplier (0.93)
*Scale all values from 35K



Color Variation:
2 step MacAdam ellipse

Output (VI technology):
Variable Intensity (VI) technology allows precise specification of fixture output/wattage. Fixture will be programmed and labeled to specification. Indirect and direct hemispheres can be independently specified. Specify each in 50 lumen increments/ft within the below range:

	Lumens/ft	Nomenclature
Direct		
Min:	300	D030
Max:	1000	D100

Driver:*
NDM: Non-dimming. Fixture will be wired for fixed light output.
D05: Osram 100%-5% dimming range, Fixture will be wired for low voltage 0-10V dimming control. Only applicable if either 2230TD, 2750T or 2765T is selected.
D01: 100%-1% dimming range. Fixture will be wired for low voltage 0-10V dimming control.
DS1: Soft-Start 100%-1% dimming range. Fixture will be wired for low voltage 0-10V dimming control.
D00: Dim-to-off 100%-1% Dimming range. Fixture will be wired for low voltage 0-10V dimming control.
DS0: Soft-Start Dim-to-off 100%-1% dimming range. Fixture will be wired for low voltage 0-10V dimming control.
LEC: Hi-Lume 1% EcoSystem LED Driver with Soft-on, Fade-to-Black dimming technology.
DALI: DALI compatible.
Driver* (continued):
DALIP: Self-Powered DALI bus (e.g. DEXAL)
*See driver limitations in Output Restrictions above.

Field Accessibility:
LED boards and drivers can be accessed and removed from fixture, while installed. Entire LED module can be removed and replaced.

Circuiting:
1C (1 Circuit) Fixture wired for a single circuit.

Nightlight:
See separate LC-Nightlight spec sheet for additional details.

Emergency:
EF-10W battery powered driver.
Provides a minimum of 90 minutes of emergency lighting.
Inverter-Compatible. Provided by others.
Available in 4'+ fixtures.

Thru wiring:
See separate LC-Thruwire spec sheet for additional details.

NX Distributed Intelligence: NX DISTRIBUTED INTELLIGENCE™
Supports indoor and outdoor applications, wired, wireless and hybrid networked NX lighting control deployments and enabled emerging applications, such as Hubbell Lighting's SpectraSync™ Color Tuning Technology.
See separate NX Application Guide for additional details.
See Hubbell Controls Solution NX Brochure.

Sensors:
SD1: Daylight sensor(Wattstopper part #FD301). Installs between diffusers.
SO1: Occupancy sensor(Wattstopper FS-305 with FS-L6 lens). Installs between diffusers.
NX: NX Sensors installs between diffusers.
See separate Control Options Guide for additional details.

SpectraSync™ Color Tuning Technology: SpectraSync™ Color Tuning Technology
Control your space based on the needs of the application, specific activities throughout the day and preferences of the occupants with two distinct SpectraSync™ Color Tuning Technology.
Dim to Warm: Dim to Warm mimics the familiar warming effect that occurs with traditional incandescent sources as they are dimmed. (Available with 2200K-3000K).
Tunable White: Tunable White offers users the ability to tailor CCT to their personal preference, enhancing task visibility, material and colors or the aesthetics of the space. (Available with 2700K-5000K or 2700K-6500K).
See separate SpectraSync™ Tech Sheet for additional details.
See separate NX™ Solutions Guide for additional details.

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2L-W-D

MOD™ 2 LED Wall Direct

Details (continued)

System Connectors:
90°, 120°, 135° illuminated corners available. One piece construction, ready to install, with diffusers that match adjoining fixtures. Corner system connectors must be used to form patterns. The length of each outside or inside lighted corner is 12".

Rated Life (LED Board):
Tested in accordance to LM79-2008 & derived from EPA TM-21 calculator
L70: >61,000 (reported per TM-21/LM80 6x's limitation)
L90: >61,000 (reported per TM-21/LM80 6x's limitation)
Driver: ≥50,000 hours (5 year Warranty)

Rated Life (Driver):
Standard = 100,000 hours
Lutron = 50,000 hours

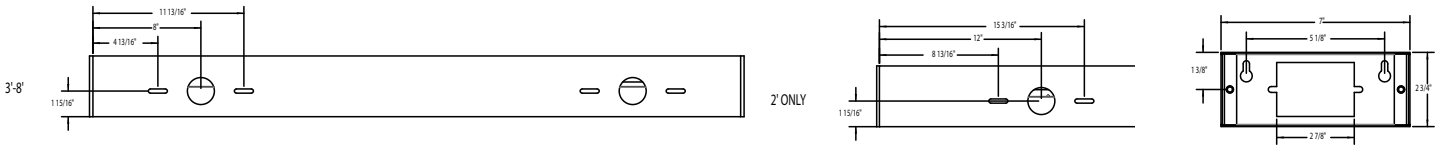
Fixture weight:
3 lbs/ft.

Ratings:
CSA listed for damp locations. IBEW. AF of L. UL924.
This product qualifies as a "designated country construction material" per FAR 52.225-11 Buy American-Construction. Materials under Trade Agreements effective 8/14/2020.
See Buy American Act Solutions. Contact factory for configurations including SpectraSync, EM, NX, or sensors.

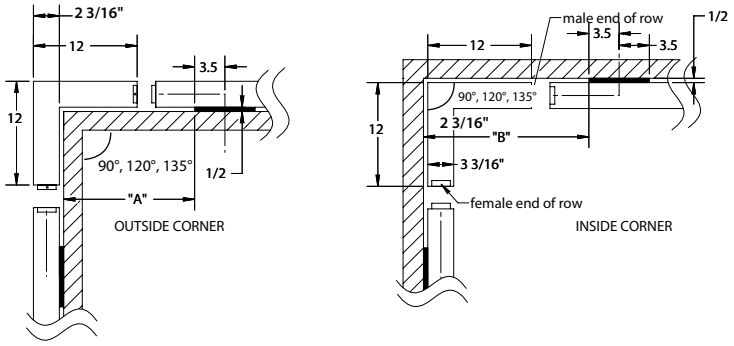
BUY AMERICAN SOLUTIONS
See Certification Specifications

Warranty:
LED Boards- 5 years
LED Drivers (Standard)- 5 years, Lutron- 3 years

Wall Mounting:



Patterns:



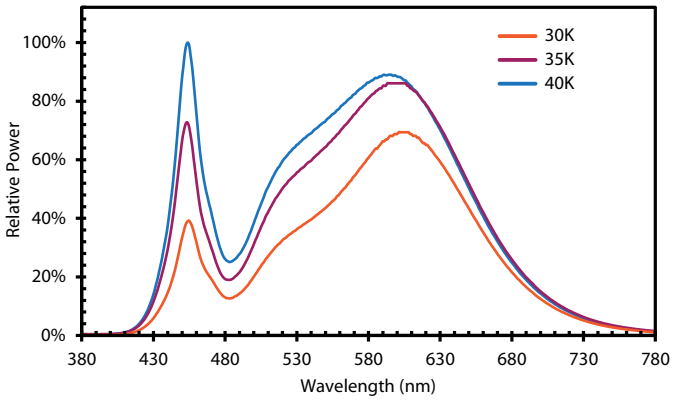
2L-W-D
MOD™ 2 LED Wall Direct

Details (continued)

Color Characteristics:

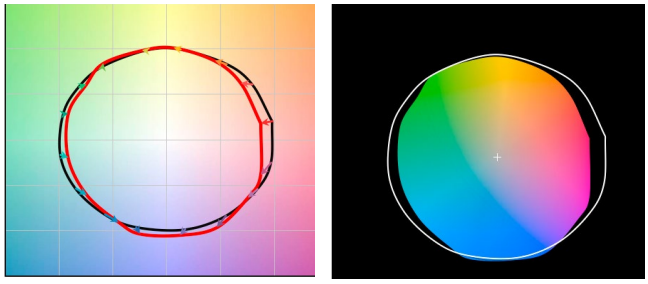
Value	Ordering Code		
	30K	35K	40K
Rf	83	82	82
Rg	96	96	96
CCT (K)	3009	3494	3975
Duv	-0.0009	-0.0004	-0.0003
x	0.435	0.4052	0.3814
y	0.4012	0.3898	0.3768
CIE Ra	83	83	84

Spectral Distribution:

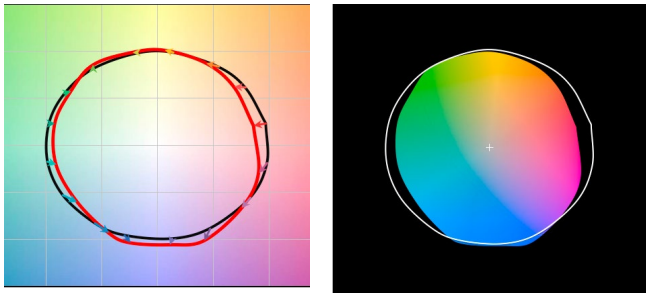


Color Vector Graphic:

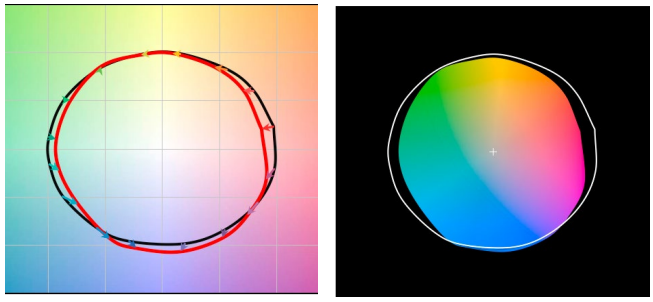
30K:



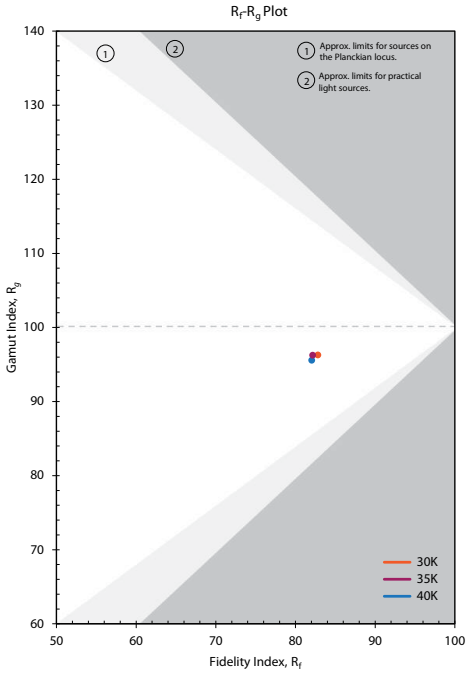
35K:



40K:



Color Gamut/Fidelity Plot



CRI:
80 minimum

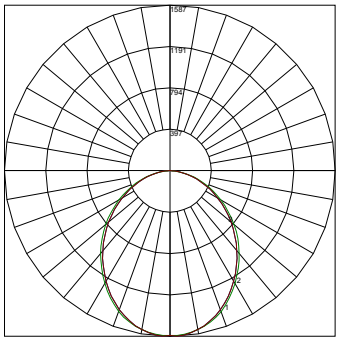
CCT	CRI	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14
30K	83	82	91	97	81	82	89	84	62	13	79	79	69	84	99
35K	83	81	89	95	81	81	85	86	65	13	73	79	62	83	97
40K	84	82	90	94	82	82	85	87	68	17	74	80	60	84	97

65 Spring Street Plympton, MA 02367 / Tel **781.294.0100** / Website **www.litecontrol.com**

2L-W-D
MOD™ 2 LED Wall Direct

Photometry

Fixture: 2L-W-D-XX-XX-SOF-CX-35K-D100
CCT: 3500K
Output: D100
Nominal lumens: 1000 lumens/ft
Efficacy: 95 lm/W
Test report:2L-W-D-04-SOF-X-CX-35K-D100.IES

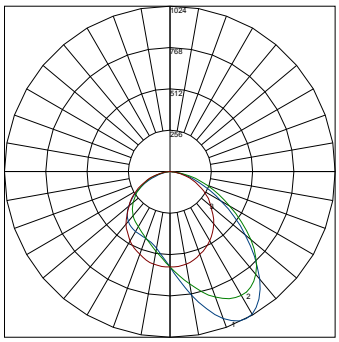


Legend:
0-deg: Blue
45-deg: Green
90-deg: Red

Zonal Lumens

Zone	Lumens	Lamp %
0-40	1905.97	47.70
0-60	3229.26	80.70
0-90	3999.61	100.0
90-180	0.00	0.00
0-180	3999.61	100.00

Fixture: 2L-W-AD-XX-XX-ASYM-CX-35K-D050
CCT: 3500K
Output: D050
Nominal lumens: 500 lumens/ft
Efficacy: 82 lm/W
Test report:2L-W-AD-4-ASYM-X-CX-35K-D050.IES

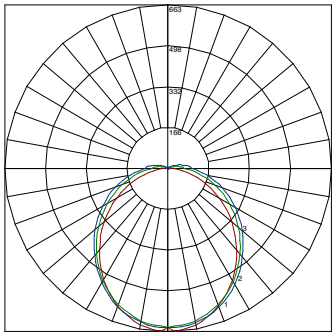


Legend:
0-deg: Blue
45-deg: Green
90-deg: Red

Zonal Lumens

Zone	Lumens	Lamp %
0-40	896.16	44.80
0-60	1613.68	80.70
0-90	1999.5	100.0
90-180	0.46	0.00
0-180	3999.96	100.0

Fixture: 2L-X-D-04-DRP-CX-35K-D050
CCT: 3500K
Output: D050
Nominal lumens: 500 lumens/ft
Efficacy: 95 lm/W
Test report: 2L-X-D-04-DRP-CX-35K-D050.IES



Legend:
0-deg: Blue
45-deg: Green
90-deg: Red

Zonal Lumens

Zone	Lumens	Lamp %
0-40	801.88	40.10
0-60	1408.37	70.40
0-90	1904.98	95.20
90-180	94.99	4.70
0-180	1999.98	100.00

65 Spring Street Plympton, MA 02367 / Tel **781.294.0100** / Website **www.litecontrol.com**

NANOLUME

Micro Profile LED Task and Cove Fixture

Customer: Date: Type:

Project:

- Compact, variable light fixture.
- Fixture comes in 4" increments with a 12" minimum.
- Reflector boosts overall output by 10%. Reflector only available with 120° Optics.
- Boca Flasher's patented CleanDim® technology ensures even dimming from 0-100%.
- Many options in color temperature to suit a range of projects.
- Uses standard line voltage dimming.
- Fixtures are compatible with both forward and reverse phase dimming, can have 0-10V direct dimming or can use Boca's SDS module for 0-10V DALI or DMX Dimming.
- Interior installations only.
- The housing is a high temperature ABS plastic with a durable white or black finish, making it temperature and abrasion resistant.
- Total linear feet per power feed (6W): 120V = 80 ft., 277V = 150 ft.
- Contact Boca Flasher for tips with custom installation procedures.

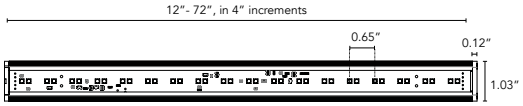
PRODUCT SPECIFICATIONS:

	WATTAGE	COLOR OPTION	VOLTAGE	OPTIC	FINISH	MOUNTING	LENS	BAFFLE	REFLECTOR	DIMMING*
Nanolume										
	3W **6W**	**2000K** **2400K** **2700K** **3000K** **3500K** **4000K**	**120V** **277V**	**10°** **15°x 40°** **120°**	**W** White **B** Black	**S** Swivel **H** Hinge	**C** Clear **CLD** Clear Light Diffused (Not Available with Optics) **HD** Heavy Diffused (Not Available with Optics)	**SQ** Square **ASYM** Asymmetric	**(Only Available with 120° Optics)** **Y** Yes **N** No	**STANDARD DIMMING** **0-10V DIRECT** **0-10V REMOTE** **DMX REMOTE** **DALI REMOTE**

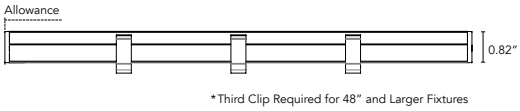
*Additional Charges May Apply

DIMENSIONS:

Plan View

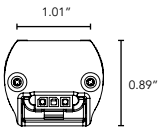


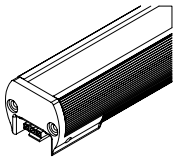
Elevation View



*Third Clip Required for 48" and Larger Fixtures

End View





Boca Flasher, Inc. 508 South Military Trail, Deerfield Beach, Florida 33442 USA Phone: 561.989.5338 Fax: 561.982.8323

REV 11022020

NANOLUME

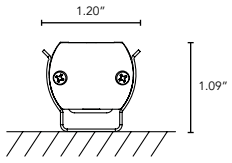
Micro Profile LED Task and Cove Fixture

TECHNICAL SPECIFICATIONS:

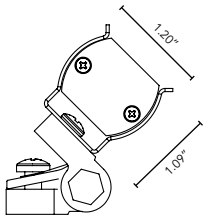
WATTAGE	3 or 6 watts per linear ft.
INPUT VOLTAGE	90-120V 230-277V
CONTROL	Leading Edge/Trailing Edge line dimmer, 0-10V, DALI, DMX
LED SPACING	5/8" on center
LENGTH	12-72", in 4" increment allow 1/4" for each end cap and 1.25" for power feed cable
TOTAL WIDTH	1.04"
TOTAL HEIGHT	0.82"
COLOR OPTIONS	2000K, 2400K, 2700K, 3000K, 3500K, 4000K
MOUNTING	Swivel, Hinge
AVAILABLE OPTICS	10°, 15°×40°, 120°
COLOR RENDERING INDEX (CRI)	90 + CRI
RATING	Interior Only IP50

MOUNTING INFORMATION:

- For vertical installation please contact the factory for specific mounting instructions.
- For installations above 4' please contact the factory.



Swivel



Hinge

LUMINAIRE INFORMATION:

CCT (K)	Wattage	Lumens	LPW
2000	6	432	72
2400	6	510	85
2700	6	560	94
3000	6	588	98
3500	6	618	103
4000	6	636	106

* Typical delivered lumen data is approximate. Actual lumens will vary due to installation environment and beam pattern. Please see IES files.

Boca Flasher, Inc. 508 South Military Trail, Deerfield Beach, Florida 33442 USA Phone: 561.989.5338 Fax: 561.982.8323

REV 11022020

Columbia LIGHTING

DATE: LOCATION:

TYPE: PROJECT:

CATALOG #:

MPS

MULTIPURPOSE LINEAR

FEATURES

- Uninterrupted ribbon of light; row mounting optional
- Long life 60,000 hour LEDs at L80 for reduced maintenance
- Superior color consistency within a 3-step MacAdam ellipse and greater than 80 CRI
- Available in 2', 4' or 8' lengths
- Optional integral emergency battery pack
- Three lens options as well as less lens (NL)
- Modular replaceable LED boards and driver accessible for future maintenance or upgrades
- Surface mount, wall mount or suspended

Built to UL 924 Standards

BUY AMERICAN SOLUTIONS

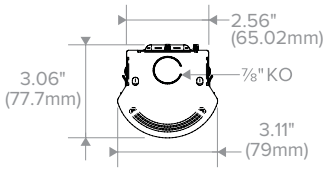
See Certification Specifications

RELATED PRODUCTS

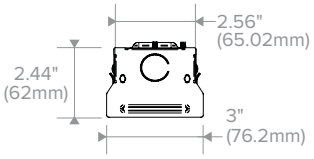
Revalume™ Linear Wrap

Reverie™ Decorative Low Bay

End View—Curve Lens



End View—Flat Lens



CONTROL TECHNOLOGY

SpectraSync™ Color Tuning Technology

NX DISTRIBUTED™ INTELLIGENCE

SPECTRASAFE™

SPECIFICATIONS

CONSTRUCTION

- Housing, wireway, and ends are formed from code-gauge steel
- Housing components act as heat sink for LED heat dissipation
- White painted parts are treated with a five stage phosphate bonding process and finished with high reflectance baked enamel

OPTICS

- Available with or without frosted acrylic lens

INSTALLATION

- Knockouts are provided for electrical access and mounting

ELECTRICAL

- Long-life LEDs are rated for 60,000 hours at L80 lumen maintenance
- Driver options include fixed output for on/off function, step dimming (high/low/off), or continuous 0–10V dimming
- Superior drivers and long-life LEDs provide quality illumination for prolonged service life
- Drivers < 10% THD at 120V, power factor > 0.95

CONTROLS

- Optional SpectraSync™ offers two modes of Tunable White solutions and integrates seamlessly into a variety of control systems
- NX Distributed Intelligence™ provides options for standalone and networked integrated sensor with wired or wireless connectivity for NX system deployments

TECHNOLOGY

- SpectraSAFE™ is a scalable, cloud-enabled and lighting-based wireless video security solution for interior commercial and industrial applications

CERTIFICATIONS

- IC label is standard for recessed products
- All luminaires are built to UL 1598 and 2108 standards, and bear appropriate cCSAus labels
- Damp Location label standard
- CSA certified to UL 924 standards with battery pack or DTS (Dimming Bypass Module) options

CERTIFICATIONS (CONTINUED)

- Adheres to LM79, LM80, and TM21 industry standards
- The DTS, Dimming Bypass Module, is for emergency circuit control loads including sensors and wireless systems CSA certified to UL 924. See page 10 for wiring diagram. Link to Dimming Bypass Module Specification sheet
- This product qualifies as a "designated country construction material" per FAR 52.225-11 Buy American-Construction Materials under Trade Agreements effective 06/01/2020. See Buy American Solutions

WARRANTY

- 5 year warranty
- See HLI Standard Warranty for additional information

KEY DATA	
Lumen Range	1377–16,833
Wattage Range	13.5–133.8
Efficacy Range (LPW)	111–142
Reported Life (Hours)	L80–60,000

HUBBELL Lighting

Columbia LIGHTING

DATE: LOCATION:

TYPE: PROJECT:

CATALOG #:

MPS

MULTIPURPOSE LINEAR

ORDERING GUIDE

Example: MPS4–40ML–CW–EDU

CATALOG #

MPS –

Model	Size [1]	CRI
MPS MultiPurpose Linear	**2** 2'	**Blank** >80
	4 4'	**9** 90 [2]
	8 8'	

Color Temp	
30	3000K
35	3500K
40	4000K
50	5000K
2750T	2700K–5000K SpectraSync™ Tunable White [3]
2765T	2700K–6500K SpectraSync™ Tunable White [3]

Nominal Lumens [4]			
XW	4' (2700), 8' (5400)	**LWHE**	2' (2600), 4' (4100), 8' (8200)
XWHE	4' (2500), 8' (5000)	**ML**	2' (3600), 4' (4800), 8' (9500)
VW	2' (1700), 4' (3400), 8' (6900)	**MLHE**	4' (4700), 8' (9400)
VWHE	4' (3300), 8' (6600)	**HL**	2' (3800), 4' (6000), 8' (12,000)
MW	2' (2300), 4' (3800), 8' (7700)	**HLHE**	4' (5700), 8' (11,500)
MWHE	2' (2100), 4' (3700), 8' (7400)	**VL**	4' (7100), 8' (14,200)
LW	2' (2500), 4' (4200), 8' (8400)	**XL**	4' (8400), 8' (17,000)

Lens	
C	Curve, Frosted Acrylic
F	Flat, Frosted Acrylic
NL	Less Lens
CP	Curve, Frosted Polycarbonate

Distribution [5]	
N	Narrow Distribution [6]
W	Wide Distribution

–

Driver	
E	Fixed Output
ED	0-10V Dimming
ED1	0-10V 1% Dimming
EDD	0-10V Dim-to-Dark
ESD	Step Dimming
LUTH	Hi-lume 1% EcoSystem LED driver with Soft-on, Fade-to-Black dimming technology [7]
LUT5	5-Series EcoSystem LED driver [7]
DALIP	DALI Power Bus [8]

Voltage	
U	120V-277V
347	347V (E, ED, ED1 only)

–

Options	
ELL14	Emergency Battery Pack, 10W [9,10,11]
ELL14H2	Emergency Battery Pack, 2-Hour Run Time [9,10,11]
GLR	Fast Blow Fuse
GTD	Generator Transfer Device [12]
DTS	Dimming Bypass Module [13]
MPSCE	Injection Molded ABS Material Curve Endcap [23]
MPSCE-MB	Injection Molded ABS Material Curve Endcap, Matte Black
MPSFE	Injection Molded ABS Material Flat Endcap [23]
MPSFE-MB	Injection Molded ABS Material Flat Endcap, Matte Black
MB	Matte Black
ZT	ZET Metallic Silver
PAF	Painted After Fabrication
SAF	SpectraSAFE™ Integrated Surveillance Lighting System [14]
MST	MASTER fixture that controls one or more SATELLITE fixtures in a continuous row application [15,16,17,18,19,20,21]
SAT	SATELLITE fixture controlled by MASTER fixture in a continuous row application [16,17,18,19,20,21]
INT	Intermediate (provides ends with wiring access for continuous row mounting) [18,20,21,22]
EOR	End of Row (provides end wiring access for continuous row mounting) [18,20,21,22]

Control Options [23, 24, 25]	
NX Standalone	
NXS	NX, PIR BT Occupancy/Daylight Sensor, Slide Mount [26,28]
NX Networked – Wired	
NXE	NX, Dual SmartPORTs [26,27,28]
NXES	NX, PIR BT Occupancy/Daylight Sensor, Slide Mount, Dual SmartPORTs [26,27,28]
NX Networked – Wireless	
NXSW	NX Wireless, PIR BT Occupancy/Daylight Sensor [26,28]
NXWE	NX Wireless Enabled [26,28]
Third-Party Control Options	
ODPG	Occupancy and Daylight Sensors w/ Grouping, Philips SNS200 [29,31]
LVR	Lutron Vive Integral Fixture Control DFCSJ-OEM-RF (RF only) [29,30,31]
LVS	Lutron Vive Integral Fixture Control DFCSJ-OEM-OCC (RF with daylight and occupancy sensing) [29,30,31]

Accessories

☐	**S18**	18" Stem, Canopy
☐	**SS18**	18" Swivel Stem—45° Swivel
☐	**CM24SCF3-KIT**	24" Adjustable Cable Mounting Kit, 3-wire feed [32]
☐	**CM48SCF3-KIT**	48" Adjustable Cable Mounting Kit, 3-wire feed [32]
☐	**CM24NF-KIT**	Single Point Non-Feed Cable Mount with Canopy, Single - 24" [32]
☐	**CM48NF-KIT**	Single Point Non-Feed Cable Mount with Canopy, Single - 48" [32]
☐	**CSHC**	Chain Hanger Assembly
☐	**MPSZT**	Zip Tee Hanger - 1½" Spacer on T-Bar Ceiling
☐	**MPSTH**	Slide Tong Hanger
☐	**MPSCRK-C**	Continuous Row Kit, Curve
☐	**MPSCRK-F**	Continuous Row Kit, Flat
☐	**MPSWG2**	2' Wire Guard
☐	**MPSWG4**	4' Wire Guard, two Required for 8' Fixture
☐	**MPSCE**	Injection Molded ABS Material Curve Endcap
☐	**MPSCE-MB**	Injection Molded ABS Material Curve Endcap, Matte Black
☐	**MPSFE**	Injection Molded ABS Material Flat Endcap
☐	**MPSFE-MB**	Injection Molded ABS Material Flat Endcap, Matte Black

Notes:

1 For continuous row mounting, see Continuous Row Mount Example Guide on page 3
2 Not available with HE lumen packages
3 See SpectraSync and NX Availability Table on page 6
4 High efficacy versions designated with "HE"
5 Applicable to lens only
6 Only available with Curve, Frosted Acrylic lens
7 Not available in VL, XL, HE packages
8 DALIP only available when LVS, LVR or ODPG control options are selected
9 Delivered Emergency Lumens = ELL14 = 1210 lms
10 Not available in 2ft size or with thru wire on XL 4ft and 8ft
11 Emergency battery pack max ambient temperature: 25˚C
12 Only available with fixed output driver
13 For emergency circuit control loads including sensors and wireless systems CSA certified to UL 924. Not availble with ESD driver option. Universal voltage only. DTS with 2' cannot be combined with Controls or SpectraSync options. See page 10 for wiring diagram
14 SpectraSync+NX+SAF can not be configured. Only available with NXE or NXWE. Not available in 347V

Continuous-Row Options:

15 MST option not available with INT row position
16 Multiple SAT fixtures can be controlled by one MST fixture. Any one SAT fixture can have no more than one connected MST fixture
17 NX is supported for this application, consult Brand for use with other controls systems
18 Not available with DTS,GTD,ATSD
19 Not available with LUTH or LUT5
20 All fixtures in a row must be the same driver type and voltage
21 Includes quick-connect wiring harness
22 Suspension support required at every fixture coupling; see Mounting Accessories Guide

NX In-Fixture Control Options:

23 Standard PAF when this option is chosen
24 Control Options include Injection Molded ABS End Cap
25 Fixtures with Control Options are Dry Location rated only
26 Only available with 0–10V dimming drivers (ED, ED1 & EDD)
27 Not available with surface mounting
28 Not available in 2ft when SpectraSync and SpectraSAFE are chosen

Third-Party Control Options:

29 LVS, LVR and ODPG only available with DALIP driver option
30 VIVE is a trademark of Lutron Electronics Co., Inc
31 Not available with SpectraSync (2750T or 2765T)

Accessory Notes:

32 See Columbia Mounting Accessories page for additional options

HUBBELL Lighting

MPS

MULTIPURPOSE LINEAR

ORDERING GUIDE (CONTINUED)

CONTINUOUS ROW MOUNT EXAMPLE GUIDE					
Continuous Row Length	MPS4	MPS8	MPSCRK-*	CM**SCF*-KIT	CM**NF-KIT
12' — Option 1	1	1	1	1	1
12' — Option 2	3	0	2	1	1
16' — Option 1	0	2	1	1	1
16' — Option 2	2	1	2	1	2
32' — Option 1	0	4	3	2	1
32' — Option 2	2	3	4	2	1

Link to Columbia Mounting Accessories page

PRODUCT EXCEPTIONS & DETAILS

Driver options listed below are available for the outputs as shown.

DRIVER AVAILABILITY TABLE — 2'							
	VW	MW	MWHE	LW	LWHE	ML	HL
E	x	x	x	x	x	x	x
ED	x	x	x	x	x	x	x
ED1	x	x	x	x	x	x	x
EDD	x	x		x		x	x
ESD	x	x		x		x	x
LUT5	x	x		x		x	x
LUTH	x	x		x		x	x
347	x	x		x		x	x
DALIP	x	x	x	x	x	x	x

DRIVER AVAILABILITY TABLE — 4' & 8'														
	XW	XWHE	VW	VWHE	MW	MWHE	LW	LWHE	ML	MLHE	HL	HLHE	VL	XL
E	x	x	x	x	x	x	x	x	x	x	x	x	x	x
ED	x	x	x	x	x	x	x	x	x	x	x	x	x	x
ED1	x	x	x	x	x	x	x	x	x	x	x	x	x	x
EDD	x		x		x		x		x		x		x	x
ESD	x		x		x		x		x		x		x	x
347	x		x		x		x		x		x		x	x
LUT5	x		x		x		x		x		x			
LUTH	x		x		x		x		x		x			
DALIP	x	x	x	x	x	x	x	x	x	x	x	x	x	x

TEMPERATURE TABLE (C°) — 4' & 8'											
		80 CRI									
		E/ED/ED1		ESDU		ED347		EDD		LUT	
Size	Lumen Package	Ceiling/ Surface Mount	Pendant/ TH Mount	Ceiling/ Surface Mount	Pendant/ TH Mount	Ceiling/ Surface Mount	Pendant/ TH Mount	Ceiling/ Surface Mount	Pendant/ TH Mount	Ceiling/ Surface Mount	Pendant/ TH Mount
2'	VW	35	40	35	40	35	40	35	40	35	40
	MW	35	40	35	40	35	40	35	40	35	40
	LW	35	40	35	40	35	40	35	40	35	40
	ML	35	40	35	40	35	40	35	40	35	40
	HL	30	35	30	35	30	35	30	35	30	35
	XW	35	45	35	45	35	45	30	35	30	35
4'	VW	35	45	35	45	35	45	30	35	30	35
	MW	35	45	35	45	35	45	30	35	30	35
	LW	35	45	35	45	35	45	30	35	30	35
	ML	35	45	35	45	35	45	30	35	30	35
	HL	35	40	35	40	35	40	25	30	30	35
	VL	30	30	30	30	30	30	30	30	—	—
	XL*	25	25	25	25	25	25	25	25	—	—
8'	XW	35	45	35	45	35	45	30	35	30	35
	VW	35	45	35	45	35	45	30	35	30	35
	MW	35	45	35	45	35	45	30	35	30	35
	LW	35	45	35	45	35	45	30	35	30	35
	ML	35	45	35	45	35	45	30	35	30	35
	VL	30	30	30	30	30	30	30	30	—	—
	XL*	25	25	25	25	25	25	25	25	—	—

*XL not available with thru wire

Columbia LIGHTING

MPS

MULTIPURPOSE LINEAR

CONTROLS

NX Distributed Intelligence™ Lighting Controls:

Supports both indoor and outdoor applications in a variety of deployment options- wired, wireless, hybrid.
Integrates with and enables a wide array of luminaires including those with SpectraSync™ Color Tuning Technology.

NX DISTRIBUTED™ INTELLIGENCE

NX INTEGRATED CONTROLS REFERENCE								
NX Option	Sensor	Networkable	Scheduling	Occupancy	Daylight Harvesting	0–10V Dimming	On/off Control	Bluetooth® App Programming
NX Standalone								
NXS	NXSMP-SMI	No	Yes	Yes	Yes	Yes	Yes	Yes
NX Networked – Wired								
NXE	N/A	Yes	Yes	No	No	Yes	Yes	Requires NXBTC/R[1]
NXES	NXSMP-SMI	Yes	Yes	Yes	Yes	Yes	Yes	Yes
NX Networked – Wireless								
NXSW	NXSMP-SMI	Yes	Yes	Yes	Yes	Yes	Yes	Yes
NXWE	N/A	Yes	Yes	No	No	Yes	Yes	No[2]

1 NXBTC/R needs to be plugged into an available NX SmartPORT™ on the fixture network
2 To program NXWE option, need to consult factory. If connected to an area controller, programming can be done from that

Philips EasySense Controls ODPG Sensor:

- Occupancy sensing, daylight harvesting, task tuning and grouping in one device
- Standalone control or grouping to wireless switches[1]
- Uses Philips field apps for on site commissioning[2,3]
- Ability to create scenes for various room configurations
- Cost-effective solution for energy-savings and code-compliancy strategies
- DLC® Qualified: Listed on the QPL for Networked Lighting Controls. Please refer to the DLC website for specific product qualifications at www.designlights.org

1 Wireless switches only compatible with ODPG Philips EasySense
2 See link to Philips commssioning
3 Requires android device or IR dongle. See links for phone compatiblity and IR dongle

Wireless Switch Accessories[1]

☐	PESR-WH	EasySense compatible wireless single rocker switch, white
☐	PEDR-WH	EasySense compatible wireless dual rocker switch, white

SPECTRASAFE

SpectraSAFE™ Integrated Surveillance Lighting System

Technical Features

- High resolution 1080p full HD camera
- 2.8mm lens / 140° field of view
- IR emitter for low / no-light conditions
- Multiple wiring configurations available
- Supports 2-way audio communication
- Supports 2.4GHz WPA-PSK/WPA2-PSK Wi-Fi
- Data encrypted using AES 256 standard
- Low power consumption (2-5W)
- Transmissions secured using Open TLS / SSL

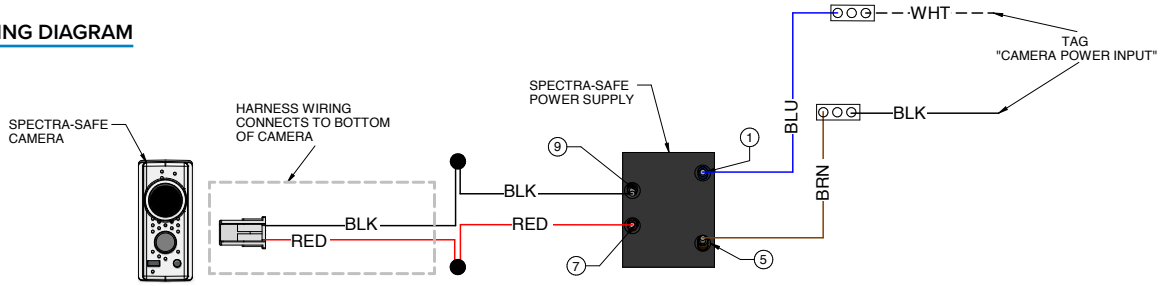
Note: Camera and end cap add 2.2" to the overall length.

Software & Support

- Free Android, iOS and web-based app
- Versatile and supports multiple applications
- Multi-tenant web-based camera application
- Phone and in-app chat technical support
- Scalable cloud services and video storage
- Supported by a 5-year warranty

SPECTRASAFE WIRING DIAGRAM

Power Supply	
Pin Connections	
Pin#	Single
1	VAC in (N)
5	VAC in (L)
7	+Vout
9	-Vout



HUBBELL Lighting

CONTROLS (CONTINUED)

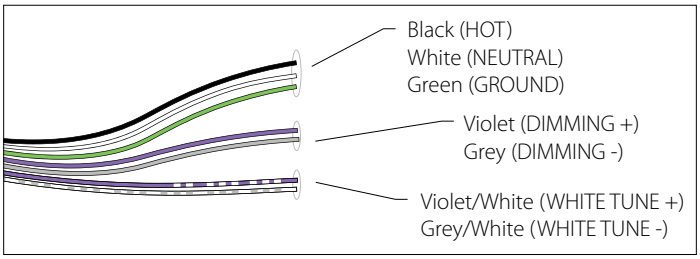
SpectraSync™ Color Tuning Technology:

Control your space based on the needs of the application, specific activities throughout the day and preferences of the occupants with distinct SpectraSync™ Color Tuning Technologies.

SPECTRASYNC COLOR TUNING TECHNOLOGY		
Mode	Kelvin Range	Description
Tunable White	2700K–5000K 2700K–6500K	Offers users the ability to tailor CCT to their personal preference, enhancing task visibility, material and colors or the aesthetics of the space

SpectraSync Tunable White

Available in two options: 2750T (2700K–5000K) or 2765T (2700K–6500K).
Requires two 0–10V controllers, one for intensity and one for CCT.
Minimum 5% dimming.

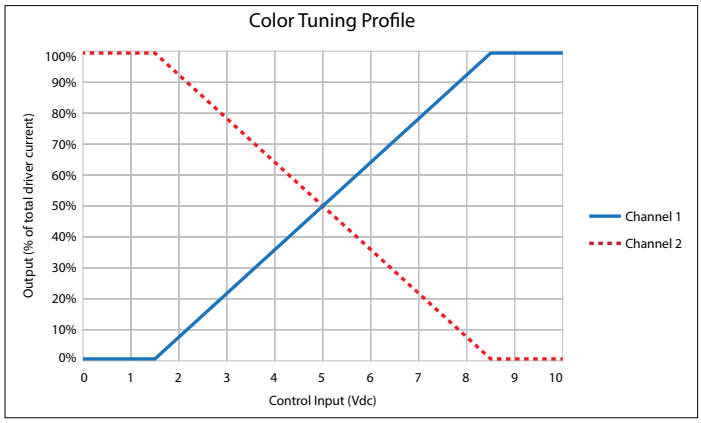


SpectraSync Tunable White luminaires are provided with two 0–10V circuits. The violet and grey circuit is for wiring to any qualified 0–10V controller for dimming. The violet/white and grey/white circuit is for wiring to any qualified 0–10V controller for Tunable White CCT control.

Controller Manufacturer Data

SpectraSync Tunable White was designed to be used with sinking style dimmers (provided by others) and is compatible with:

- Hubbell Control Solutions (HCS): NX Distributed Intelligence™ Room Controllers (NXRC) and In-fixture Controllers (NXFM)
- Lutron: DVTV, DVSTV, and NFTV dimmers
- Wattstopper: ADF120277 and CD4BL (Titan) dimmers



To enable scheduling and for use with NX wall control preset stations please refer to Hubbell Control Solutions NX SpectraSync technical sheet.

SPECTRASYNC™ AND NX AVAILABILITY TABLE

		Only With 80 CRI No Battery Pack			Only With 80 CRI With Battery Pack		
Size	Lumen package	CTC	NX	CTC+NX	CTC	NX	CTC+NX
2ft	VW	Y	Y	N	—	—	—
	MW	Y	Y	N	—	—	—
	LW	Y	Y	N	—	—	—
	ML	N	Y	N	—	—	—
	HL	N	Y	N	—	—	—
4ft	XW	Y	Y	Y	Y	Y	Y
	VW	Y	Y	Y	Y	Y	Y
	MW	Y	Y	Y	Y	Y	Y
	LW	Y	Y	Y	Y	Y	Y
	ML	Y	Y	Y	Y	Y	Y
	HL	Y	Y	Y	Y	Y	Y
	VL	N	Y	N	N	Y	N
	XL	N	Y	N	N	Y	N
8ft	XW	Y	Y	Y	Y	Y	Y
	VW	Y	Y	Y	Y	Y	Y
	MW	N	Y	N	N	Y	N
	LW	N	Y	N	N	Y	N
	ML	N	Y	N	N	Y	N
	HL	N	Y	N	N	Y	N
	VL	N	Y	N	N	Y	N
	XL	N	Y	N	N	Y	N

Columbia LIGHTING

MPS

MULTIPURPOSE LINEAR

DATE: LOCATION:

TYPE: PROJECT:

CATALOG #:

DELIVERED LUMENS

STANDARD EFFICACY PERFORMANCE TABLE						
FIXTURE	COLOR	LENS	DISTRIBUTION	LUMENS	INPUT WATTS	LPW
MPS2-VW	3500K	Curve	Wide	1659	13.8	120
			Narrow	1597	13.5	118
		Flat	Wide	1584	13.5	117
		No Lens		1724	13.8	125
	4000K	Curve	Wide	1681	13.8	122
			Narrow	1618	13.5	120
		Flat	Wide	1604	13.5	119
		No Lens		1746	13.8	127
MPS2-MW	3500K	Curve	Wide	2201	18.2	121
			Narrow	2092	17.8	118
		Flat	Wide	2076	17.8	117
		No Lens		2287	18.2	126
	4000K	Curve	Wide	2229	18.2	122
			Narrow	2119	17.8	119
		Flat	Wide	2102	17.8	118
		No Lens		2316	18.2	127
MPS2-LW	3500K	Curve	Wide	2444	20.4	120
			Narrow	2328	19.9	117
		Flat	Wide	2309	19.9	116
		No Lens		2540	20.4	124
	4000K	Curve	Wide	2475	20.4	121
			Narrow	2358	19.9	118
		Flat	Wide	2338	19.9	118
		No Lens		2572	20.4	126
MPS2-ML	3500K	Curve	Wide	3452	29	119
			Narrow	3447	28.8	120
		Flat	Wide	3414	28.8	119
		No Lens		3587	29	124
	4000K	Curve	Wide	3496	29	121
			Narrow	3491	28.8	121
		Flat	Wide	3458	28.8	120
		No Lens		3632	29	125
MPS2-HL	3500K	Curve	Wide	3655	31.7	115
			Narrow	3707	31.5	118
		Flat	Wide	3678	31.5	117
		No Lens		3797	31.7	120
	4000K	Curve	Wide	3701	31.7	117
			Narrow	3754	31.5	119
		Flat	Wide	3725	31.5	118
		No Lens		3846	31.7	121
MPS4-XW	3500K	Curve	Wide	2574	20	129
			Narrow	2574	20	129
		Flat	Wide	2463	20	123
		No Lens		2674	20	134
	4000K	Curve	Wide	2606	20	130
			Narrow	2574	20	129
		Flat	Wide	2494	20	125
		No Lens		2708	20	135
MPS4-VW	3500K	Curve	Wide	3279	26.7	123
			Narrow	3152	26.5	119
		Flat	Wide	3134	26.5	118
		No Lens		3450	26.7	129
	4000K	Curve	Wide	3321	26.7	124
			Narrow	3192	26.5	120
		Flat	Wide	3174	26.5	120
		No Lens		3564	26.7	133
MPS4-MW	3500K	Curve	Wide	3656	30.4	120
			Narrow	3511	30.1	117
		Flat	Wide	3491	30.1	116
		No Lens		3847	30.4	127
	4000K	Curve	Wide	3702	30.4	122
			Narrow	3556	30.1	118
		Flat	Wide	3535	30.1	117
		No Lens		3974	30.4	131
MPS4-LW	3500K	Curve	Wide	4043	34.4	118
			Narrow	4094	32.5	126
		Flat	Wide	4072	32.5	125
		No Lens		4255	34.4	124
	4000K	Curve	Wide	4095	34.4	119
			Narrow	4147	32.5	128
		Flat	Wide	4124	32.5	127
		No Lens		4395	34.4	128

HUBBELL Lighting

DELIVERED LUMENS (CONTINUED)

STANDARD EFFICACY PERFORMANCE TABLE						
FIXTURE	COLOR	LENS	DISTRIBUTION	LUMENS	INPUT WATTS	LPW
MPS4-ML	3500K	Curve	Wide	4556	40.1	114
			Narrow	4649	37.7	123
		Flat	Wide	4625	37.8	122
		No Lens		4794	40.1	120
	4000K	Curve	Wide	4614	40.1	115
			Narrow	4709	37.7	125
		Flat	Wide	4684	37.8	124
		No Lens		4952	40.1	123
MPS4-HL	3500K	Curve	Wide	5760	49.5	116
			Narrow	5781	49.4	117
		Flat	Wide	5741	49.4	116
		No Lens		6061	49.5	122
	4000K	Curve	Wide	5833	49.5	118
			Narrow	5855	49.4	119
		Flat	Wide	5814	49.4	118
		No Lens		6261	49.5	126
MPS4-VL	3500K	Curve	Wide	6769	54.1	125
			Narrow	6675	54.1	123
		Flat	Wide	6637	54.1	123
		No Lens		7122	54.1	132
	4000K	Curve	Wide	6855	54.1	127
			Narrow	6760	54.1	125
		Flat	Wide	6722	54.1	124
		No Lens		7357	54.1	136
MPS4-XL	3500K	Curve	Wide	8045	66.5	121
			Narrow	7878	66.8	118
		Flat	Wide	7813	66.9	117
		No Lens		8466	66.5	127
	4000K	Curve	Wide	8148	66.5	123
			Narrow	7979	66.8	119
		Flat	Wide	7913	66.9	118
		No Lens		8745	66.5	132
MPS8-XW	3500K	Curve	Wide	5147	40	129
			Narrow	4939	39.8	124
		Flat	Wide	4925	40	123
		No Lens		5348	40	134
	4000K	Curve	Wide	5213	40	130
			Narrow	5002	39.8	126
		Flat	Wide	4988	40	125
		No Lens		5416	40	135
MPS8-VW	3500K	Curve	Wide	6558	53.4	123
			Narrow	6303	53	119
		Flat	Wide	6269	53	118
		No Lens		6814	53.4	128
	4000K	Curve	Wide	6642	53.4	124
			Narrow	6384	53	120
		Flat	Wide	6349	53	120
		No Lens		6901	53.4	129
MPS8-MW	3500K	Curve	Wide	7311	60.8	120
			Narrow	7022	60.2	117
		Flat	Wide	6981	60.2	116
		No Lens		7596	60.8	125
	4000K	Curve	Wide	7405	60.8	122
			Narrow	7112	60.2	118
		Flat	Wide	7071	60.2	117
		No Lens		7693	60.8	127
MPS8-LW	3500K	Curve	Wide	8087	68.8	118
			Narrow	8189	65	126
		Flat	Wide	8144	65	125
		No Lens		8402	68.8	122
	4000K	Curve	Wide	8190	68.8	119
			Narrow	8293	65	128
		Flat	Wide	8248	65	127
		No Lens		8510	68.8	124
MPS8-ML	3500K	Curve	Wide	9111	80.2	114
			Narrow	9298	75.4	123
		Flat	Wide	9250	75.6	122
		No Lens		9466	80.2	118
	4000K	Curve	Wide	9227	80.2	115
			Narrow	9417	75.4	125
		Flat	Wide	9368	75.6	124
		No Lens		9587	80.2	120

MPS

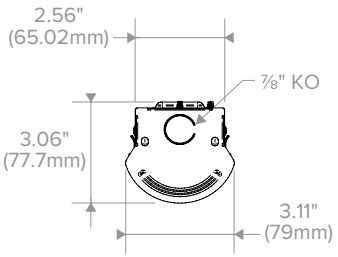
MULTIPURPOSE LINEAR

DELIVERED LUMENS (CONTINUED)

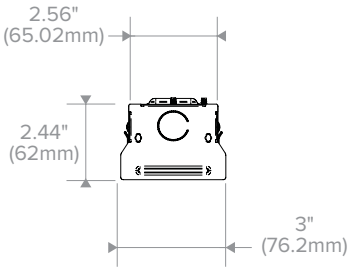
STANDARD EFFICACY PERFORMANCE TABLE						
FIXTURE	COLOR	LENS	DISTRIBUTION	LUMENS	INPUT WATTS	LPW
MPS8-HL	3500K	Curve	Wide	11520	99	116
			Narrow	11562	98.8	117
		Flat	Wide	11481	98.8	116
		No Lens		11969	99	121
	4000K	Curve	Wide	11667	99	118
			Narrow	11710	98.8	119
		Flat	Wide	11628	98.8	118
		No Lens		12122	99	122
MPS8-VL	3500K	Curve	Wide	13537	108.2	125
			Narrow	13350	108.2	123
		Flat	Wide	13275	108.2	123
		No Lens		14065	108.2	130
	4000K	Curve	Wide	13710	108.2	127
			Narrow	13521	108.2	125
		Flat	Wide	13444	108.2	124
		No Lens		14245	108.2	132
MPS8-XL	3500K	Curve	Wide	16091	133	121
			Narrow	15757	133.6	118
		Flat	Wide	15626	133.8	117
		No Lens		16718	133	126
	4000K	Curve	Wide	16296	133	123
			Narrow	15958	133.6	119
		Flat	Wide	15826	133.8	118
		No Lens		16932	133	127

DIMENSIONS

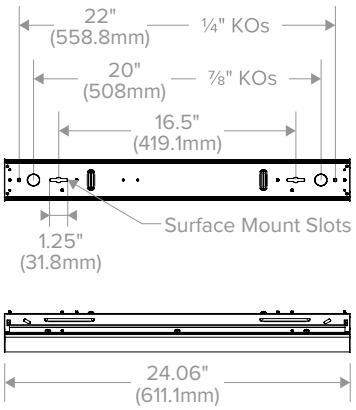
MPS END View - Curve Lens



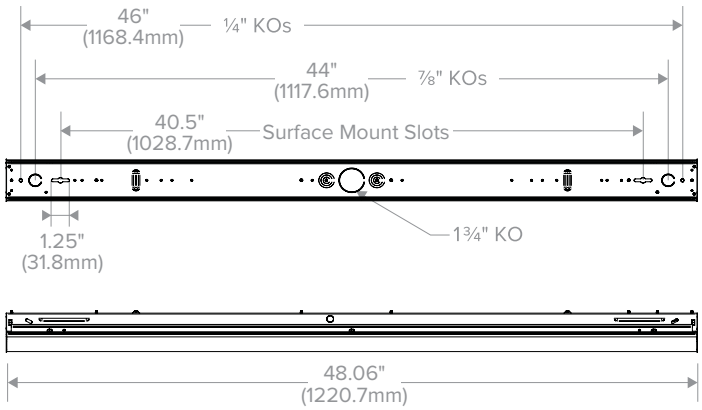
MPS END View - FLAT Lens



MPS 2' Dimensions



MPS 4' Dimensions

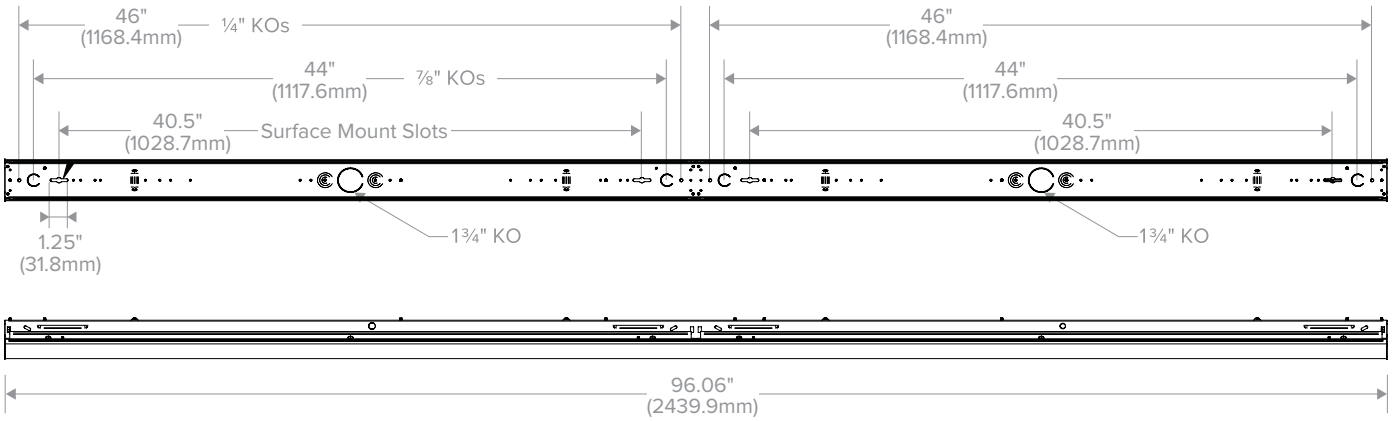


MPS

MULTIPURPOSE LINEAR

DIMENSIONS (CONTINUED)

MPS 8' Dimensions



PHOTOMETRY

MPS4-40ML-CN-EDU

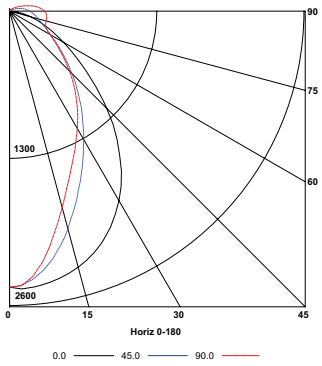
LUMINAIRE DATA

Test No.	**19735**
Description	**MultiPurpose Linear, Narrow, LED 4ft, Frosted Linear Prismed Lens**
Delivered Lumens	**4742**
Watts	**37.70**
Efficacy	**126**
Mounting	**Surface**
Spacing Criterion	**0° = 1.18 90° = 1.77**

ZONAL LUMEN SUMMARY

Zone	Lumens	% Luminaire
0–30	1542	32.5
0–40	2326	49.1
0–60	3518	74.2
0–90	4385	92.5
0–180	4742	100

POLAR GRAPH



MPS4-40ML-CW-EDU

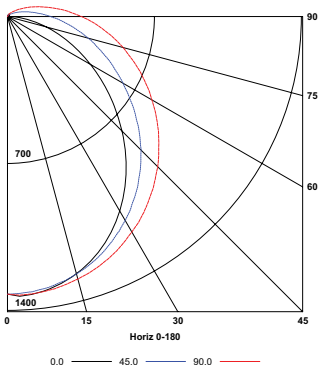
LUMINAIRE DATA

Test No.	**19600**
Description	**MultiPurpose Linear, Wide, LED 4ft, Frosted Linear Prismed Lens**
Delivered Lumens	**4615**
Watts	**40.10**
Efficacy	**115**
Mounting	**Surface**
Spacing Criterion	**0° = 1.20 90° = 1.33**

ZONAL LUMEN SUMMARY

Zone	Lumens	% Luminaire
0–30	1029	22.3
0–40	1688	36.6
0–60	3019	65.4
0–90	4248	92
0–180	4615	100

POLAR GRAPH



PHOTOMETRY
IES
PDF
IES
PDF

Columbia LIGHTING

MPS

MULTIPURPOSE LINEAR

DATE: LOCATION:

TYPE: PROJECT:

CATALOG #:

PHOTOMETRY (CONTINUED)

MPS4-40ML-FW-EDU

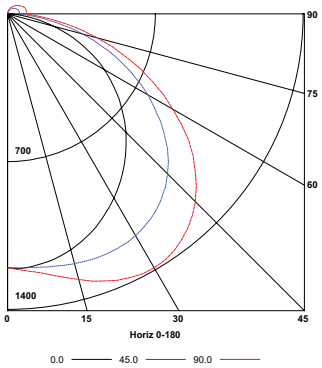
LUMINAIRE DATA

Test No.	**19652**
Description	**MultiPurpose Linear, Wide, LED 4ft, Frosted Linear Prismed Lens**
Delivered Lumens	**4685**
Watts	**37.80**
Efficacy	**124**
Mounting	**Surface**
Spacing Criterion	**0° = 1.24 90° = 1.67**

ZONAL LUMEN SUMMARY

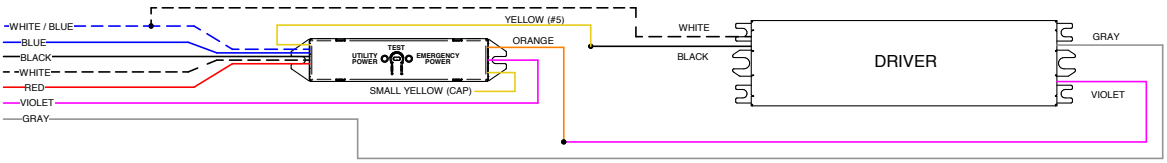
Zone	Lumens	% Luminaire
0–30	1026	21.9
0–40	1756	37.5
0–60	3324	70.9
0–90	4435	94.7
0–180	4685	100

POLAR GRAPH



ADDITIONAL INFORMATION

DTS WIRING DIAGRAM (0–10V DIMMING DRIVER SHOWN)



WHITE/BLUE	Emergency Neutral
BLUE	Emergency Line
BLACK	Utility Line (Unswitched Hot)
WHITE	Utility Neutral
RED	Switched Hot
VIOLET	Dimming
GRAY	Dimming

IES PDF DTS Integration Guide

HUBBELL Lighting

Columbia LIGHTING

DATE: LOCATION:

TYPE: PROJECT:

CATALOG #:

MPS

MULTIPURPOSE LINEAR

FEATURES

- Uninterrupted ribbon of light; row mounting optional
- Long life 60,000 hour LEDs at L80 for reduced maintenance
- Superior color consistency within a 3-step MacAdam ellipse and greater than 80 CRI
- Available in 2', 4' or 8' lengths
- Optional integral emergency battery pack
- Three lens options as well as less lens (NL)
- Modular replaceable LED boards and driver accessible for future maintenance or upgrades
- Surface mount, wall mount or suspended

Built to UL 924 Standards

BUY AMERICAN SOLUTIONS

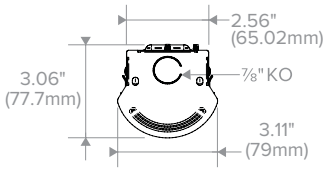
See Certification Specifications

RELATED PRODUCTS

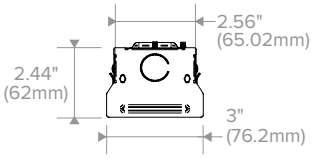
Revalume™ Linear Wrap

Reverie™ Decorative Low Bay

End View—Curve Lens



End View—Flat Lens



CONTROL TECHNOLOGY

SpectraSync™ Color Tuning Technology

NX DISTRIBUTED™ INTELLIGENCE

SPECTRASAFE™

SPECIFICATIONS

CONSTRUCTION

- Housing, wireway, and ends are formed from code-gauge steel
- Housing components act as heat sink for LED heat dissipation
- White painted parts are treated with a five stage phosphate bonding process and finished with high reflectance baked enamel

OPTICS

- Available with or without frosted acrylic lens

INSTALLATION

- Knockouts are provided for electrical access and mounting

ELECTRICAL

- Long-life LEDs are rated for 60,000 hours at L80 lumen maintenance
- Driver options include fixed output for on/off function, step dimming (high/low/off), or continuous 0–10V dimming
- Superior drivers and long-life LEDs provide quality illumination for prolonged service life
- Drivers < 10% THD at 120V, power factor > 0.95

CONTROLS

- Optional SpectraSync™ offers two modes of Tunable White solutions and integrates seamlessly into a variety of control systems
- NX Distributed Intelligence™ provides options for standalone and networked integrated sensor with wired or wireless connectivity for NX system deployments

TECHNOLOGY

- SpectraSAFE™ is a scalable, cloud-enabled and lighting-based wireless video security solution for interior commercial and industrial applications

CERTIFICATIONS

- IC label is standard for recessed products
- All luminaires are built to UL 1598 and 2108 standards, and bear appropriate cCSAus labels
- Damp Location label standard
- CSA certified to UL 924 standards with battery pack or DTS (Dimming Bypass Module) options

CERTIFICATIONS (CONTINUED)

- Adheres to LM79, LM80, and TM21 industry standards
- The DTS, Dimming Bypass Module, is for emergency circuit control loads including sensors and wireless systems CSA certified to UL 924. See page 10 for wiring diagram. Link to Dimming Bypass Module Specification sheet
- This product qualifies as a "designated country construction material" per FAR 52.225-11 Buy American-Construction Materials under Trade Agreements effective 06/01/2020. See Buy American Solutions

WARRANTY

- 5 year warranty
- See HLI Standard Warranty for additional information

KEY DATA	
Lumen Range	1377–16,833
Wattage Range	13.5–133.8
Efficacy Range (LPW)	111–142
Reported Life (Hours)	L80–60,000

HUBBELL Lighting

Columbia LIGHTING

DATE: LOCATION:

TYPE: PROJECT:

CATALOG #:

MPS

MULTIPURPOSE LINEAR

ORDERING GUIDE

Example: MPS4–40ML–CW–EDU

CATALOG #

MPS –

Model	Size [1]	CRI
MPS MultiPurpose Linear	**2** 2'	**Blank** >80
	4 4'	**9** 90 [2]
	8 8'	

Color Temp	
30	3000K
35	3500K
40	4000K
50	5000K
2750T	2700K–5000K SpectraSync™ Tunable White [3]
2765T	2700K–6500K SpectraSync™ Tunable White [3]

Nominal Lumens [4]			
XW	4' (2700), 8' (5400)	**LWHE**	2' (2600), 4' (4100), 8' (8200)
XWHE	4' (2500), 8' (5000)	**ML**	2' (3600), 4' (4800), 8' (9500)
VW	2' (1700), 4' (3400), 8' (6900)	**MLHE**	4' (4700), 8' (9400)
VWHE	4' (3300), 8' (6600)	**HL**	2' (3800), 4' (6000), 8' (12,000)
MW	2' (2300), 4' (3800), 8' (7700)	**HLHE**	4' (5700), 8' (11,500)
MWHE	2' (2100), 4' (3700), 8' (7400)	**VL**	4' (7100), 8' (14,200)
LW	2' (2500), 4' (4200), 8' (8400)	**XL**	4' (8400), 8' (17,000)

Lens	
C	Curve, Frosted Acrylic
F	Flat, Frosted Acrylic
NL	Less Lens
CP	Curve, Frosted Polycarbonate

Distribution [5]	
N	Narrow Distribution [6]
W	Wide Distribution

–

Driver	
E	Fixed Output
ED	0-10V Dimming
ED1	0-10V 1% Dimming
EDD	0-10V Dim-to-Dark
ESD	Step Dimming
LUTH	Hi-lume 1% EcoSystem LED driver with Soft-on, Fade-to-Black dimming technology [7]
LUT5	5-Series EcoSystem LED driver [7]
DALIP	DALI Power Bus [8]

Voltage	
U	120V-277V
347	347V (E, ED, ED1 only)

–

Options	
ELL14	Emergency Battery Pack, 10W [9,10,11]
ELL14H2	Emergency Battery Pack, 2-Hour Run Time [9,10,11]
GLR	Fast Blow Fuse
GTD	Generator Transfer Device [12]
DTS	Dimming Bypass Module [13]
MPSCE	Injection Molded ABS Material Curve Endcap [23]
MPSCE-MB	Injection Molded ABS Material Curve Endcap, Matte Black
MPSFE	Injection Molded ABS Material Flat Endcap [23]
MPSFE-MB	Injection Molded ABS Material Flat Endcap, Matte Black
MB	Matte Black
ZT	ZET Metallic Silver
PAF	Painted After Fabrication
SAF	SpectraSAFE™ Integrated Surveillance Lighting System [14]
MST	MASTER fixture that controls one or more SATELLITE fixtures in a continuous row application [15,16,17,18,19,20,21]
SAT	SATELLITE fixture controlled by MASTER fixture in a continuous row application [16,17,18,19,20,21]
INT	Intermediate (provides ends with wiring access for continuous row mounting) [18,20,21,22]
EOR	End of Row (provides end wiring access for continuous row mounting) [18,20,21,22]

Control Options [23, 24, 25]	
NX Standalone	
NXS	NX, PIR BT Occupancy/Daylight Sensor, Slide Mount [26,28]
NX Networked – Wired	
NXE	NX, Dual SmartPORTs [26,27,28]
NXES	NX, PIR BT Occupancy/Daylight Sensor, Slide Mount, Dual SmartPORTs [26,27,28]
NX Networked – Wireless	
NXSW	NX Wireless, PIR BT Occupancy/Daylight Sensor [26,28]
NXWE	NX Wireless Enabled [26,28]
Third-Party Control Options	
ODPG	Occupancy and Daylight Sensors w/ Grouping, Philips SNS200 [29,31]
LVR	Lutron Vive Integral Fixture Control DFCSJ-OEM-RF (RF only) [29,30,31]
LVS	Lutron Vive Integral Fixture Control DFCSJ-OEM-OCC (RF with daylight and occupancy sensing) [29,30,31]

Accessories

☐	**S18**	18" Stem, Canopy
☐	**SS18**	18" Swivel Stem—45° Swivel
☐	**CM24SCF3-KIT**	24" Adjustable Cable Mounting Kit, 3-wire feed [32]
☐	**CM48SCF3-KIT**	48" Adjustable Cable Mounting Kit, 3-wire feed [32]
☐	**CM24NF-KIT**	Single Point Non-Feed Cable Mount with Canopy, Single - 24" [32]
☐	**CM48NF-KIT**	Single Point Non-Feed Cable Mount with Canopy, Single - 48" [32]
☐	**CSHC**	Chain Hanger Assembly
☐	**MPSZT**	Zip Tee Hanger - 1½" Spacer on T-Bar Ceiling
☐	**MPSTH**	Slide Tong Hanger
☐	**MPSCRK-C**	Continuous Row Kit, Curve
☐	**MPSCRK-F**	Continuous Row Kit, Flat
☐	**MPSWG2**	2' Wire Guard
☐	**MPSWG4**	4' Wire Guard, two Required for 8' Fixture
☐	**MPSCE**	Injection Molded ABS Material Curve Endcap
☐	**MPSCE-MB**	Injection Molded ABS Material Curve Endcap, Matte Black
☐	**MPSFE**	Injection Molded ABS Material Flat Endcap
☐	**MPSFE-MB**	Injection Molded ABS Material Flat Endcap, Matte Black

Notes:

1 For continuous row mounting, see Continuous Row Mount Example Guide on page 3
2 Not available with HE lumen packages
3 See SpectraSync and NX Availability Table on page 6
4 High efficacy versions designated with "HE"
5 Applicable to lens only
6 Only available with Curve, Frosted Acrylic lens
7 Not available in VL, XL, HE packages
8 DALIP only available when LVS, LVR or ODPG control options are selected
9 Delivered Emergency Lumens = ELL14 = 1210 lms
10 Not available in 2ft size or with thru wire on XL 4ft and 8ft
11 Emergency battery pack max ambient temperature: 25˚C
12 Only available with fixed output driver
13 For emergency circuit control loads including sensors and wireless systems CSA certified to UL 924. Not availble with ESD driver option. Universal voltage only. DTS with 2' cannot be combined with Controls or SpectraSync options. See page 10 for wiring diagram
14 SpectraSync+NX+SAF can not be configured. Only available with NXE or NXWE. Not available in 347V

Continuous-Row Options:

15 MST option not available with INT row position
16 Multiple SAT fixtures can be controlled by one MST fixture. Any one SAT fixture can have no more than one connected MST fixture
17 NX is supported for this application, consult Brand for use with other controls systems
18 Not available with DTS,GTD,ATSD
19 Not available with LUTH or LUT5
20 All fixtures in a row must be the same driver type and voltage
21 Includes quick-connect wiring harness
22 Suspension support required at every fixture coupling; see Mounting Accessories Guide

NX In-Fixture Control Options:

23 Standard PAF when this option is chosen
24 Control Options include Injection Molded ABS End Cap
25 Fixtures with Control Options are Dry Location rated only
26 Only available with 0–10V dimming drivers (ED, ED1 & EDD)
27 Not available with surface mounting
28 Not available in 2ft when SpectraSync and SpectraSAFE are chosen

Third-Party Control Options:

29 LVS, LVR and ODPG only available with DALIP driver option
30 VIVE is a trademark of Lutron Electronics Co., Inc
31 Not available with SpectraSync (2750T or 2765T)

Accessory Notes:

32 See Columbia Mounting Accessories page for additional options

HUBBELL Lighting

MPS

MULTIPURPOSE LINEAR

ORDERING GUIDE (CONTINUED)

CONTINUOUS ROW MOUNT EXAMPLE GUIDE					
Continuous Row Length	MPS4	MPS8	MPSCRK-*	CM**SCF*-KIT	CM**NF-KIT
12' — Option 1	1	1	1	1	1
12' — Option 2	3	0	2	1	1
16' — Option 1	0	2	1	1	1
16' — Option 2	2	1	2	1	2
32' — Option 1	0	4	3	2	1
32' — Option 2	2	3	4	2	1

Link to Columbia Mounting Accessories page

PRODUCT EXCEPTIONS & DETAILS

Driver options listed below are available for the outputs as shown.

DRIVER AVAILABILITY TABLE — 2'							
	VW	MW	MWHE	LW	LWHE	ML	HL
E	x	x	x	x	x	x	x
ED	x	x	x	x	x	x	x
ED1	x	x	x	x	x	x	x
EDD	x	x		x		x	x
ESD	x	x		x		x	x
LUT5	x	x		x		x	x
LUTH	x	x		x		x	x
347	x	x		x		x	x
DALIP	x	x	x	x	x	x	x

DRIVER AVAILABILITY TABLE — 4' & 8'														
	XW	XWHE	VW	VWHE	MW	MWHE	LW	LWHE	ML	MLHE	HL	HLHE	VL	XL
E	x	x	x	x	x	x	x	x	x	x	x	x	x	x
ED	x	x	x	x	x	x	x	x	x	x	x	x	x	x
ED1	x	x	x	x	x	x	x	x	x	x	x	x	x	x
EDD	x		x		x		x		x		x		x	x
ESD	x		x		x		x		x		x		x	x
347	x		x		x		x		x		x		x	x
LUT5	x		x		x		x		x		x			
LUTH	x		x		x		x		x		x			
DALIP	x	x	x	x	x	x	x	x	x	x	x	x	x	x

TEMPERATURE TABLE (C°) — 4' & 8'											
		80 CRI									
		E/ED/ED1		ESDU		ED347		EDD		LUT	
Size	Lumen Package	Ceiling/ Surface Mount	Pendant/ TH Mount	Ceiling/ Surface Mount	Pendant/ TH Mount	Ceiling/ Surface Mount	Pendant/ TH Mount	Ceiling/ Surface Mount	Pendant/ TH Mount	Ceiling/ Surface Mount	Pendant/ TH Mount
2'	VW	35	40	35	40	35	40	35	40	35	40
	MW	35	40	35	40	35	40	35	40	35	40
	LW	35	40	35	40	35	40	35	40	35	40
	ML	35	40	35	40	35	40	35	40	35	40
	HL	30	35	30	35	30	35	30	35	30	35
	XW	35	45	35	45	35	45	30	35	30	35
4'	VW	35	45	35	45	35	45	30	35	30	35
	MW	35	45	35	45	35	45	30	35	30	35
	LW	35	45	35	45	35	45	30	35	30	35
	ML	35	45	35	45	35	45	30	35	30	35
	HL	35	40	35	40	35	40	25	30	30	35
	VL	30	30	30	30	30	30	30	30	—	—
	XL*	25	25	25	25	25	25	25	25	—	—
8'	XW	35	45	35	45	35	45	30	35	30	35
	VW	35	45	35	45	35	45	30	35	30	35
	MW	35	45	35	45	35	45	30	35	30	35
	LW	35	45	35	45	35	45	30	35	30	35
	ML	35	45	35	45	35	45	30	35	30	35
	VL	30	30	30	30	30	30	30	30	—	—
	XL*	25	25	25	25	25	25	25	25	—	—

*XL not available with thru wire

Columbia LIGHTING

MPS

MULTIPURPOSE LINEAR

CONTROLS

NX Distributed Intelligence™ Lighting Controls:

Supports both indoor and outdoor applications in a variety of deployment options- wired, wireless, hybrid.
Integrates with and enables a wide array of luminaires including those with SpectraSync™ Color Tuning Technology.

NX DISTRIBUTED™ INTELLIGENCE

NX INTEGRATED CONTROLS REFERENCE								
NX Option	Sensor	Networkable	Scheduling	Occupancy	Daylight Harvesting	0–10V Dimming	On/off Control	Bluetooth® App Programming
NX Standalone								
NXS	NXSMP-SMI	No	Yes	Yes	Yes	Yes	Yes	Yes
NX Networked – Wired								
NXE	N/A	Yes	Yes	No	No	Yes	Yes	Requires NXBTC/R[1]
NXES	NXSMP-SMI	Yes	Yes	Yes	Yes	Yes	Yes	Yes
NX Networked – Wireless								
NXSW	NXSMP-SMI	Yes	Yes	Yes	Yes	Yes	Yes	Yes
NXWE	N/A	Yes	Yes	No	No	Yes	Yes	No[2]

1 NXBTC/R needs to be plugged into an available NX SmartPORT™ on the fixture network
2 To program NXWE option, need to consult factory. If connected to an area controller, programming can be done from that

Philips EasySense Controls ODPG Sensor:

- Occupancy sensing, daylight harvesting, task tuning and grouping in one device
- Standalone control or grouping to wireless switches[1]
- Uses Philips field apps for on site commissioning[2,3]
- Ability to create scenes for various room configurations
- Cost-effective solution for energy-savings and code-compliancy strategies
- DLC® Qualified: Listed on the QPL for Networked Lighting Controls. Please refer to the DLC website for specific product qualifications at www.designlights.org

1 Wireless switches only compatible with ODPG Philips EasySense
2 See link to Philips commssioning
3 Requires android device or IR dongle. See links for phone compatiblity and IR dongle

Wireless Switch Accessories[1]

☐	PESR-WH	EasySense compatible wireless single rocker switch, white
☐	PEDR-WH	EasySense compatible wireless dual rocker switch, white

SPECTRASAFE

SpectraSAFE™ Integrated Surveillance Lighting System

Technical Features

- High resolution 1080p full HD camera
- 2.8mm lens / 140° field of view
- IR emitter for low / no-light conditions
- Multiple wiring configurations available
- Supports 2-way audio communication
- Supports 2.4GHz WPA-PSK/WPA2-PSK Wi-Fi
- Data encrypted using AES 256 standard
- Low power consumption (2-5W)
- Transmissions secured using Open TLS / SSL

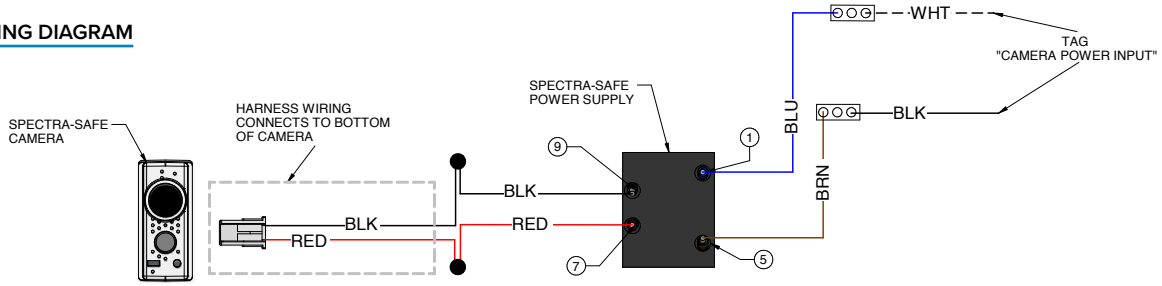
Note: Camera and end cap add 2.2" to the overall length.

Software & Support

- Free Android, iOS and web-based app
- Versatile and supports multiple applications
- Multi-tenant web-based camera application
- Phone and in-app chat technical support
- Scalable cloud services and video storage
- Supported by a 5-year warranty

SPECTRASAFE WIRING DIAGRAM

Power Supply	
Pin Connections	
Pin#	Single
1	VAC in (N)
5	VAC in (L)
7	+Vout
9	-Vout



HUBBELL Lighting

CONTROLS (CONTINUED)

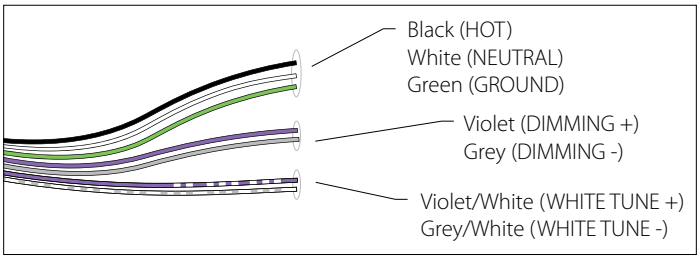
SpectraSync™ Color Tuning Technology:

Control your space based on the needs of the application, specific activities throughout the day and preferences of the occupants with distinct SpectraSync™ Color Tuning Technologies.

SPECTRASYNC COLOR TUNING TECHNOLOGY		
Mode	Kelvin Range	Description
Tunable White	2700K–5000K 2700K–6500K	Offers users the ability to tailor CCT to their personal preference, enhancing task visibility, material and colors or the aesthetics of the space

SpectraSync Tunable White

Available in two options: 2750T (2700K–5000K) or 2765T (2700K–6500K).
Requires two 0–10V controllers, one for intensity and one for CCT.
Minimum 5% dimming.

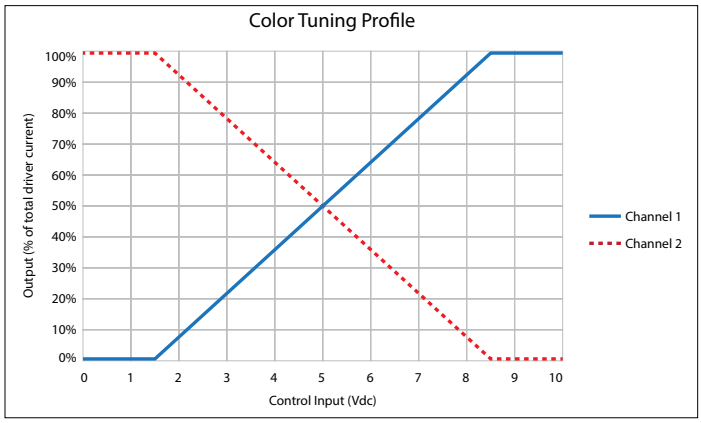


SpectraSync Tunable White luminaires are provided with two 0–10V circuits. The violet and grey circuit is for wiring to any qualified 0–10V controller for dimming. The violet/white and grey/white circuit is for wiring to any qualified 0–10V controller for Tunable White CCT control.

Controller Manufacturer Data

SpectraSync Tunable White was designed to be used with sinking style dimmers (provided by others) and is compatible with:

- Hubbell Control Solutions (HCS): NX Distributed Intelligence™ Room Controllers (NXRC) and In-fixture Controllers (NXFM)
- Lutron: DVTV, DVSTV, and NFTV dimmers
- Wattstopper: ADF120277 and CD4BL (Titan) dimmers



To enable scheduling and for use with NX wall control preset stations please refer to Hubbell Control Solutions NX SpectraSync technical sheet.

SPECTRASYNC™ AND NX AVAILABILITY TABLE

		Only With 80 CRI No Battery Pack			Only With 80 CRI With Battery Pack		
Size	Lumen package	CTC	NX	CTC+NX	CTC	NX	CTC+NX
2ft	VW	Y	Y	N	—	—	—
	MW	Y	Y	N	—	—	—
	LW	Y	Y	N	—	—	—
	ML	N	Y	N	—	—	—
	HL	N	Y	N	—	—	—
4ft	XW	Y	Y	Y	Y	Y	Y
	VW	Y	Y	Y	Y	Y	Y
	MW	Y	Y	Y	Y	Y	Y
	LW	Y	Y	Y	Y	Y	Y
	ML	Y	Y	Y	Y	Y	Y
	HL	Y	Y	Y	Y	Y	Y
	VL	N	Y	N	N	Y	N
	XL	N	Y	N	N	Y	N
8ft	XW	Y	Y	Y	Y	Y	Y
	VW	Y	Y	Y	Y	Y	Y
	MW	N	Y	N	N	Y	N
	LW	N	Y	N	N	Y	N
	ML	N	Y	N	N	Y	N
	HL	N	Y	N	N	Y	N
	VL	N	Y	N	N	Y	N
	XL	N	Y	N	N	Y	N

Columbia LIGHTING

MPS

MULTIPURPOSE LINEAR

DATE: LOCATION:

TYPE: PROJECT:

CATALOG #:

DELIVERED LUMENS

STANDARD EFFICACY PERFORMANCE TABLE						
FIXTURE	COLOR	LENS	DISTRIBUTION	LUMENS	INPUT WATTS	LPW
MPS2-VW	3500K	Curve	Wide	1659	13.8	120
			Narrow	1597	13.5	118
		Flat	Wide	1584	13.5	117
		No Lens		1724	13.8	125
	4000K	Curve	Wide	1681	13.8	122
			Narrow	1618	13.5	120
		Flat	Wide	1604	13.5	119
		No Lens		1746	13.8	127
MPS2-MW	3500K	Curve	Wide	2201	18.2	121
			Narrow	2092	17.8	118
		Flat	Wide	2076	17.8	117
		No Lens		2287	18.2	126
	4000K	Curve	Wide	2229	18.2	122
			Narrow	2119	17.8	119
		Flat	Wide	2102	17.8	118
		No Lens		2316	18.2	127
MPS2-LW	3500K	Curve	Wide	2444	20.4	120
			Narrow	2328	19.9	117
		Flat	Wide	2309	19.9	116
		No Lens		2540	20.4	124
	4000K	Curve	Wide	2475	20.4	121
			Narrow	2358	19.9	118
		Flat	Wide	2338	19.9	118
		No Lens		2572	20.4	126
MPS2-ML	3500K	Curve	Wide	3452	29	119
			Narrow	3447	28.8	120
		Flat	Wide	3414	28.8	119
		No Lens		3587	29	124
	4000K	Curve	Wide	3496	29	121
			Narrow	3491	28.8	121
		Flat	Wide	3458	28.8	120
		No Lens		3632	29	125
MPS2-HL	3500K	Curve	Wide	3655	31.7	115
			Narrow	3707	31.5	118
		Flat	Wide	3678	31.5	117
		No Lens		3797	31.7	120
	4000K	Curve	Wide	3701	31.7	117
			Narrow	3754	31.5	119
		Flat	Wide	3725	31.5	118
		No Lens		3846	31.7	121
MPS4-XW	3500K	Curve	Wide	2574	20	129
			Narrow	2574	20	129
		Flat	Wide	2463	20	123
		No Lens		2674	20	134
	4000K	Curve	Wide	2606	20	130
			Narrow	2574	20	129
		Flat	Wide	2494	20	125
		No Lens		2708	20	135
MPS4-VW	3500K	Curve	Wide	3279	26.7	123
			Narrow	3152	26.5	119
		Flat	Wide	3134	26.5	118
		No Lens		3450	26.7	129
	4000K	Curve	Wide	3321	26.7	124
			Narrow	3192	26.5	120
		Flat	Wide	3174	26.5	120
		No Lens		3564	26.7	133
MPS4-MW	3500K	Curve	Wide	3656	30.4	120
			Narrow	3511	30.1	117
		Flat	Wide	3491	30.1	116
		No Lens		3847	30.4	127
	4000K	Curve	Wide	3702	30.4	122
			Narrow	3556	30.1	118
		Flat	Wide	3535	30.1	117
		No Lens		3974	30.4	131
MPS4-LW	3500K	Curve	Wide	4043	34.4	118
			Narrow	4094	32.5	126
		Flat	Wide	4072	32.5	125
		No Lens		4255	34.4	124
	4000K	Curve	Wide	4095	34.4	119
			Narrow	4147	32.5	128
		Flat	Wide	4124	32.5	127
		No Lens		4395	34.4	128

HUBBELL Lighting

DELIVERED LUMENS (CONTINUED)

STANDARD EFFICACY PERFORMANCE TABLE						
FIXTURE	COLOR	LENS	DISTRIBUTION	LUMENS	INPUT WATTS	LPW
MPS4-ML	3500K	Curve	Wide	4556	40.1	114
			Narrow	4649	37.7	123
		Flat	Wide	4625	37.8	122
		No Lens		4794	40.1	120
	4000K	Curve	Wide	4614	40.1	115
			Narrow	4709	37.7	125
		Flat	Wide	4684	37.8	124
		No Lens		4952	40.1	123
MPS4-HL	3500K	Curve	Wide	5760	49.5	116
			Narrow	5781	49.4	117
		Flat	Wide	5741	49.4	116
		No Lens		6061	49.5	122
	4000K	Curve	Wide	5833	49.5	118
			Narrow	5855	49.4	119
		Flat	Wide	5814	49.4	118
		No Lens		6261	49.5	126
MPS4-VL	3500K	Curve	Wide	6769	54.1	125
			Narrow	6675	54.1	123
		Flat	Wide	6637	54.1	123
		No Lens		7122	54.1	132
	4000K	Curve	Wide	6855	54.1	127
			Narrow	6760	54.1	125
		Flat	Wide	6722	54.1	124
		No Lens		7357	54.1	136
MPS4-XL	3500K	Curve	Wide	8045	66.5	121
			Narrow	7878	66.8	118
		Flat	Wide	7813	66.9	117
		No Lens		8466	66.5	127
	4000K	Curve	Wide	8148	66.5	123
			Narrow	7979	66.8	119
		Flat	Wide	7913	66.9	118
		No Lens		8745	66.5	132
MPS8-XW	3500K	Curve	Wide	5147	40	129
			Narrow	4939	39.8	124
		Flat	Wide	4925	40	123
		No Lens		5348	40	134
	4000K	Curve	Wide	5213	40	130
			Narrow	5002	39.8	126
		Flat	Wide	4988	40	125
		No Lens		5416	40	135
MPS8-VW	3500K	Curve	Wide	6558	53.4	123
			Narrow	6303	53	119
		Flat	Wide	6269	53	118
		No Lens		6814	53.4	128
	4000K	Curve	Wide	6642	53.4	124
			Narrow	6384	53	120
		Flat	Wide	6349	53	120
		No Lens		6901	53.4	129
MPS8-MW	3500K	Curve	Wide	7311	60.8	120
			Narrow	7022	60.2	117
		Flat	Wide	6981	60.2	116
		No Lens		7596	60.8	125
	4000K	Curve	Wide	7405	60.8	122
			Narrow	7112	60.2	118
		Flat	Wide	7071	60.2	117
		No Lens		7693	60.8	127
MPS8-LW	3500K	Curve	Wide	8087	68.8	118
			Narrow	8189	65	126
		Flat	Wide	8144	65	125
		No Lens		8402	68.8	122
	4000K	Curve	Wide	8190	68.8	119
			Narrow	8293	65	128
		Flat	Wide	8248	65	127
		No Lens		8510	68.8	124
MPS8-ML	3500K	Curve	Wide	9111	80.2	114
			Narrow	9298	75.4	123
		Flat	Wide	9250	75.6	122
		No Lens		9466	80.2	118
	4000K	Curve	Wide	9227	80.2	115
			Narrow	9417	75.4	125
		Flat	Wide	9368	75.6	124
		No Lens		9587	80.2	120

MPS

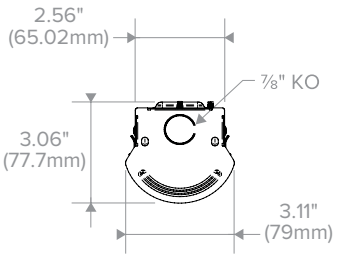
MULTIPURPOSE LINEAR

DELIVERED LUMENS (CONTINUED)

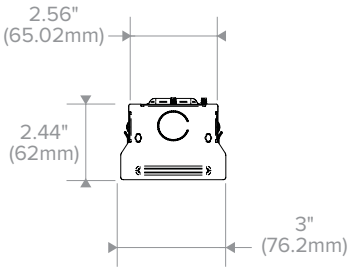
STANDARD EFFICACY PERFORMANCE TABLE						
FIXTURE	COLOR	LENS	DISTRIBUTION	LUMENS	INPUT WATTS	LPW
MPS8-HL	3500K	Curve	Wide	11520	99	116
			Narrow	11562	98.8	117
		Flat	Wide	11481	98.8	116
		No Lens		11969	99	121
	4000K	Curve	Wide	11667	99	118
			Narrow	11710	98.8	119
		Flat	Wide	11628	98.8	118
		No Lens		12122	99	122
MPS8-VL	3500K	Curve	Wide	13537	108.2	125
			Narrow	13350	108.2	123
		Flat	Wide	13275	108.2	123
		No Lens		14065	108.2	130
	4000K	Curve	Wide	13710	108.2	127
			Narrow	13521	108.2	125
		Flat	Wide	13444	108.2	124
		No Lens		14245	108.2	132
MPS8-XL	3500K	Curve	Wide	16091	133	121
			Narrow	15757	133.6	118
		Flat	Wide	15626	133.8	117
		No Lens		16718	133	126
	4000K	Curve	Wide	16296	133	123
			Narrow	15958	133.6	119
		Flat	Wide	15826	133.8	118
		No Lens		16932	133	127

DIMENSIONS

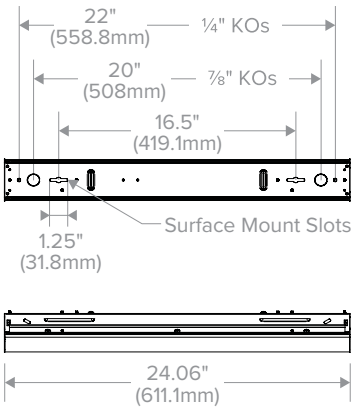
MPS END View - Curve Lens



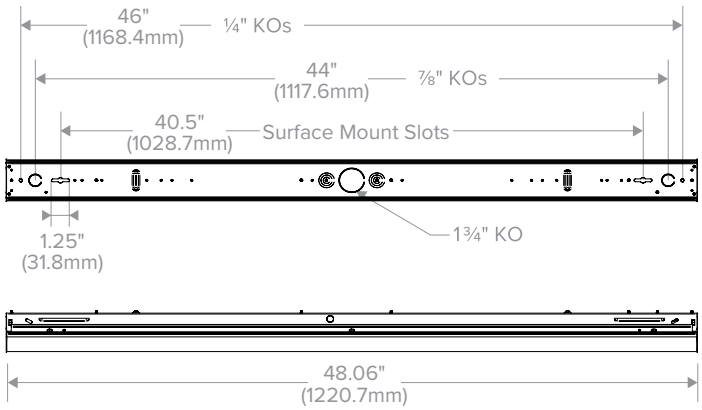
MPS END View - FLAT Lens



MPS 2' Dimensions



MPS 4' Dimensions

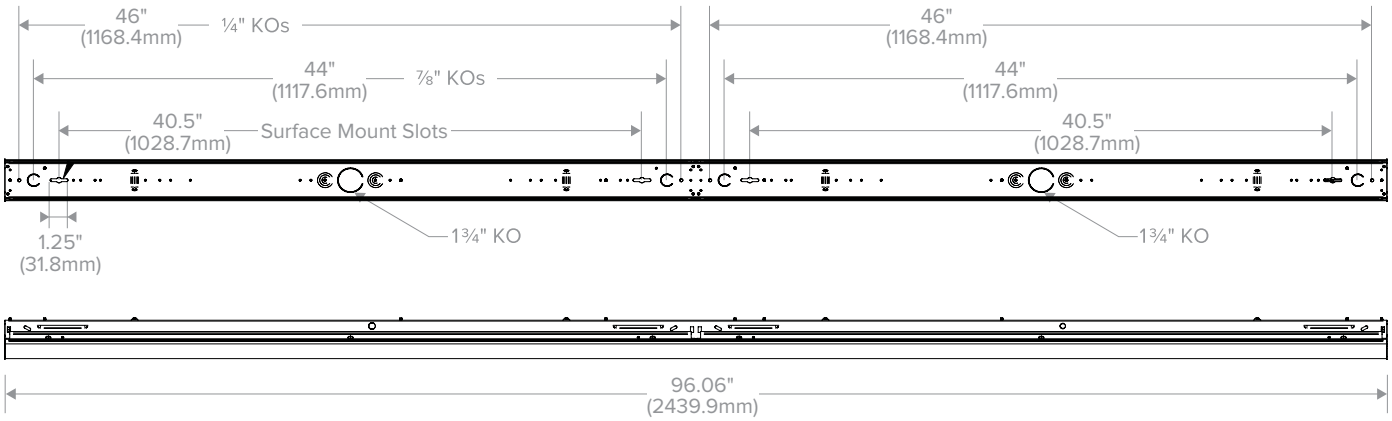


MPS

MULTIPURPOSE LINEAR

DIMENSIONS (CONTINUED)

MPS 8' Dimensions



PHOTOMETRY

MPS4-40ML-CN-EDU

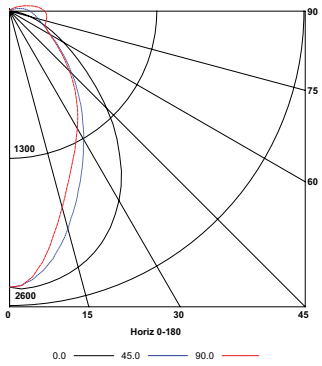
LUMINAIRE DATA

Test No.	**19735**
Description	**MultiPurpose Linear, Narrow, LED 4ft, Frosted Linear Prismed Lens**
Delivered Lumens	**4742**
Watts	**37.70**
Efficacy	**126**
Mounting	**Surface**
Spacing Criterion	**0° = 1.18 90° = 1.77**

ZONAL LUMEN SUMMARY

Zone	Lumens	% Luminaire
0–30	1542	32.5
0–40	2326	49.1
0–60	3518	74.2
0–90	4385	92.5
0–180	4742	100

POLAR GRAPH



MPS4-40ML-CW-EDU

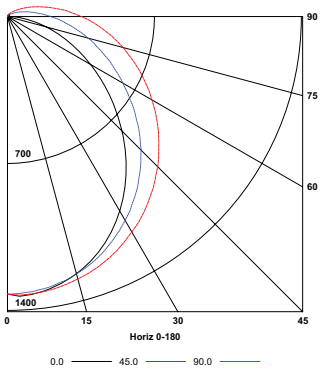
LUMINAIRE DATA

Test No.	**19600**
Description	**MultiPurpose Linear, Wide, LED 4ft, Frosted Linear Prismed Lens**
Delivered Lumens	**4615**
Watts	**40.10**
Efficacy	**115**
Mounting	**Surface**
Spacing Criterion	**0° = 1.20 90° = 1.33**

ZONAL LUMEN SUMMARY

Zone	Lumens	% Luminaire
0–30	1029	22.3
0–40	1688	36.6
0–60	3019	65.4
0–90	4248	92
0–180	4615	100

POLAR GRAPH



PHOTOMETRY
IES
PDF
IES
PDF

Columbia LIGHTING

MPS

MULTIPURPOSE LINEAR

DATE: LOCATION:

TYPE: PROJECT:

CATALOG #:

PHOTOMETRY (CONTINUED)

MPS4-40ML-FW-EDU

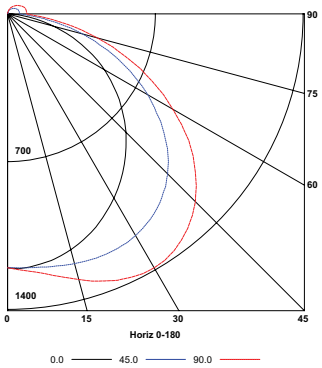
LUMINAIRE DATA

Test No.	**19652**
Description	**MultiPurpose Linear, Wide, LED 4ft, Frosted Linear Prismed Lens**
Delivered Lumens	**4685**
Watts	**37.80**
Efficacy	**124**
Mounting	**Surface**
Spacing Criterion	**0° = 1.24 90° = 1.67**

ZONAL LUMEN SUMMARY

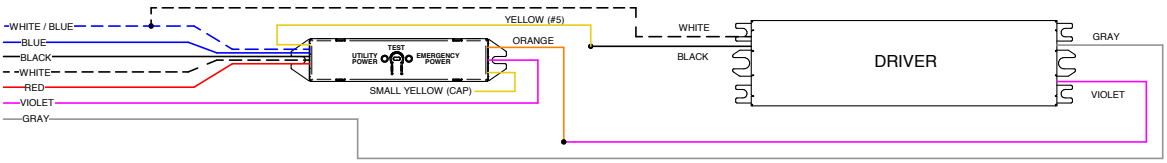
Zone	Lumens	% Luminaire
0–30	1026	21.9
0–40	1756	37.5
0–60	3324	70.9
0–90	4435	94.7
0–180	4685	100

POLAR GRAPH



ADDITIONAL INFORMATION

DTS WIRING DIAGRAM (0–10V DIMMING DRIVER SHOWN)



WHITE/BLUE	Emergency Neutral
BLUE	Emergency Line
BLACK	Utility Line (Unswitched Hot)
WHITE	Utility Neutral
RED	Switched Hot
VIOLET	Dimming
GRAY	Dimming

IES PDF DTS Integration Guide

HUBBELL Lighting

Columbia LIGHTING

DATE: LOCATION:

TYPE: PROJECT:

CATALOG #:

MPS

MULTIPURPOSE LINEAR

FEATURES

- Uninterrupted ribbon of light; row mounting optional
- Long life 60,000 hour LEDs at L80 for reduced maintenance
- Superior color consistency within a 3-step MacAdam ellipse and greater than 80 CRI
- Available in 2', 4' or 8' lengths
- Optional integral emergency battery pack
- Three lens options as well as less lens (NL)
- Modular replaceable LED boards and driver accessible for future maintenance or upgrades
- Surface mount, wall mount or suspended

Built to UL 924 Standards

BUY AMERICAN SOLUTIONS

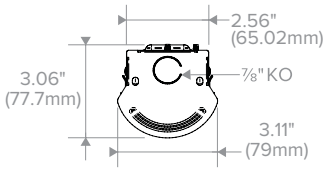
See Certification Specifications

RELATED PRODUCTS

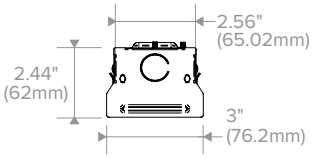
Revalume™ Linear Wrap

Reverie™ Decorative Low Bay

End View—Curve Lens



End View—Flat Lens



CONTROL TECHNOLOGY

SpectraSync™ Color Tuning Technology

NX DISTRIBUTED™ INTELLIGENCE

SPECTRASAFE™

SPECIFICATIONS

CONSTRUCTION

- Housing, wireway, and ends are formed from code-gauge steel
- Housing components act as heat sink for LED heat dissipation
- White painted parts are treated with a five stage phosphate bonding process and finished with high reflectance baked enamel

OPTICS

- Available with or without frosted acrylic lens

INSTALLATION

- Knockouts are provided for electrical access and mounting

ELECTRICAL

- Long-life LEDs are rated for 60,000 hours at L80 lumen maintenance
- Driver options include fixed output for on/off function, step dimming (high/low/off), or continuous 0–10V dimming
- Superior drivers and long-life LEDs provide quality illumination for prolonged service life
- Drivers < 10% THD at 120V, power factor > 0.95

CONTROLS

- Optional SpectraSync™ offers two modes of Tunable White solutions and integrates seamlessly into a variety of control systems
- NX Distributed Intelligence™ provides options for standalone and networked integrated sensor with wired or wireless connectivity for NX system deployments

TECHNOLOGY

- SpectraSAFE™ is a scalable, cloud-enabled and lighting-based wireless video security solution for interior commercial and industrial applications

CERTIFICATIONS

- IC label is standard for recessed products
- All luminaires are built to UL 1598 and 2108 standards, and bear appropriate cCSAus labels
- Damp Location label standard
- CSA certified to UL 924 standards with battery pack or DTS (Dimming Bypass Module) options

CERTIFICATIONS (CONTINUED)

- Adheres to LM79, LM80, and TM21 industry standards
- The DTS, Dimming Bypass Module, is for emergency circuit control loads including sensors and wireless systems CSA certified to UL 924. See page 10 for wiring diagram. Link to Dimming Bypass Module Specification sheet
- This product qualifies as a "designated country construction material" per FAR 52.225-11 Buy American-Construction Materials under Trade Agreements effective 06/01/2020. See Buy American Solutions

WARRANTY

- 5 year warranty
- See HLI Standard Warranty for additional information

KEY DATA	
Lumen Range	1377–16,833
Wattage Range	13.5–133.8
Efficacy Range (LPW)	111–142
Reported Life (Hours)	L80–60,000

HUBBELL Lighting

Columbia LIGHTING

DATE: LOCATION:

TYPE: PROJECT:

CATALOG #:

MPS

MULTIPURPOSE LINEAR

ORDERING GUIDE

Example: MPS4–40ML–CW–EDU

CATALOG #

MPS –

Model	Size [1]	CRI
MPS MultiPurpose Linear	**2** 2'	**Blank** >80
	4 4'	**9** 90 [2]
	8 8'	

Color Temp	
30	3000K
35	3500K
40	4000K
50	5000K
2750T	2700K–5000K SpectraSync™ Tunable White [3]
2765T	2700K–6500K SpectraSync™ Tunable White [3]

Nominal Lumens [4]			
XW	4' (2700), 8' (5400)	**LWHE**	2' (2600), 4' (4100), 8' (8200)
XWHE	4' (2500), 8' (5000)	**ML**	2' (3600), 4' (4800), 8' (9500)
VW	2' (1700), 4' (3400), 8' (6900)	**MLHE**	4' (4700), 8' (9400)
VWHE	4' (3300), 8' (6600)	**HL**	2' (3800), 4' (6000), 8' (12,000)
MW	2' (2300), 4' (3800), 8' (7700)	**HLHE**	4' (5700), 8' (11,500)
MWHE	2' (2100), 4' (3700), 8' (7400)	**VL**	4' (7100), 8' (14,200)
LW	2' (2500), 4' (4200), 8' (8400)	**XL**	4' (8400), 8' (17,000)

Lens	
C	Curve, Frosted Acrylic
F	Flat, Frosted Acrylic
NL	Less Lens
CP	Curve, Frosted Polycarbonate

Distribution [5]	
N	Narrow Distribution [6]
W	Wide Distribution

–

Driver	
E	Fixed Output
ED	0-10V Dimming
ED1	0-10V 1% Dimming
EDD	0-10V Dim-to-Dark
ESD	Step Dimming
LUTH	Hi-lume 1% EcoSystem LED driver with Soft-on, Fade-to-Black dimming technology [7]
LUT5	5-Series EcoSystem LED driver [7]
DALIP	DALI Power Bus [8]

Voltage	
U	120V-277V
347	347V (E, ED, ED1 only)

–

Options	
ELL14	Emergency Battery Pack, 10W [9,10,11]
ELL14H2	Emergency Battery Pack, 2-Hour Run Time [9,10,11]
GLR	Fast Blow Fuse
GTD	Generator Transfer Device [12]
DTS	Dimming Bypass Module [13]
MPSCE	Injection Molded ABS Material Curve Endcap [23]
MPSCE-MB	Injection Molded ABS Material Curve Endcap, Matte Black
MPSFE	Injection Molded ABS Material Flat Endcap [23]
MPSFE-MB	Injection Molded ABS Material Flat Endcap, Matte Black
MB	Matte Black
ZT	ZET Metallic Silver
PAF	Painted After Fabrication
SAF	SpectraSAFE™ Integrated Surveillance Lighting System [14]
MST	MASTER fixture that controls one or more SATELLITE fixtures in a continuous row application [15,16,17,18,19,20,21]
SAT	SATELLITE fixture controlled by MASTER fixture in a continuous row application [16,17,18,19,20,21]
INT	Intermediate (provides ends with wiring access for continuous row mounting) [18,20,21,22]
EOR	End of Row (provides end wiring access for continuous row mounting) [18,20,21,22]

Control Options [23, 24, 25]	
NX Standalone	
NXS	NX, PIR BT Occupancy/Daylight Sensor, Slide Mount [26,28]
NX Networked – Wired	
NXE	NX, Dual SmartPORTs [26,27,28]
NXES	NX, PIR BT Occupancy/Daylight Sensor, Slide Mount, Dual SmartPORTs [26,27,28]
NX Networked – Wireless	
NXSW	NX Wireless, PIR BT Occupancy/Daylight Sensor [26,28]
NXWE	NX Wireless Enabled [26,28]
Third-Party Control Options	
ODPG	Occupancy and Daylight Sensors w/ Grouping, Philips SNS200 [29,31]
LVR	Lutron Vive Integral Fixture Control DFCSJ-OEM-RF (RF only) [29,30,31]
LVS	Lutron Vive Integral Fixture Control DFCSJ-OEM-OCC (RF with daylight and occupancy sensing) [29,30,31]

Accessories

☐	**S18**	18" Stem, Canopy
☐	**SS18**	18" Swivel Stem—45° Swivel
☐	**CM24SCF3-KIT**	24" Adjustable Cable Mounting Kit, 3-wire feed [32]
☐	**CM48SCF3-KIT**	48" Adjustable Cable Mounting Kit, 3-wire feed [32]
☐	**CM24NF-KIT**	Single Point Non-Feed Cable Mount with Canopy, Single - 24" [32]
☐	**CM48NF-KIT**	Single Point Non-Feed Cable Mount with Canopy, Single - 48" [32]
☐	**CSHC**	Chain Hanger Assembly
☐	**MPSZT**	Zip Tee Hanger - 1½" Spacer on T-Bar Ceiling
☐	**MPSTH**	Slide Tong Hanger
☐	**MPSCRK-C**	Continuous Row Kit, Curve
☐	**MPSCRK-F**	Continuous Row Kit, Flat
☐	**MPSWG2**	2' Wire Guard
☐	**MPSWG4**	4' Wire Guard, two Required for 8' Fixture
☐	**MPSCE**	Injection Molded ABS Material Curve Endcap
☐	**MPSCE-MB**	Injection Molded ABS Material Curve Endcap, Matte Black
☐	**MPSFE**	Injection Molded ABS Material Flat Endcap
☐	**MPSFE-MB**	Injection Molded ABS Material Flat Endcap, Matte Black

Notes:

1 For continuous row mounting, see Continuous Row Mount Example Guide on page 3
2 Not available with HE lumen packages
3 See SpectraSync and NX Availability Table on page 6
4 High efficacy versions designated with "HE"
5 Applicable to lens only
6 Only available with Curve, Frosted Acrylic lens
7 Not available in VL, XL, HE packages
8 DALIP only available when LVS, LVR or ODPG control options are selected
9 Delivered Emergency Lumens = ELL14 = 1210 lms
10 Not available in 2ft size or with thru wire on XL 4ft and 8ft
11 Emergency battery pack max ambient temperature: 25˚C
12 Only available with fixed output driver
13 For emergency circuit control loads including sensors and wireless systems CSA certified to UL 924. Not availble with ESD driver option. Universal voltage only. DTS with 2' cannot be combined with Controls or SpectraSync options. See page 10 for wiring diagram
14 SpectraSync+NX+SAF can not be configured. Only available with NXE or NXWE. Not available in 347V

Continuous-Row Options:

15 MST option not available with INT row position
16 Multiple SAT fixtures can be controlled by one MST fixture. Any one SAT fixture can have no more than one connected MST fixture
17 NX is supported for this application, consult Brand for use with other controls systems
18 Not available with DTS,GTD,ATSD
19 Not available with LUTH or LUT5
20 All fixtures in a row must be the same driver type and voltage
21 Includes quick-connect wiring harness
22 Suspension support required at every fixture coupling; see Mounting Accessories Guide

NX In-Fixture Control Options:

23 Standard PAF when this option is chosen
24 Control Options include Injection Molded ABS End Cap
25 Fixtures with Control Options are Dry Location rated only
26 Only available with 0–10V dimming drivers (ED, ED1 & EDD)
27 Not available with surface mounting
28 Not available in 2ft when SpectraSync and SpectraSAFE are chosen

Third-Party Control Options:

29 LVS, LVR and ODPG only available with DALIP driver option
30 VIVE is a trademark of Lutron Electronics Co., Inc
31 Not available with SpectraSync (2750T or 2765T)

Accessory Notes:

32 See Columbia Mounting Accessories page for additional options

HUBBELL Lighting

MPS

MULTIPURPOSE LINEAR

ORDERING GUIDE (CONTINUED)

CONTINUOUS ROW MOUNT EXAMPLE GUIDE					
Continuous Row Length	MPS4	MPS8	MPSCRK-*	CM**SCF*-KIT	CM**NF-KIT
12' — Option 1	1	1	1	1	1
12' — Option 2	3	0	2	1	1
16' — Option 1	0	2	1	1	1
16' — Option 2	2	1	2	1	2
32' — Option 1	0	4	3	2	1
32' — Option 2	2	3	4	2	1

Link to Columbia Mounting Accessories page

PRODUCT EXCEPTIONS & DETAILS

Driver options listed below are available for the outputs as shown.

DRIVER AVAILABILITY TABLE — 2'							
	VW	MW	MWHE	LW	LWHE	ML	HL
E	x	x	x	x	x	x	x
ED	x	x	x	x	x	x	x
ED1	x	x	x	x	x	x	x
EDD	x	x		x		x	x
ESD	x	x		x		x	x
LUT5	x	x		x		x	x
LUTH	x	x		x		x	x
347	x	x		x		x	x
DALIP	x	x	x	x	x	x	x

DRIVER AVAILABILITY TABLE — 4' & 8'														
	XW	XWHE	VW	VWHE	MW	MWHE	LW	LWHE	ML	MLHE	HL	HLHE	VL	XL
E	x	x	x	x	x	x	x	x	x	x	x	x	x	x
ED	x	x	x	x	x	x	x	x	x	x	x	x	x	x
ED1	x	x	x	x	x	x	x	x	x	x	x	x	x	x
EDD	x		x		x		x		x		x		x	x
ESD	x		x		x		x		x		x		x	x
347	x		x		x		x		x		x		x	x
LUT5	x		x		x		x		x		x			
LUTH	x		x		x		x		x		x			
DALIP	x	x	x	x	x	x	x	x	x	x	x	x	x	x

TEMPERATURE TABLE (C°) — 4' & 8'											
		80 CRI									
		E/ED/ED1		ESDU		ED347		EDD		LUT	
Size	Lumen Package	Ceiling/ Surface Mount	Pendant/ TH Mount	Ceiling/ Surface Mount	Pendant/ TH Mount	Ceiling/ Surface Mount	Pendant/ TH Mount	Ceiling/ Surface Mount	Pendant/ TH Mount	Ceiling/ Surface Mount	Pendant/ TH Mount
2'	VW	35	40	35	40	35	40	35	40	35	40
	MW	35	40	35	40	35	40	35	40	35	40
	LW	35	40	35	40	35	40	35	40	35	40
	ML	35	40	35	40	35	40	35	40	35	40
	HL	30	35	30	35	30	35	30	35	30	35
	XW	35	45	35	45	35	45	30	35	30	35
4'	VW	35	45	35	45	35	45	30	35	30	35
	MW	35	45	35	45	35	45	30	35	30	35
	LW	35	45	35	45	35	45	30	35	30	35
	ML	35	45	35	45	35	45	30	35	30	35
	HL	35	40	35	40	35	40	25	30	30	35
	VL	30	30	30	30	30	30	30	30	—	—
	XL*	25	25	25	25	25	25	25	25	—	—
8'	XW	35	45	35	45	35	45	30	35	30	35
	VW	35	45	35	45	35	45	30	35	30	35
	MW	35	45	35	45	35	45	30	35	30	35
	LW	35	45	35	45	35	45	30	35	30	35
	ML	35	45	35	45	35	45	30	35	30	35
	VL	30	30	30	30	30	30	30	30	—	—
	XL*	25	25	25	25	25	25	25	25	—	—

*XL not available with thru wire

Columbia LIGHTING

MPS

MULTIPURPOSE LINEAR

CONTROLS

NX Distributed Intelligence™ Lighting Controls:

Supports both indoor and outdoor applications in a variety of deployment options- wired, wireless, hybrid.
Integrates with and enables a wide array of luminaires including those with SpectraSync™ Color Tuning Technology.

NX DISTRIBUTED™ INTELLIGENCE

NX INTEGRATED CONTROLS REFERENCE								
NX Option	Sensor	Networkable	Scheduling	Occupancy	Daylight Harvesting	0–10V Dimming	On/off Control	Bluetooth® App Programming
NX Standalone								
NXS	NXSMP-SMI	No	Yes	Yes	Yes	Yes	Yes	Yes
NX Networked – Wired								
NXE	N/A	Yes	Yes	No	No	Yes	Yes	Requires NXBTC/R[1]
NXES	NXSMP-SMI	Yes	Yes	Yes	Yes	Yes	Yes	Yes
NX Networked – Wireless								
NXSW	NXSMP-SMI	Yes	Yes	Yes	Yes	Yes	Yes	Yes
NXWE	N/A	Yes	Yes	No	No	Yes	Yes	No[2]

1 NXBTC/R needs to be plugged into an available NX SmartPORT™ on the fixture network
2 To program NXWE option, need to consult factory. If connected to an area controller, programming can be done from that

Philips EasySense Controls ODPG Sensor:

- Occupancy sensing, daylight harvesting, task tuning and grouping in one device
- Standalone control or grouping to wireless switches[1]
- Uses Philips field apps for on site commissioning[2,3]
- Ability to create scenes for various room configurations
- Cost-effective solution for energy-savings and code-compliancy strategies
- DLC® Qualified: Listed on the QPL for Networked Lighting Controls. Please refer to the DLC website for specific product qualifications at www.designlights.org

1 Wireless switches only compatible with ODPG Philips EasySense
2 See link to Philips commssioning
3 Requires android device or IR dongle. See links for phone compatiblity and IR dongle

Wireless Switch Accessories[1]

☐	PESR-WH	EasySense compatible wireless single rocker switch, white
☐	PEDR-WH	EasySense compatible wireless dual rocker switch, white

SPECTRASAFE

SpectraSAFE™ Integrated Surveillance Lighting System

Technical Features

- High resolution 1080p full HD camera
- 2.8mm lens / 140° field of view
- IR emitter for low / no-light conditions
- Multiple wiring configurations available
- Supports 2-way audio communication
- Supports 2.4GHz WPA-PSK/WPA2-PSK Wi-Fi
- Data encrypted using AES 256 standard
- Low power consumption (2-5W)
- Transmissions secured using Open TLS / SSL

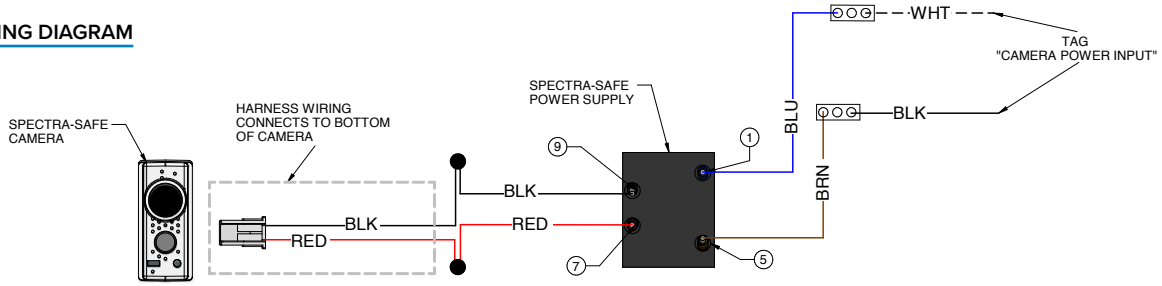
Note: Camera and end cap add 2.2" to the overall length.

Software & Support

- Free Android, iOS and web-based app
- Versatile and supports multiple applications
- Multi-tenant web-based camera application
- Phone and in-app chat technical support
- Scalable cloud services and video storage
- Supported by a 5-year warranty

SPECTRASAFE WIRING DIAGRAM

Power Supply	
Pin Connections	
Pin#	Single
1	VAC in (N)
5	VAC in (L)
7	+Vout
9	-Vout



HUBBELL Lighting

CONTROLS (CONTINUED)

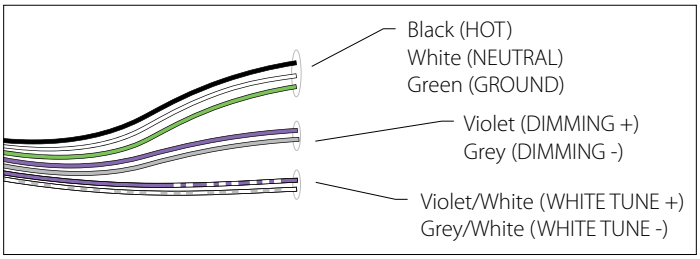
SpectraSync™ Color Tuning Technology:

Control your space based on the needs of the application, specific activities throughout the day and preferences of the occupants with distinct SpectraSync™ Color Tuning Technologies.

SPECTRASYNC COLOR TUNING TECHNOLOGY		
Mode	Kelvin Range	Description
Tunable White	2700K–5000K 2700K–6500K	Offers users the ability to tailor CCT to their personal preference, enhancing task visibility, material and colors or the aesthetics of the space

SpectraSync Tunable White

Available in two options: 2750T (2700K–5000K) or 2765T (2700K–6500K).
Requires two 0–10V controllers, one for intensity and one for CCT.
Minimum 5% dimming.

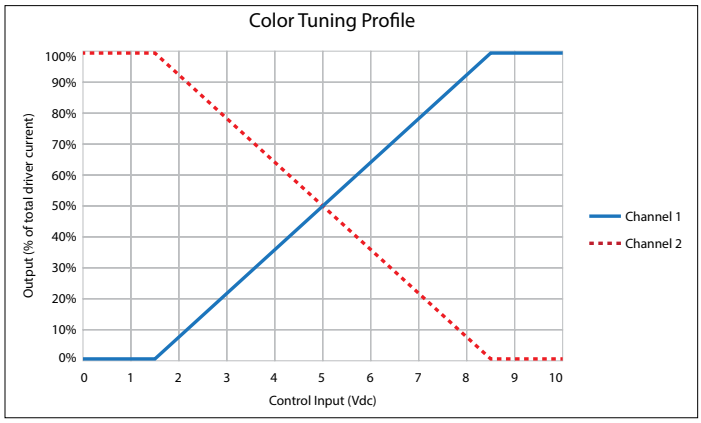


SpectraSync Tunable White luminaires are provided with two 0–10V circuits. The violet and grey circuit is for wiring to any qualified 0–10V controller for dimming. The violet/white and grey/white circuit is for wiring to any qualified 0–10V controller for Tunable White CCT control.

Controller Manufacturer Data

SpectraSync Tunable White was designed to be used with sinking style dimmers (provided by others) and is compatible with:

- Hubbell Control Solutions (HCS): NX Distributed Intelligence™ Room Controllers (NXRC) and In-fixture Controllers (NXFM)
- Lutron: DVTV, DVSTV, and NFTV dimmers
- Wattstopper: ADF120277 and CD4BL (Titan) dimmers



To enable scheduling and for use with NX wall control preset stations please refer to Hubbell Control Solutions NX SpectraSync technical sheet.

SPECTRASYNC™ AND NX AVAILABILITY TABLE

		Only With 80 CRI No Battery Pack			Only With 80 CRI With Battery Pack		
Size	Lumen package	CTC	NX	CTC+NX	CTC	NX	CTC+NX
2ft	VW	Y	Y	N	—	—	—
	MW	Y	Y	N	—	—	—
	LW	Y	Y	N	—	—	—
	ML	N	Y	N	—	—	—
	HL	N	Y	N	—	—	—
4ft	XW	Y	Y	Y	Y	Y	Y
	VW	Y	Y	Y	Y	Y	Y
	MW	Y	Y	Y	Y	Y	Y
	LW	Y	Y	Y	Y	Y	Y
	ML	Y	Y	Y	Y	Y	Y
	HL	Y	Y	Y	Y	Y	Y
	VL	N	Y	N	N	Y	N
	XL	N	Y	N	N	Y	N
8ft	XW	Y	Y	Y	Y	Y	Y
	VW	Y	Y	Y	Y	Y	Y
	MW	N	Y	N	N	Y	N
	LW	N	Y	N	N	Y	N
	ML	N	Y	N	N	Y	N
	HL	N	Y	N	N	Y	N
	VL	N	Y	N	N	Y	N
	XL	N	Y	N	N	Y	N

Columbia LIGHTING

MPS

MULTIPURPOSE LINEAR

DATE: LOCATION:

TYPE: PROJECT:

CATALOG #:

DELIVERED LUMENS

STANDARD EFFICACY PERFORMANCE TABLE						
FIXTURE	COLOR	LENS	DISTRIBUTION	LUMENS	INPUT WATTS	LPW
MPS2-VW	3500K	Curve	Wide	1659	13.8	120
			Narrow	1597	13.5	118
		Flat	Wide	1584	13.5	117
		No Lens		1724	13.8	125
	4000K	Curve	Wide	1681	13.8	122
			Narrow	1618	13.5	120
		Flat	Wide	1604	13.5	119
		No Lens		1746	13.8	127
MPS2-MW	3500K	Curve	Wide	2201	18.2	121
			Narrow	2092	17.8	118
		Flat	Wide	2076	17.8	117
		No Lens		2287	18.2	126
	4000K	Curve	Wide	2229	18.2	122
			Narrow	2119	17.8	119
		Flat	Wide	2102	17.8	118
		No Lens		2316	18.2	127
MPS2-LW	3500K	Curve	Wide	2444	20.4	120
			Narrow	2328	19.9	117
		Flat	Wide	2309	19.9	116
		No Lens		2540	20.4	124
	4000K	Curve	Wide	2475	20.4	121
			Narrow	2358	19.9	118
		Flat	Wide	2338	19.9	118
		No Lens		2572	20.4	126
MPS2-ML	3500K	Curve	Wide	3452	29	119
			Narrow	3447	28.8	120
		Flat	Wide	3414	28.8	119
		No Lens		3587	29	124
	4000K	Curve	Wide	3496	29	121
			Narrow	3491	28.8	121
		Flat	Wide	3458	28.8	120
		No Lens		3632	29	125
MPS2-HL	3500K	Curve	Wide	3655	31.7	115
			Narrow	3707	31.5	118
		Flat	Wide	3678	31.5	117
		No Lens		3797	31.7	120
	4000K	Curve	Wide	3701	31.7	117
			Narrow	3754	31.5	119
		Flat	Wide	3725	31.5	118
		No Lens		3846	31.7	121
MPS4-XW	3500K	Curve	Wide	2574	20	129
			Narrow	2574	20	129
		Flat	Wide	2463	20	123
		No Lens		2674	20	134
	4000K	Curve	Wide	2606	20	130
			Narrow	2574	20	129
		Flat	Wide	2494	20	125
		No Lens		2708	20	135
MPS4-VW	3500K	Curve	Wide	3279	26.7	123
			Narrow	3152	26.5	119
		Flat	Wide	3134	26.5	118
		No Lens		3450	26.7	129
	4000K	Curve	Wide	3321	26.7	124
			Narrow	3192	26.5	120
		Flat	Wide	3174	26.5	120
		No Lens		3564	26.7	133
MPS4-MW	3500K	Curve	Wide	3656	30.4	120
			Narrow	3511	30.1	117
		Flat	Wide	3491	30.1	116
		No Lens		3847	30.4	127
	4000K	Curve	Wide	3702	30.4	122
			Narrow	3556	30.1	118
		Flat	Wide	3535	30.1	117
		No Lens		3974	30.4	131
MPS4-LW	3500K	Curve	Wide	4043	34.4	118
			Narrow	4094	32.5	126
		Flat	Wide	4072	32.5	125
		No Lens		4255	34.4	124
	4000K	Curve	Wide	4095	34.4	119
			Narrow	4147	32.5	128
		Flat	Wide	4124	32.5	127
		No Lens		4395	34.4	128

HUBBELL Lighting

DELIVERED LUMENS (CONTINUED)

STANDARD EFFICACY PERFORMANCE TABLE						
FIXTURE	COLOR	LENS	DISTRIBUTION	LUMENS	INPUT WATTS	LPW
MPS4-ML	3500K	Curve	Wide	4556	40.1	114
			Narrow	4649	37.7	123
		Flat	Wide	4625	37.8	122
		No Lens		4794	40.1	120
	4000K	Curve	Wide	4614	40.1	115
			Narrow	4709	37.7	125
		Flat	Wide	4684	37.8	124
		No Lens		4952	40.1	123
MPS4-HL	3500K	Curve	Wide	5760	49.5	116
			Narrow	5781	49.4	117
		Flat	Wide	5741	49.4	116
		No Lens		6061	49.5	122
	4000K	Curve	Wide	5833	49.5	118
			Narrow	5855	49.4	119
		Flat	Wide	5814	49.4	118
		No Lens		6261	49.5	126
MPS4-VL	3500K	Curve	Wide	6769	54.1	125
			Narrow	6675	54.1	123
		Flat	Wide	6637	54.1	123
		No Lens		7122	54.1	132
	4000K	Curve	Wide	6855	54.1	127
			Narrow	6760	54.1	125
		Flat	Wide	6722	54.1	124
		No Lens		7357	54.1	136
MPS4-XL	3500K	Curve	Wide	8045	66.5	121
			Narrow	7878	66.8	118
		Flat	Wide	7813	66.9	117
		No Lens		8466	66.5	127
	4000K	Curve	Wide	8148	66.5	123
			Narrow	7979	66.8	119
		Flat	Wide	7913	66.9	118
		No Lens		8745	66.5	132
MPS8-XW	3500K	Curve	Wide	5147	40	129
			Narrow	4939	39.8	124
		Flat	Wide	4925	40	123
		No Lens		5348	40	134
	4000K	Curve	Wide	5213	40	130
			Narrow	5002	39.8	126
		Flat	Wide	4988	40	125
		No Lens		5416	40	135
MPS8-VW	3500K	Curve	Wide	6558	53.4	123
			Narrow	6303	53	119
		Flat	Wide	6269	53	118
		No Lens		6814	53.4	128
	4000K	Curve	Wide	6642	53.4	124
			Narrow	6384	53	120
		Flat	Wide	6349	53	120
		No Lens		6901	53.4	129
MPS8-MW	3500K	Curve	Wide	7311	60.8	120
			Narrow	7022	60.2	117
		Flat	Wide	6981	60.2	116
		No Lens		7596	60.8	125
	4000K	Curve	Wide	7405	60.8	122
			Narrow	7112	60.2	118
		Flat	Wide	7071	60.2	117
		No Lens		7693	60.8	127
MPS8-LW	3500K	Curve	Wide	8087	68.8	118
			Narrow	8189	65	126
		Flat	Wide	8144	65	125
		No Lens		8402	68.8	122
	4000K	Curve	Wide	8190	68.8	119
			Narrow	8293	65	128
		Flat	Wide	8248	65	127
		No Lens		8510	68.8	124
MPS8-ML	3500K	Curve	Wide	9111	80.2	114
			Narrow	9298	75.4	123
		Flat	Wide	9250	75.6	122
		No Lens		9466	80.2	118
	4000K	Curve	Wide	9227	80.2	115
			Narrow	9417	75.4	125
		Flat	Wide	9368	75.6	124
		No Lens		9587	80.2	120

MPS

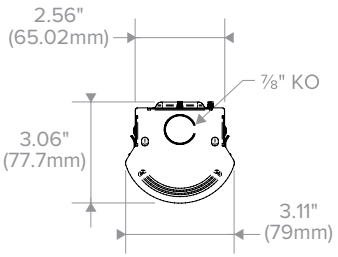
MULTIPURPOSE LINEAR

DELIVERED LUMENS (CONTINUED)

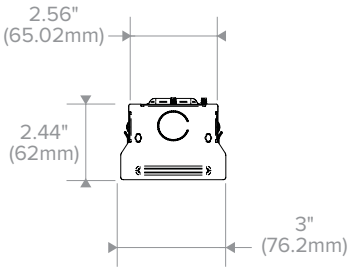
STANDARD EFFICACY PERFORMANCE TABLE						
FIXTURE	COLOR	LENS	DISTRIBUTION	LUMENS	INPUT WATTS	LPW
MPS8-HL	3500K	Curve	Wide	11520	99	116
			Narrow	11562	98.8	117
		Flat	Wide	11481	98.8	116
		No Lens		11969	99	121
	4000K	Curve	Wide	11667	99	118
			Narrow	11710	98.8	119
		Flat	Wide	11628	98.8	118
		No Lens		12122	99	122
MPS8-VL	3500K	Curve	Wide	13537	108.2	125
			Narrow	13350	108.2	123
		Flat	Wide	13275	108.2	123
		No Lens		14065	108.2	130
	4000K	Curve	Wide	13710	108.2	127
			Narrow	13521	108.2	125
		Flat	Wide	13444	108.2	124
		No Lens		14245	108.2	132
MPS8-XL	3500K	Curve	Wide	16091	133	121
			Narrow	15757	133.6	118
		Flat	Wide	15626	133.8	117
		No Lens		16718	133	126
	4000K	Curve	Wide	16296	133	123
			Narrow	15958	133.6	119
		Flat	Wide	15826	133.8	118
		No Lens		16932	133	127

DIMENSIONS

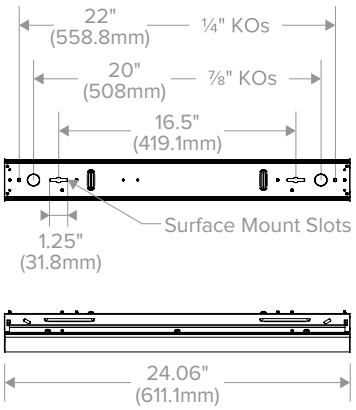
MPS END View - Curve Lens



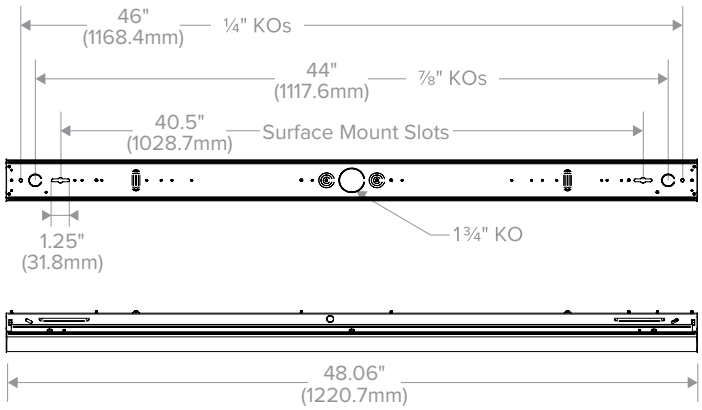
MPS END View - FLAT Lens



MPS 2' Dimensions



MPS 4' Dimensions

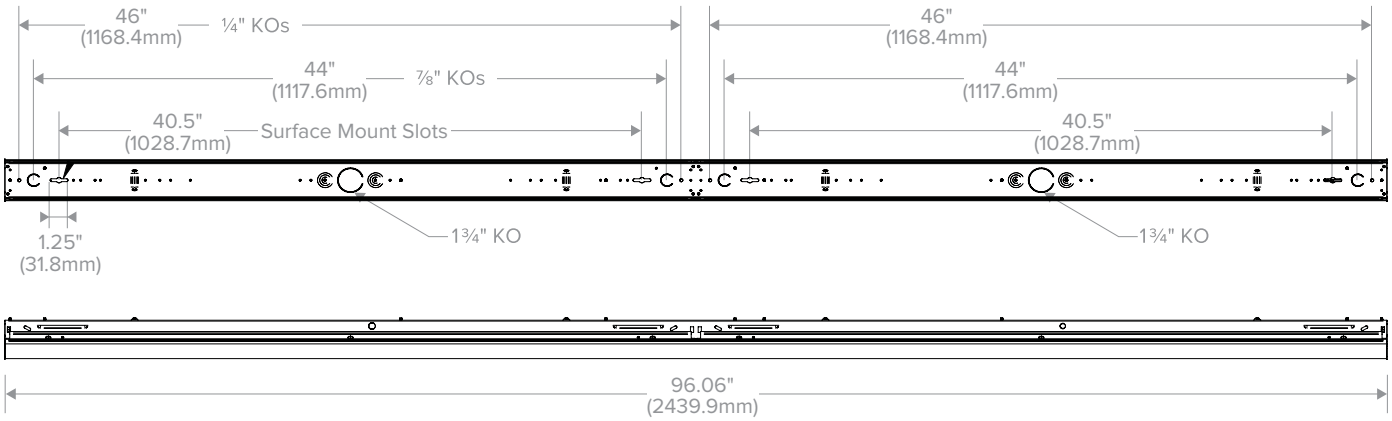


MPS

MULTIPURPOSE LINEAR

DIMENSIONS (CONTINUED)

MPS 8' Dimensions



PHOTOMETRY

MPS4-40ML-CN-EDU

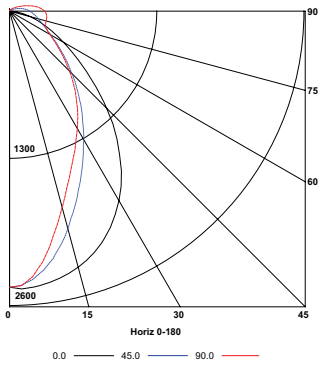
LUMINAIRE DATA

Test No.	**19735**
Description	**MultiPurpose Linear, Narrow, LED 4ft, Frosted Linear Prismed Lens**
Delivered Lumens	**4742**
Watts	**37.70**
Efficacy	**126**
Mounting	**Surface**
Spacing Criterion	**0° = 1.18 90° = 1.77**

ZONAL LUMEN SUMMARY

Zone	Lumens	% Luminaire
0–30	1542	32.5
0–40	2326	49.1
0–60	3518	74.2
0–90	4385	92.5
0–180	4742	100

POLAR GRAPH



MPS4-40ML-CW-EDU

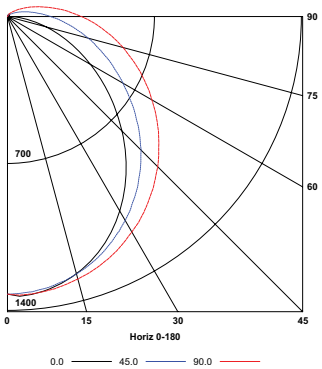
LUMINAIRE DATA

Test No.	**19600**
Description	**MultiPurpose Linear, Wide, LED 4ft, Frosted Linear Prismed Lens**
Delivered Lumens	**4615**
Watts	**40.10**
Efficacy	**115**
Mounting	**Surface**
Spacing Criterion	**0° = 1.20 90° = 1.33**

ZONAL LUMEN SUMMARY

Zone	Lumens	% Luminaire
0–30	1029	22.3
0–40	1688	36.6
0–60	3019	65.4
0–90	4248	92
0–180	4615	100

POLAR GRAPH



PHOTOMETRY
IES
PDF
IES
PDF

Columbia LIGHTING

MPS

MULTIPURPOSE LINEAR

DATE: LOCATION:

TYPE: PROJECT:

CATALOG #:

PHOTOMETRY (CONTINUED)

MPS4-40ML-FW-EDU

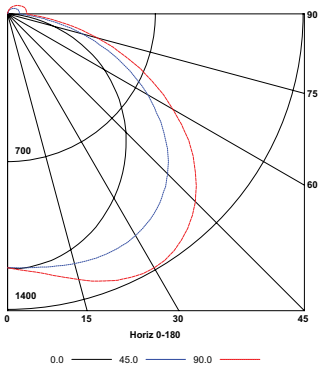
LUMINAIRE DATA

Test No.	**19652**
Description	**MultiPurpose Linear, Wide, LED 4ft, Frosted Linear Prismed Lens**
Delivered Lumens	**4685**
Watts	**37.80**
Efficacy	**124**
Mounting	**Surface**
Spacing Criterion	**0° = 1.24 90° = 1.67**

ZONAL LUMEN SUMMARY

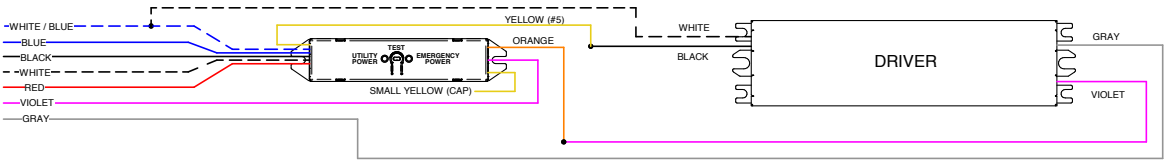
Zone	Lumens	% Luminaire
0–30	1026	21.9
0–40	1756	37.5
0–60	3324	70.9
0–90	4435	94.7
0–180	4685	100

POLAR GRAPH



ADDITIONAL INFORMATION

DTS WIRING DIAGRAM (0–10V DIMMING DRIVER SHOWN)



WHITE/BLUE	Emergency Neutral
BLUE	Emergency Line
BLACK	Utility Line (Unswitched Hot)
WHITE	Utility Neutral
RED	Switched Hot
VIOLET	Dimming
GRAY	Dimming

IES PDF DTS Integration Guide

HUBBELL Lighting

Columbia LIGHTING

HEM

Hazardous Enclosed and Gasketed Fiberglass Extreme Environment / LED

createchange

PROJECT INFORMATION

Project Name

Catalog No.

LT-17
Type

Date

FEATURES

- LED Hazardous Location Enclosed and Gasketed
- Long life 60,000 hour LEDs at L80 for reduced maintenance
- Four LED color choices and 80 CRI
- Class 1, Division 2, Groups A, B, C, & D
- IP65, IP66, and IP67 all sizes
- Available in 4' or 8' lengths
- Fiberglass housing with F1 weatherability rating, standard
- Smooth housing for easy cleaning
- Gasket is non-porous to ensure seal
- Impact modified acrylic lens equivalent to 100% DR for shatterproof applications
- Wide range of lens selections
- Stainless steel latching optional
- Removable gear tray electrical access for modular replaceability
- Standard ambient -40ºC to 40ºC
- Includes surface mounting brackets
- DLC® (DesignLights Consortium) Qualified - see www.designlights.org
- Five year warranty

CONSTRUCTION

Housing is formed from UL 5VA fiberglass. F1 weatherability rating, suitable for indoor or outdoor use with respect to exposure to UV light. Pour-in-place non-porous gasketing assures seal. LED affixed to removable heat sinked gear tray. 14 Latches per 8', 8 per 4'. Latches are provided tamper resistance ready, tamper resistant screws by others. Latches are standard polyacetal (POM), optional in stainless steel. Access openings are provided for electrical connection.

SHIELDING

Lineal ribbed frosted acrylic lens impact modified equivalent to 100% DR; modification adds flexibility to reduce impact breakage compared to standard acrylic formulations. Optional ribbed polycarbonate lens or deep acrylic. All lenses available in clear or frost.

FINISH

White painted parts are treated with a five-stage phosphate bonding process and finished with high reflectance baked enamel.

ELECTRICAL

Long-life LEDs are rated for 60,000 hours at L80 lumen maintenance. Driver options include fixed output for on/off function, or continuous 0-10V dimming. QR code label affixed to housing for easy traceability.

CERTIFICATION

All luminaires are built to UL 1598 and 2108 standards, and bear appropriate CSA labels. Ingress protection IP65 and IP67 standard. IP66 standard when polyacetal (POM) latches are used. UL Sanitation Certified per NSF Standards. Wet location labeling is standard. Certified for Hazardous Locations Class 1, Division 2, Groups A, B, C, & D, NSF Certified. DLC® (DesignLights Consortium) Qualified. Please refer to the DLC website for specific product qualifications at www.designlights.org.

WARRANTY

Five year warranty (Terms and Conditions Apply).

ORDERING INFORMATION

EXAMPLE HEM4-40HL-RFA-EDU-SSL

HEM – ___ – ___ – ___ – **U** – ___

MODEL
- **HEM** Hazardous LED Enclosed and Gasketed

SIZE
- **4** 4'
- **8** 8'

COLOR TEMP
- **30** 3000K
- **35** 3500K
- **40** 4000K
- **50** 5000K

LUMEN OUTPUT
- **ML** Medium Lumen
- **HL** High Lumen
- **VL** Very High Lumen

SHIELDING
- **RFA** Ribbed Frosted Acrylic
- **RA** Ribbed Clear Acrylic
- **DFA** Deep Frosted Acrylic
- **DCA** Deep Clear Acrylic
- **RFP** Ribbed Frosted Polycarbonate[1]

DRIVER
- **E** Fixed Output
- **ED** 0-10V Dimming
- **ED1** 0-10V 1% Dimming

VOLTAGE
- **U** 120V-277V

OPTIONS
- **SSL** Stainless Steel Tamper Resistance Ready Latches
- **TP** Tamper Proof Latches
- **F3C8W** 3 Wire 8' Wet Cord
- **F3C15W** 3 Wire 15' Wet Cord
- **XEDPM** Dual Pendant Brackets (pendant by others)[2]

PRODUCT AVAILABILITY

Size	Lumen Package	Nominal Lumen Range (DFA Lens)	Nominal Watts	Lumens/ Watt (Highest)	Max Temp
4'	ML	4850-5350	47	114	40°C
	HL	5800-6400	52	123	40°C
	VL	7350-8150	68	120	40°C
8'	ML	9700-10700	94	114	40°C
	HL	11600-12800	104	123	40°C
	VL	14700-16300	136	120	40°C

Lumens vary according to color temperatures and other factors. See specific photometric test(s). Output levels based on the DFA lens option.

ACCESSORIES (ORDER SEPARATELY)
- **XEHC** Chain Hanger Kit (Includes 14" Chain)
- **XE45MB** 45° Mounting Bracket
- **XE45MBSS** 45° Stainless Steel Mounting Bracket

[1] 4' only. 8' not available.
[2] Requires 3/8" OD threaded rod by others.

701 Millennium Blvd. Greenville, SC 29607 / Tel **864.678.1000** / Website **www.columbialighting.com**

HUBBELL Lighting

PHOTOMETRIC DATA

Test **15.00582** Test Date **4/15/15**

LUMINAIRE DATA

Luminaire	**HEM4-40ML-DFA-EU** **HEM LED Enclosed and Gasketed Fiberglass, Extreme Environment** **7" x 51" led with deep frosted acrylic diffuser**
Ballast	**D23CC90UNVT**
Ballast Factor	**1.00**
Lamp	**LED**
Fixture Lumens	**5427**
Watts	**46.10**
Mounting	**Surface**
Shielding Angle	**0° = 90 90° = 90**
Spacing Criterion	**0° = 1.24 90° = 1.29**
Luminous Opening in Feet	**Length: 4.00** **Width: 0.50** **Height: 0.33**

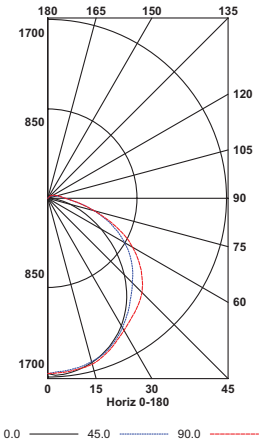
ZONAL LUMEN SUMMARY

Zone	Lumens	% Lamp	% Fixt.
0-30	1306	24.1	24.1
0-40	2141	39.5	39.5
0-60	3846	70.9	70.9
0-90	5148	94.9	94.9
0-180	5427	100.0	100.0

ENERGY DATA

Total Luminaire Efficiency	**100%**
Total Lumens per Watt	**118**
ANSI/IESNA RP-1-2004 Compliance	**Noncompliant**
Comparative Yearly Lighting Energy Cost per 1000 Lumens	**$2.03 based on 3000 hrs. and $0.08 per KWH**

INDOOR CANDELA PLOT



Test **15.00646** Test Date **4/22/15**

LUMINAIRE DATA

Luminaire	**HEM4-40HL-DFA-EU** **HEM LED Enclosed and Gasketed Fiberglass, Extreme Environment** **7" x 51" led with deep frosted acrylic diffuser**
Ballast	**D23CC90UNVT-F**
Ballast Factor	**1.00**
Lamp	**LED**
Fixture Lumens	**6535**
Watts	**54.10**
Mounting	**Surface**
Shielding Angle	**0° = 90 90° = 90**
Spacing Criterion	**0° = 1.24 90° = 1.29**
Luminous Opening in Feet	**Length: 0.40** **Width: 0.46** **Height: 0.29**

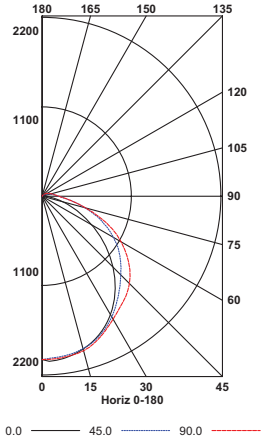
ZONAL LUMEN SUMMARY

Zone	Lumens	% Lamp	% Fixt.
0-30	1575	24.1	24.1
0-40	2580	39.5	29.5
0-60	4638	70.8	70.8
0-90	6194	94.8	94.8
0-180	6535	100.0	100.0

ENERGY DATA

Total Luminaire Efficiency	**100%**
Total Lumens per Watt	**121**
ANSI/IESNA RP-1-2004 Compliance	**Noncompliant**
Comparative Yearly Lighting Energy Cost per 1000 Lumens	**$1.98 based on 3000 hrs. and $0.08 per KWH**

INDOOR CANDELA PLOT



Test **15428** Test Date **2/19/15**

LUMINAIRE DATA

Luminaire	**HEM4-40VL-DFA-EU** **HEM LED Enclosed and Gasketed Fiberglass, Extreme Environment** **7" x 51" led with deep frosted acrylic diffuser**
Ballast	**D23CC90UNVTF 1915**
Ballast Factor	**1.00**
Lamp	**LED**
Fixture Lumens	**7876**
Watts	**67.70**
Mounting	**Surface**
Shielding Angle	**0° = 90 90° = 90**
Spacing Criterion	**0° = 1.24 90° = 1.29**
Luminous Opening in Feet	**Length: 4.25** **Width: 0.50** **Height: 0.25**

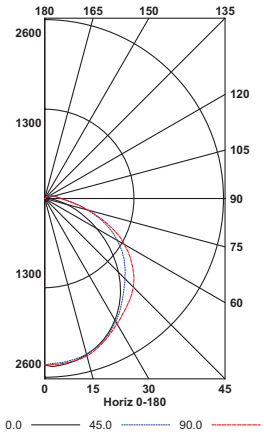
ZONAL LUMEN SUMMARY

Zone	Lumens	% Lamp	% Fixt.
0-30	1899	24.1	24.1
0-40	3114	39.5	39.5
0-60	5588	71.0	71.0
0-90	7461	94.7	94.7
0-180	7876	100.0	100.0

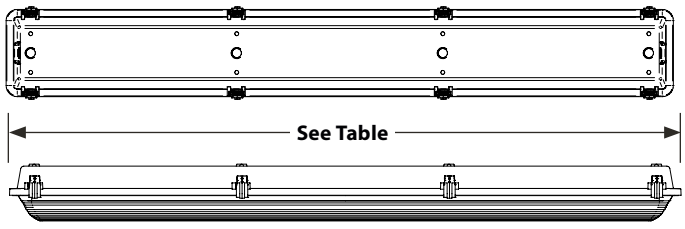
ENERGY DATA

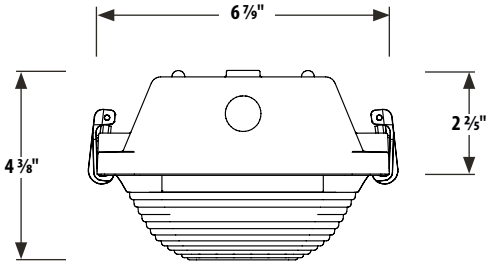
Total Luminaire Efficiency	**100%**
Total Lumens per Watt	**116**
ANSI/IESNA RP-1-2004 Compliance	**Noncompliant**
Comparative Yearly Lighting Energy Cost per 1000 Lumens	**$2.07 based on 3000 hrs. and $0.08 per KWH**

INDOOR CANDELA PLOT

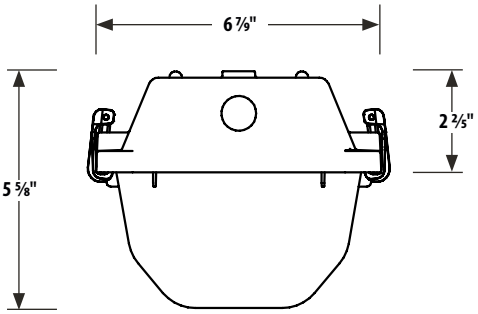


DIMENSIONAL DATA





RA, RFA Lens: 4', 8', RFP Lens: 4'



DFA, DCA Lens: 4', 8'

HEM LENGTH DIMENSIONS

SIZE	LENS	LENGTH	SIZE	LENS	LENGTH
4'	RA, RFA	51²⁄₃"	8'	RA, RFA	100"
	RFP	51²⁄₃"		RFP	N/A
	DFA, DCA	51²⁄₃"		DFA, DCA	100"

NOTE: All dimensions are in inches; dimensions and specifications are subject to change without notice. Please consult factory or check sample for verification.

701 Millennium Blvd. Greenville, SC 29607 / Tel **864.678.1000** / Website **www.columbialighting.com**

NANOLUME

Micro Profile LED Task and Cove Fixture

Customer: Date: Type:

Project:

- Compact, variable light fixture.
- Fixture comes in 4" increments with a 12" minimum.
- Reflector boosts overall output by 10%. Reflector only available with 120° Optics.
- Boca Flasher's patented CleanDim® technology ensures even dimming from 0-100%.
- Many options in color temperature to suit a range of projects.
- Uses standard line voltage dimming.
- Fixtures are compatible with both forward and reverse phase dimming, can have 0-10V direct dimming or can use Boca's SDS module for 0-10V DALI or DMX Dimming.
- Interior installations only.
- The housing is a high temperature ABS plastic with a durable white or black finish, making it temperature and abrasion resistant.
- Total linear feet per power feed (6W): 120V = 80 ft., 277V = 150 ft.
- Contact Boca Flasher for tips with custom installation procedures.

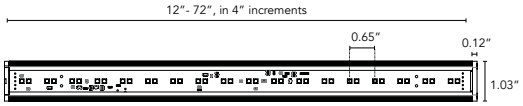
PRODUCT SPECIFICATIONS:

	WATTAGE	COLOR OPTION	VOLTAGE	OPTIC	FINISH	MOUNTING	LENS	BAFFLE	REFLECTOR	DIMMING*
Nanolume										
	3W **6W**	**2000K** **2400K** **2700K** **3000K** **3500K** **4000K**	**120V** **277V**	**10°** **15°x 40°** **120°**	**W** White **B** Black	**S** Swivel **H** Hinge	**C** Clear **CLD** Clear Light Diffused (Not Available with Optics) **HD** Heavy Diffused (Not Available with Optics)	**SQ** Square **ASYM** Asymmetric	**(Only Available with 120° Optics)** **Y** Yes **N** No	**STANDARD DIMMING** **0-10V DIRECT** **0-10V REMOTE** **DMX REMOTE** **DALI REMOTE**

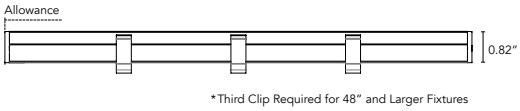
*Additional Charges May Apply

DIMENSIONS:

Plan View

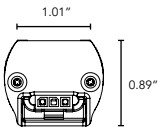


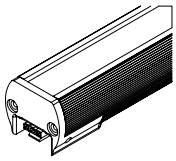
Elevation View



*Third Clip Required for 48" and Larger Fixtures

End View





Boca Flasher, Inc. 508 South Military Trail, Deerfield Beach, Florida 33442 USA Phone: 561.989.5338 Fax: 561.982.8323

REV 11022020

NANOLUME

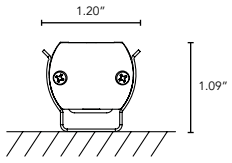
Micro Profile LED Task and Cove Fixture

TECHNICAL SPECIFICATIONS:

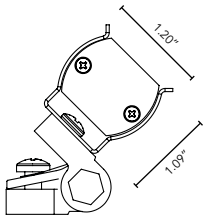
WATTAGE	3 or 6 watts per linear ft.
INPUT VOLTAGE	90-120V 230-277V
CONTROL	Leading Edge/Trailing Edge line dimmer, 0-10V, DALI, DMX
LED SPACING	5/8" on center
LENGTH	12-72", in 4" increment allow 1/4" for each end cap and 1.25" for power feed cable
TOTAL WIDTH	1.04"
TOTAL HEIGHT	0.82"
COLOR OPTIONS	2000K, 2400K, 2700K, 3000K, 3500K, 4000K
MOUNTING	Swivel, Hinge
AVAILABLE OPTICS	10°, 15°×40°, 120°
COLOR RENDERING INDEX (CRI)	90 + CRI
RATING	Interior Only IP50

MOUNTING INFORMATION:

- For vertical installation please contact the factory for specific mounting instructions.
- For installations above 4' please contact the factory.



Swivel



Hinge

LUMINAIRE INFORMATION:

CCT (K)	Wattage	Lumens	LPW
2000	6	432	72
2400	6	510	85
2700	6	560	94
3000	6	588	98
3500	6	618	103
4000	6	636	106

* Typical delivered lumen data is approximate. Actual lumens will vary due to installation environment and beam pattern. Please see IES files.

Boca Flasher, Inc. 508 South Military Trail, Deerfield Beach, Florida 33442 USA Phone: 561.989.5338 Fax: 561.982.8323

REV 11022020

EVENLITE
Lives Depend On Us

PROJECT NAME:	APPROVED BY:
CATALOG NO:	TYPE NO: LT-19

SOVEREIGN - LED Exit Signs

Architectural Edgelit

EYE APPEAL

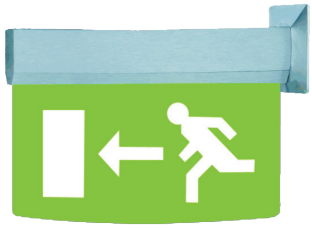
Sovereign LED edgelit exit signs set the standard for architectural appeal; always enhancing their surroundings and pleasing even the most discerning eye. Subtle lines and soft curves create a distinctive "floating" edgelit look. Quality construction includes precision die cast aluminum housings with a unique, crystal clear, laser-formed thin acrylic legend. The Sovereign has been designed with the latest high efficiency LED light sources to provide vivid pronouncement of its exit legend with exceptional uniformity and luminance levels – 4X the UL requirement. Engineered for reliability and ease of installation, Sovereign comes in many cost-effective configurations offering superlative quality, performance, and aesthetics.

Construction

- Recessed ceiling back box features universal adjustable mounting brackets with quick-fit retaining clips to suit most ceiling types
- Full size universal, self-adhesive Chevron arrows with template enable on-site configuration
- Lens Panel is "Last-to-Assemble" snap-in for versatility and ease of installation
- Hinged retaining springs eliminate exposed mounting hardware on recessed model
- Slim line low profile surface mount housing eliminates need for recessing box in wall mount applications
- Low profile recessed housing is suitable for old or new work installations and is type IC Rated
- Modular design provides ease of installation and matching configurations
- Quality brushed aluminum sealed finish is standard, optional White, Black, brushed painted Brass finishes available. Consult factory for custom finishes.
- Contoured, crystal clear laser formed edge lit lens
- Custom legends with white LED light source available to order
- Precision pressure die cast aluminum legend holder, trim and surface mount housing
- Available with a range of information signage or custom graphics to order
- Recessed AC Indicator and Test Switch

Surface Wall Mount

Surface Ceiling Mount



Surface End Mount

Electrical

- Unique electronic driver circuit provides current control and protection ensuring optimum LED efficiency and life
- Available with Master/Remote combinations
- Zero current LVCO ensures positive charge acceptance following extended discharge
- Brownout sensing assures emergency illumination during periods of low line voltage
- All versions feature fully integrated electronic components
- Universal 120/277 VAC field selectable input
- Battery Diagnostic Circuit monitors battery status, detects cell failure and issues alert of reduced capacity and the need to replace battery
- Diagnostic Battery Monitoring on all "EM" models
- Premium long life high temperature rated, fused Nickel Cadmium battery, operating temperature 10º to 40ºC

Illumination

- Refractive light guide engineered to optimize LED utilization and illumination uniformity
- Maintenance free LED Light source with 25+ years life expectancy

Certification

- Approved for use in New York City calendar #48851
- UL Listed 3 hour emergency duration standard
- UL 924 Listed by Underwriters Laboratories and meets or exceeds all performance standards as required by NFPA 101, NFPA 70- NEC and OSHA
- California Energy Commission (CEC) Title 20 Compliant

UL LISTED

CEC Title 20 E Compliant

Warranty

- 5 year limited warranty

2575 Metropolitan Drive | Trevose, PA 19053 | T: 1.800.872.0879 | F: 215.244.4208 | mail@evenlite.com | www.evenlite.com

Sovereign LED Exit Signs

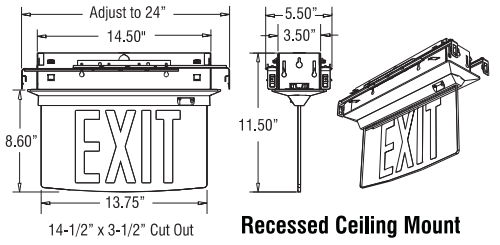
ORDERING GUIDE – SOV

Example: SOV-EM-R-1C-BA-RC-AR-SD-FT

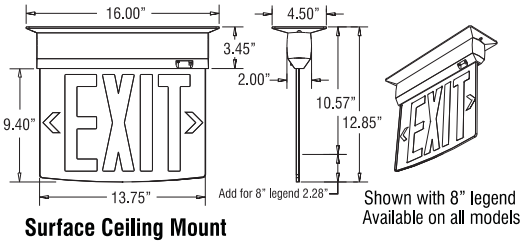
Model	Operation	Legend Size/ Letter Color	Faces/ Background	Trim/ Housing Color	Mounting	Chevron Direction	Options
SOV	**AC** AC Only 120/277 VAC **EM** Battery Backup Emergency	**R** RED Standard 6" EXIT **G** GREEN Standard 6" EXIT **NR** RED 8" EXIT **NG** GREEN 8" EXIT	**1C** Single Face, Clear Background (standard) **1M** Single Face, Mirror Background **2M** Double Face, Mirror Background (Mirror simulates clear background for double face exits) **1W** Single Face, White Background **2W** Double Face, White Background	**BA** Brushed Aluminum (standard) **WH** White Finish **BK** Black Finish **BR** Brushed Brass Painted Finish **CC** Custom Color (specify)	**Standard Mounting** **RC** Recessed Ceiling **SC** Surface Ceiling **SW** Surface Wall **SE** Surface End **Optional Mounting** **MM** Mullion Mount **PA** 12 " Swivel Pendant Mount **PB** 24" Swivel Pendant Mount **PC** 36" Swivel Pendant Mount **PD** 48" Swivel Pendant Mount **UP** Back Box Pre Shipped	**UC** Field Installed Adhesive Chevron Indicators **AR** Arrow Right EXIT> **AL** Arrow Left <EXIT **AA** Double Arrow <EXIT> **LR** Arrow Left/ Arrow Right <EXIT/EXIT> (Double Face units only) Factory installation of Chevrons is recommended for Double Face Signs	**DK** Two Circuit Input –Specify Input Voltage AC Models only) **DL** Damp location listed **EU** Euro Legends (Consult factory for full range) **F** Flash in Emergency Mode (EM Models) or continuous Flash in AC models **FA** Flash in AC and Emergency mode on 12-24V (AC or DC) normally-off fire alarm signal (Available for AC and EM models) **FB** FA Option including Buzzer **FZ** F Option including Buzzer **FP** Flat Panel (no curve on panel bottom) **FT** Flat Trim for Recessed Ceiling Mount **IN** Inverted Legend – Use with Mullion Mount **IR** Self-Diagnostics with Infrared remote Testing (EM models only) **TLRT** Infrared hand held Transmitter (order separately) **LL** Remote is the Razor Mk3 LL model with security cover **SD** Self-Test / Self-Diagnostic (EM models Only) **VA** Other Input Supply Voltage (Consult Factory)
SOV							

Fill in fields from categories above and complete type and part number.

Type Number:	*Full Part Number:*



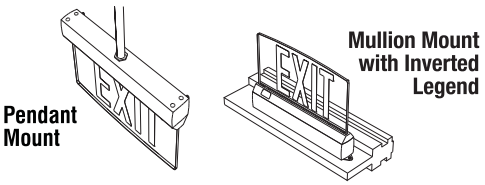
Recessed Ceiling Mount

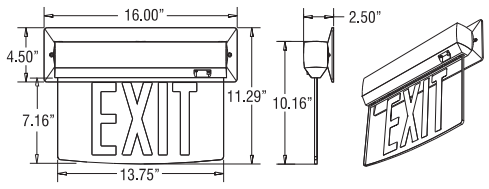


Surface Ceiling Mount

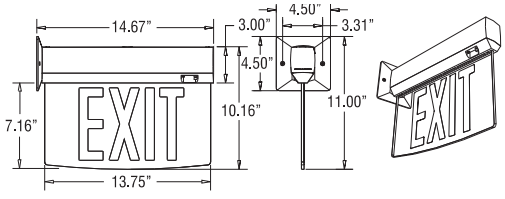
Shown with 8" legend Available on all models

Surface Wall Mount





Surface Wall Mount



Surface End Mount

Power Consumption

Type		Volts	Max Watts	Power Factor
RED	AC Only	120 / 277	1.5	.70
RED	Battery Backup	120 / 277	2.5	.70
RED	Battery Backup with Remote	120 / 277	3.0	.73
GREEN	AC Only	120 / 277	2.3	.70
GREEN	Battery Backup	120 / 277	3.0	.76
GREEN	Battery Backup with Remote	120 / 277	4.0	.81

EVENLITE

Lives Depend On Us

www.evenlite.com

Columbia LIGHTING

DATE: | LOCATION:

TYPE: LT-20 | PROJECT:

CATALOG #:

MPS

MULTIPURPOSE LINEAR

FEATURES

- Uninterrupted ribbon of light; row mounting optional
- Long life 60,000 hour LEDs at L80 for reduced maintenance
- Superior color consistency within a 3-step MacAdam ellipse and greater than 80 CRI
- Available in 2', 4' or 8' lengths
- Optional integral emergency battery pack
- Three lens options as well as less lens (NL)
- Modular replaceable LED boards and driver accessible for future maintenance or upgrades
- Surface mount, wall mount or suspended

Built to UL 924 Standards

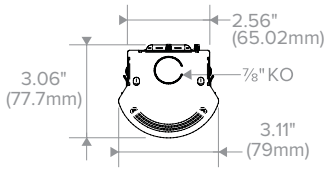
BUY AMERICAN SOLUTIONS

See Certification Specifications

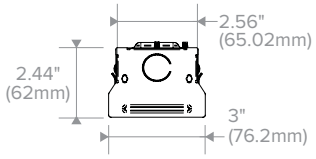
RELATED PRODUCTS

Revalume™ Linear Wrap | Reverie™ Decorative Low Bay

End View—Curve Lens



End View—Flat Lens



CONTROLS TECHNOLOGY

SpectraSync™ Color Tuning Technology | NX DISTRIBUTED™ INTELLIGENCE | SPECTRASAFE™

SPECIFICATIONS

CONSTRUCTION

- Housing, wireway, and ends are formed from code-gauge steel
- Housing components act as heat sink for LED heat dissipation
- White painted parts are treated with a five stage phosphate bonding process and finished with high reflectance baked enamel

OPTICS

- Available with or without frosted acrylic lens

INSTALLATION

- Knockouts are provided for electrical access and mounting

ELECTRICAL

- Long-life LEDs are rated for 60,000 hours at L80 lumen maintenance
- Driver options include fixed output for on/off function, step dimming (high/low/off), or continuous 0–10V dimming
- Superior drivers and long-life LEDs provide quality illumination for prolonged service life
- Drivers < 10% THD at 120V, power factor > 0.95

CONTROLS

- Optional SpectraSync™ offers two modes of Tunable White solutions and integrates seamlessly into a variety of control systems
- NX Distributed Intelligence™ provides options for standalone and networked integrated sensor with wired or wireless connectivity for NX system deployments

TECHNOLOGY

- SpectraSAFE™ is a scalable, cloud-enabled and lighting-based wireless video security solution for interior commercial and industrial applications

CERTIFICATIONS

- IC label is standard for recessed products
- All luminaires are built to UL 1598 and 2108 standards, and bear appropriate cCSAus labels
- Damp Location label standard
- CSA certified to UL 924 standards with battery pack or DTS (Dimming Bypass Module) options

CERTIFICATIONS (CONTINUED)

- Adheres to LM79, LM80, and TM21 industry standards
- The DTS, Dimming Bypass Module, is for emergency circuit control loads including sensors and wireless systems CSA certified to UL 924. See page 10 for wiring diagram. Link to Dimming Bypass Module Specification sheet
- This product qualifies as a "designated country construction material" per FAR 52.225-11 Buy American-Construction Materials under Trade Agreements effective 06/01/2020. See Buy American Solutions

WARRANTY

- 5 year warranty
- See HLI Standard Warranty for additional information

KEY DATA	
Lumen Range	1377–16,833
Wattage Range	13.5–133.8
Efficacy Range (LPW)	111–142
Reported Life (Hours)	L80–60,000

HUBBELL Lighting

Columbia LIGHTING

MPS

MULTIPURPOSE LINEAR

DATE:	LOCATION:
TYPE:	PROJECT:
CATALOG #:	

ORDERING GUIDE

Example: MPS4–40ML–CW–EDU

CATALOG # ____________________

Model	Size [1]	CRI	–	Color Temp	Nominal Lumens [4]	–	Lens	Distribution [5]	–
MPS MultiPurpose Linear	**2** 2' **4** 4' **8** 8'	**Blank** >80 **9** 90 [2]		**30** 3000K **35** 3500K **40** 4000K **50** 5000K **2750T** 2700K–5000K SpectraSync™ Tunable White [3] **2765T** 2700K–6500K SpectraSync™ Tunable White [3]	**XW** 4' (2700), 8' (5400) **XWHE** 4' (2500), 8' (5000) **VW** 2' (1700), 4' (3400), 8' (6900) **VWHE** 4' (3300), 8' (6600) **MW** 2' (2300), 4' (3800), 8' (7700) **MWHE** 2' (2100), 4' (3700), 8' (7400) **LW** 2' (2500), 4' (4200), 8' (8400) **LWHE** 2' (2600), 4' (4100), 8' (8200) **ML** 2' (3600), 4' (4800), 8' (9500) **MLHE** 4' (4700), 8' (9400) **HL** 2' (3800), 4' (6000), 8' (12,000) **HLHE** 4' (5700), 8' (11,500) **VL** 4' (7100), 8' (14,200) **XL** 4' (8400), 8' (17,000)		**C** Curve, Frosted Acrylic **F** Flat, Frosted Acrylic **NL** Less Lens **CP** Curve, Frosted Polycarbonate	**N** Narrow Distribution [6] **W** Wide Distribution	

Driver	Voltage	–	Options	–	Control Options [23, 24, 25]
E Fixed Output **ED** 0-10V Dimming **ED1** 0-10V 1% Dimming **EDD** 0-10V Dim-to-Dark **ESD** Step Dimming **LUTH** Hi-lume 1% EcoSystem LED driver with Soft-on, Fade-to-Black dimming technology [7] **DALIP** DALI Power Bus [8]	**U** 120V-277V **347** 347V (E, ED, ED1 only)		**ELL14** Emergency Battery Pack, 10W [9,10,11] **ELL14H2** Emergency Battery Pack, 2-Hour Run Time [9,10,11] **GLR** Fast Blow Fuse **GTD** Generator Transfer Device [12] **DTS** Dimming Bypass Module [13] **MPSCE** Injection Molded ABS Material Curve Endcap [23] **MPSCE-MB** Injection Molded ABS Material Curve Endcap, Matte Black **MPSFE** Injection Molded ABS Material Flat Endcap [23] **MPSFE-MB** Injection Molded ABS Material Flat Endcap, Matte Black **MB** Matte Black **ZT** ZET Metallic Silver **PAF** Painted After Fabrication **SAF** SpectraSAFE™ Integrated Surveillance Lighting System [14] **MST** MASTER fixture that controls one or more SATELLITE fixtures in a continuous row application [15,16,17,18,19,20,21] **SAT** SATELLITE fixture controlled by MASTER fixture in a continuous row application [16,17,18,19,20,21] **INT** Intermediate (provides ends with wiring access for continuous row mounting) [18,20,21,22] **EOR** End of Row (provides end wiring access for continuous row mounting) [18,20,21,22]		**NX Standalone** **NXS** NX, PIR BT Occupancy/Daylight Sensor, Slide Mount [26,28] **NX Networked – Wired** **NXE** NX, Dual SmartPORTs [26,27,28] **NXES** NX, PIR BT Occupancy/Daylight Sensor, Slide Mount, Dual SmartPORTs [26,27,28] **NX Networked – Wireless** **NXSW** NX Wireless, PIR BT Occupancy/Daylight Sensor [26,28] **NXWE** NX Wireless Enabled [26,28] **Third-Party Control Options** **ODPG** Occupancy and Daylight Sensors w/ Grouping, Philips SNS200 [29, 31] **LVR** Lutron Vive Integral Fixture Control DFCSJ-OEM-RF (RF only) [29,30,31] **LVS** Lutron Vive Integral Fixture Control DFCSJ-OEM-OCC (RF with daylight and occupancy sensing) [29,30,31]

Accessories

- ☐ **S18** 18" Stem, Canopy
- ☐ **SS18** 18" Swivel Stem—45° Swivel
- ☐ **CM24SCF3-KIT** 24" Adjustable Cable Mounting Kit, 3-wire feed [32]
- ☐ **CM48SCF3-KIT** 48" Adjustable Cable Mounting Kit, 3-wire feed [32]
- ☐ **CM24NF-KIT** Single Point Non-Feed Cable Mount with Canopy, Single - 24" [32]
- ☐ **CM48NF-KIT** Single Point Non-Feed Cable Mount with Canopy, Single - 48" [32]
- ☐ **CSHC** Chain Hanger Assembly
- ☐ **MPSZT** Zip Tee Hanger - 1 ½" Spacer on T-Bar Ceiling
- ☐ **MPSTH** Slide Tong Hanger
- ☐ **MPSCRK-C** Continuous Row Kit, Curve
- ☐ **MPSCRK-F** Continuous Row Kit, Flat
- ☐ **MPSWG2** 2' Wire Guard
- ☐ **MPSWG4** 4' Wire Guard, two Required for 8' Fixture
- ☐ **MPSCE** Injection Molded ABS Material Curve Endcap
- ☐ **MPSCE-MB** Injection Molded ABS Material Curve Endcap, Matte Black
- ☐ **MPSFE** Injection Molded ABS Material Flat Endcap
- ☐ **MPSFE-MB** Injection Molded ABS Material Flat Endcap, Matte Black

Notes:

1 For continuous row mounting, see Continuous Row Mount Example Guide on page 3
2 Not available with HE lumen packages
3 See SpectraSync and NX Availability Table on page 6
4 High efficacy versions designated with "HE"
5 Applicable to lens only
6 Only available with Curve, Frosted Acrylic lens
7 Not available in VL, XL, HE packages
8 DALIP only available when LVS, LVR or ODPG control options are selected
9 Delivered Emergency Lumens = ELL14 = 1210 lms
10 Not available in 2ft size or with thru wire on XL 4ft and 8ft
11 Emergency battery pack max ambient temperature: 25°C
12 Only available with fixed output driver
13 For emergency circuit control loads including sensors and wireless systems CSA certified to UL 924. Not availble with ESD driver option. Universal voltage only. DTS with 2' cannot be combined with Controls or SpectraSync options. See page 10 for wiring diagram
14 SpectraSync+NX+SAF can not be configured. Only available with NXE or NXWE. Not available in 347V

Continuous-Row Options:

15 MST option not available with INT row position
16 Multiple SAT fixtures can be controlled by one MST fixture. Any one SAT fixture can have no more than one connected MST fixture
17 NX is supported for this application, consult Brand for use with other controls systems
18 Not available with DTS,GTD,ATSD
19 Not available with LUTH
20 All fixtures in a row must be the same driver type and voltage
21 Includes quick-connect wiring harness
22 Suspension support required at every fixture coupling; see Mounting Accessories Guide

NX In-Fixture Control Options:

23 Standard PAF when this option is chosen
24 Control Options include Injection Molded ABS End Cap
25 Fixtures with Control Options are Dry Location rated only
26 Only available with 0–10V dimming drivers (ED, ED1 & EDD)
27 Not available with surface mounting
28 Not available in 2ft when SpectraSync and SpectraSAFE are chosen

Third-Party Control Options:

29 LVS, LVR and ODPG only available with DALIP driver option
30 VIVE is a trademark of Lutron Electronics Co., Inc
31 Not available with SpectraSync (2750T or 2765T)

Accessory Notes:

32 See Columbia Mounting Accessories page for additional options

HUBBELL Lighting

MPS

MULTIPURPOSE LINEAR

ORDERING GUIDE (CONTINUED)

CONTINUOUS ROW MOUNT EXAMPLE GUIDE					
Continuous Row Length	MPS4	MPS8	MPSCRK-*	CM**SCF*-KIT	CM**NF-KIT
12' — Option 1	1	1	1	1	1
12' — Option 2	3	0	2	1	1
16' — Option 1	0	2	1	1	1
16' — Option 2	2	1	2	1	2
32' — Option 1	0	4	3	2	1
32' — Option 2	2	3	4	2	1

Link to Columbia Mounting Accessories page

PRODUCT EXCEPTIONS & DETAILS

Driver options listed below are available for the outputs as shown.

DRIVER AVAILABILITY TABLE — 2'							
	VW	MW	MWHE	LW	LWHE	ML	HL
E	x	x	x	x	x	x	x
ED	x	x	x	x	x	x	x
ED1	x	x	x	x	x	x	x
EDD	x	x		x		x	x
ESD	x	x		x		x	x
LUTH	x	x		x		x	x
347	x	x		x		x	x
DALIP	x	x	x	x	x	x	x

DRIVER AVAILABILITY TABLE — 4' & 8'														
	XW	XWHE	VW	VWHE	MW	MWHE	LW	LWHE	ML	MLHE	HL	HLHE	VL	XL
E	x	x	x	x	x	x	x	x	x	x	x	x	x	x
ED	x	x	x	x	x	x	x	x	x	x	x	x	x	x
ED1	x	x	x	x	x	x	x	x	x	x	x	x	x	x
EDD	x		x		x		x		x		x		x	x
ESD	x		x		x		x		x		x		x	x
347	x		x		x		x		x		x		x	x
LUTH	x		x		x		x		x		x			
DALIP	x	x	x	x	x	x	x	x	x	x	x	x	x	x

TEMPERATURE TABLE (C°) — 4' & 8'											
		80 CRI									
		E/ED/ED1		ESDU		ED347		EDD		LUT	
Size	Lumen Package	Ceiling/ Surface Mount	Pendant/ TH Mount	Ceiling/ Surface Mount	Pendant/ TH Mount	Ceiling/ Surface Mount	Pendant/ TH Mount	Ceiling/ Surface Mount	Pendant/ TH Mount	Ceiling/ Surface Mount	Pendant/ TH Mount
2'	VW	35	40	35	40	35	40	35	40	35	40
	MW	35	40	35	40	35	40	35	40	35	40
	LW	35	40	35	40	35	40	35	40	35	40
	ML	35	40	35	40	35	40	35	40	35	40
	HL	30	35	30	35	30	35	30	35	30	35
	XW	35	45	35	45	35	45	30	35	30	35
4'	VW	35	45	35	45	35	45	30	35	30	35
	MW	35	45	35	45	35	45	30	35	30	35
	LW	35	45	35	45	35	45	30	35	30	35
	ML	35	45	35	45	35	45	30	35	30	35
	HL	35	40	35	40	35	40	25	30	30	35
	VL	30	30	30	30	30	30	30	30	—	—
	XL*	25	25	25	25	25	25	25	25	—	—
8'	XW	35	45	35	45	35	45	30	35	30	35
	VW	35	45	35	45	35	45	30	35	30	35
	MW	35	45	35	45	35	45	30	35	30	35
	LW	35	45	35	45	35	45	30	35	30	35
	ML	35	45	35	45	35	45	30	35	30	35
	VL	30	30	30	30	30	30	30	30	—	—
	XL*	25	25	25	25	25	25	25	25	—	—

*XL not available with thru wire

Columbia LIGHTING

MPS

MULTIPURPOSE LINEAR

CONTROLS

NX Distributed Intelligence™ Lighting Controls:

Supports both indoor and outdoor applications in a variety of deployment options- wired, wireless, hybrid.
Integrates with and enables a wide array of luminaires including those with SpectraSync™ Color Tuning Technology.

NX DISTRIBUTED™ INTELLIGENCE

NX INTEGRATED CONTROLS REFERENCE								
NX Option	Sensor	Networkable	Scheduling	Occupancy	Daylight Harvesting	0–10V Dimming	On/off Control	Bluetooth® App Programming
NX Standalone								
NXS	NXSMP-SMI	No	Yes	Yes	Yes	Yes	Yes	Yes
NX Networked – Wired								
NXE	N/A	Yes	Yes	No	No	Yes	Yes	Requires NXBTC/R[1]
NXES	NXSMP-SMI	Yes	Yes	Yes	Yes	Yes	Yes	Yes
NX Networked – Wireless								
NXSW	NXSMP-SMI	Yes	Yes	Yes	Yes	Yes	Yes	Yes
NXWE	N/A	Yes	Yes	No	No	Yes	Yes	No[2]

1 NXBTC/R needs to be plugged into an available NX SmartPORT™ on the fixture network
2 To program NXWE option, need to consult factory. If connected to an area controller, programming can be done from that

Philips EasySense Controls ODPG Sensor:

- Occupancy sensing, daylight harvesting, task tuning and grouping in one device
- Standalone control or grouping to wireless switches[1]
- Uses Philips field apps for on site commissioning[2,3]
- Ability to create scenes for various room configurations
- Cost-effective solution for energy-savings and code-compliancy strategies
- DLC® Qualified: Listed on the QPL for Networked Lighting Controls. Please refer to the DLC website for specific product qualifications at www.designlights.org

1 Wireless switches only compatible with ODPG Philips EasySense
2 See link to Philips commssioning
3 Requires android device or IR dongle. See links for phone compatiblity and IR dongle

Wireless Switch Accessories[1]

☐	PESR-WH	EasySense compatible wireless single rocker switch, white
☐	PEDR-WH	EasySense compatible wireless dual rocker switch, white

SPECTRASAFE

SpectraSAFE™ Integrated Surveillance Lighting System

Technical Features

- High resolution 1080p full HD camera
- 2.8mm lens / 140° field of view
- IR emitter for low / no-light conditions
- Multiple wiring configurations available
- Supports 2-way audio communication
- Supports 2.4GHz WPA-PSK/WPA2-PSK Wi-Fi
- Data encrypted using AES 256 standard
- Low power consumption (2-5W)
- Transmissions secured using Open TLS / SSL

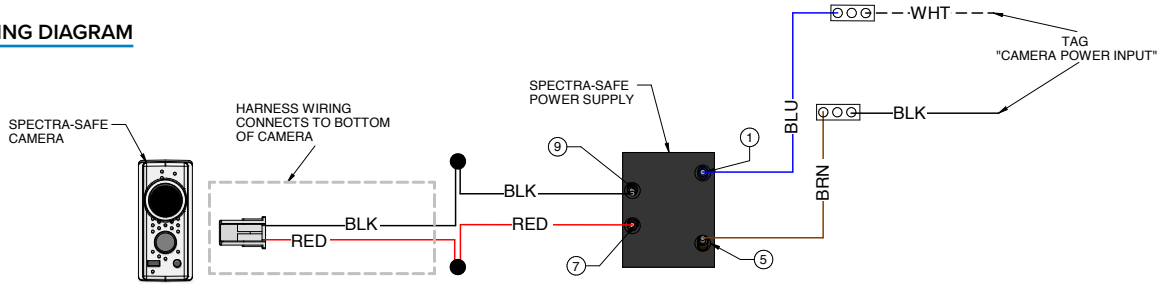
Note: Camera and end cap add 2.2" to the overall length.

Software & Support

- Free Android, iOS and web-based app
- Versatile and supports multiple applications
- Multi-tenant web-based camera application
- Phone and in-app chat technical support
- Scalable cloud services and video storage
- Supported by a 5-year warranty

SPECTRASAFE WIRING DIAGRAM

Power Supply	
Pin Connections	
Pin#	Single
1	VAC in (N)
5	VAC in (L)
7	+Vout
9	-Vout



HUBBELL Lighting

CONTROLS (CONTINUED)

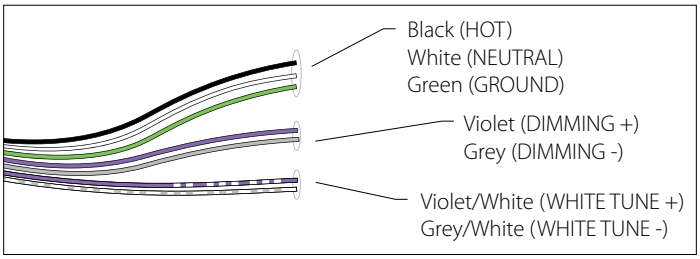
SpectraSync™ Color Tuning Technology:

Control your space based on the needs of the application, specific activities throughout the day and preferences of the occupants with distinct SpectraSync™ Color Tuning Technologies.

SPECTRASYNC COLOR TUNING TECHNOLOGY		
Mode	Kelvin Range	Description
Tunable White	2700K–5000K 2700K–6500K	Offers users the ability to tailor CCT to their personal preference, enhancing task visibility, material and colors or the aesthetics of the space

SpectraSync Tunable White

Available in two options: 2750T (2700K–5000K) or 2765T (2700K–6500K). Requires two 0–10V controllers, one for intensity and one for CCT. Minimum 5% dimming.

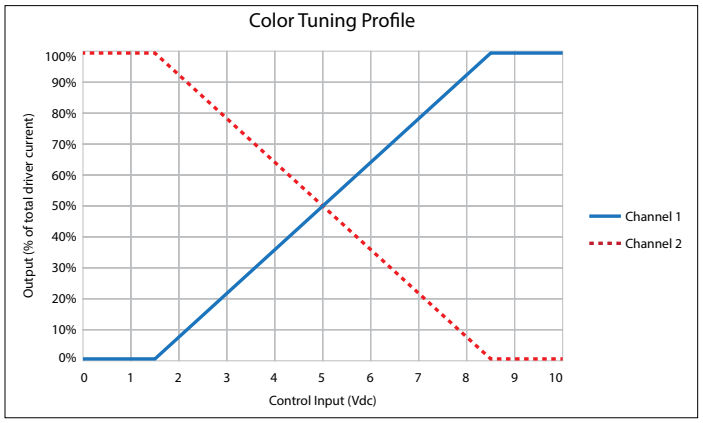


SpectraSync Tunable White luminaires are provided with two 0–10V circuits. The violet and grey circuit is for wiring to any qualified 0–10V controller for dimming. The violet/white and grey/white circuit is for wiring to any qualified 0–10V controller for Tunable White CCT control.

Controller Manufacturer Data

SpectraSync Tunable White was designed to be used with sinking style dimmers (provided by others) and is compatible with:

- Hubbell Control Solutions (HCS): NX Distributed Intelligence™ Room Controllers (NXRC) and In-fixture Controllers (NXFM)
- Lutron: DVTV, DVSTV, and NFTV dimmers
- Wattstopper: ADF120277 and CD4BL (Titan) dimmers



To enable scheduling and for use with NX wall control preset stations please refer to Hubbell Control Solutions NX SpectraSync technical sheet.

SPECTRASYNC™ AND NX AVAILABILITY TABLE

		Only With 80 CRI No Battery Pack			Only With 80 CRI With Battery Pack		
Size	Lumen package	CTC	NX	CTC+NX	CTC	NX	CTC+NX
2ft	VW	Y	Y	N	—	—	—
	MW	Y	Y	N	—	—	—
	LW	Y	Y	N	—	—	—
	ML	N	Y	N	—	—	—
	HL	N	Y	N	—	—	—
4ft	XW	Y	Y	Y	Y	Y	Y
	VW	Y	Y	Y	Y	Y	Y
	MW	Y	Y	Y	Y	Y	Y
	LW	Y	Y	Y	Y	Y	Y
	ML	Y	Y	Y	Y	Y	Y
	HL	Y	Y	Y	Y	Y	Y
	VL	N	Y	N	N	Y	N
	XL	N	Y	N	N	Y	N
8ft	XW	Y	Y	Y	Y	Y	Y
	VW	Y	Y	Y	Y	Y	Y
	MW	N	Y	N	N	Y	N
	LW	N	Y	N	N	Y	N
	ML	N	Y	N	N	Y	N
	HL	N	Y	N	N	Y	N
	VL	N	Y	N	N	Y	N
	XL	N	Y	N	N	Y	N

HUBBELL Lighting

Columbia LIGHTING

MPS

MULTIPURPOSE LINEAR

DATE: LOCATION:

TYPE: PROJECT:

CATALOG #:

DELIVERED LUMENS

STANDARD EFFICACY PERFORMANCE TABLE						
FIXTURE	COLOR	LENS	DISTRIBUTION	LUMENS	INPUT WATTS	LPW
MPS2-VW	3500K	Curve	Wide	1659	13.8	120
			Narrow	1597	13.5	118
		Flat	Wide	1584	13.5	117
		No Lens		1724	13.8	125
	4000K	Curve	Wide	1681	13.8	122
			Narrow	1618	13.5	120
		Flat	Wide	1604	13.5	119
		No Lens		1746	13.8	127
MPS2-MW	3500K	Curve	Wide	2201	18.2	121
			Narrow	2092	17.8	118
		Flat	Wide	2076	17.8	117
		No Lens		2287	18.2	126
	4000K	Curve	Wide	2229	18.2	122
			Narrow	2119	17.8	119
		Flat	Wide	2102	17.8	118
		No Lens		2316	18.2	127
MPS2-LW	3500K	Curve	Wide	2444	20.4	120
			Narrow	2328	19.9	117
		Flat	Wide	2309	19.9	116
		No Lens		2540	20.4	124
	4000K	Curve	Wide	2475	20.4	121
			Narrow	2358	19.9	118
		Flat	Wide	2338	19.9	118
		No Lens		2572	20.4	126
MPS2-ML	3500K	Curve	Wide	3452	29	119
			Narrow	3447	28.8	120
		Flat	Wide	3414	28.8	119
		No Lens		3587	29	124
	4000K	Curve	Wide	3496	29	121
			Narrow	3491	28.8	121
		Flat	Wide	3458	28.8	120
		No Lens		3632	29	125
MPS2-HL	3500K	Curve	Wide	3655	31.7	115
			Narrow	3707	31.5	118
		Flat	Wide	3678	31.5	117
		No Lens		3797	31.7	120
	4000K	Curve	Wide	3701	31.7	117
			Narrow	3754	31.5	119
		Flat	Wide	3725	31.5	118
		No Lens		3846	31.7	121
MPS4-XW	3500K	Curve	Wide	2574	20	129
			Narrow	2574	20	129
		Flat	Wide	2463	20	123
		No Lens		2674	20	134
	4000K	Curve	Wide	2606	20	130
			Narrow	2574	20	129
		Flat	Wide	2494	20	125
		No Lens		2708	20	135
MPS4-VW	3500K	Curve	Wide	3279	26.7	123
			Narrow	3152	26.5	119
		Flat	Wide	3134	26.5	118
		No Lens		3450	26.7	129
	4000K	Curve	Wide	3321	26.7	124
			Narrow	3192	26.5	120
		Flat	Wide	3174	26.5	120
		No Lens		3564	26.7	133
MPS4-MW	3500K	Curve	Wide	3656	30.4	120
			Narrow	3511	30.1	117
		Flat	Wide	3491	30.1	116
		No Lens		3847	30.4	127
	4000K	Curve	Wide	3702	30.4	122
			Narrow	3556	30.1	118
		Flat	Wide	3535	30.1	117
		No Lens		3974	30.4	131
MPS4-LW	3500K	Curve	Wide	4043	34.4	118
			Narrow	4094	32.5	126
		Flat	Wide	4072	32.5	125
		No Lens		4255	34.4	124
	4000K	Curve	Wide	4095	34.4	119
			Narrow	4147	32.5	128
		Flat	Wide	4124	32.5	127
		No Lens		4395	34.4	128

DELIVERED LUMENS (CONTINUED)

STANDARD EFFICACY PERFORMANCE TABLE						
FIXTURE	COLOR	LENS	DISTRIBUTION	LUMENS	INPUT WATTS	LPW
MPS4-ML	3500K	Curve	Wide	4556	40.1	114
			Narrow	4649	37.7	123
		Flat	Wide	4625	37.8	122
		No Lens		4794	40.1	120
	4000K	Curve	Wide	4614	40.1	115
			Narrow	4709	37.7	125
		Flat	Wide	4684	37.8	124
		No Lens		4952	40.1	123
MPS4-HL	3500K	Curve	Wide	5760	49.5	116
			Narrow	5781	49.4	117
		Flat	Wide	5741	49.4	116
		No Lens		6061	49.5	122
	4000K	Curve	Wide	5833	49.5	118
			Narrow	5855	49.4	119
		Flat	Wide	5814	49.4	118
		No Lens		6261	49.5	126
MPS4-VL	3500K	Curve	Wide	6769	54.1	125
			Narrow	6675	54.1	123
		Flat	Wide	6637	54.1	123
		No Lens		7122	54.1	132
	4000K	Curve	Wide	6855	54.1	127
			Narrow	6760	54.1	125
		Flat	Wide	6722	54.1	124
		No Lens		7357	54.1	136
MPS4-XL	3500K	Curve	Wide	8045	66.5	121
			Narrow	7878	66.8	118
		Flat	Wide	7813	66.9	117
		No Lens		8466	66.5	127
	4000K	Curve	Wide	8148	66.5	123
			Narrow	7979	66.8	119
		Flat	Wide	7913	66.9	118
		No Lens		8745	66.5	132
MPS8-XW	3500K	Curve	Wide	5147	40	129
			Narrow	4939	39.8	124
		Flat	Wide	4925	40	123
		No Lens		5348	40	134
	4000K	Curve	Wide	5213	40	130
			Narrow	5002	39.8	126
		Flat	Wide	4988	40	125
		No Lens		5416	40	135
MPS8-VW	3500K	Curve	Wide	6558	53.4	123
			Narrow	6303	53	119
		Flat	Wide	6269	53	118
		No Lens		6814	53.4	128
	4000K	Curve	Wide	6642	53.4	124
			Narrow	6384	53	120
		Flat	Wide	6349	53	120
		No Lens		6901	53.4	129
MPS8-MW	3500K	Curve	Wide	7311	60.8	120
			Narrow	7022	60.2	117
		Flat	Wide	6981	60.2	116
		No Lens		7596	60.8	125
	4000K	Curve	Wide	7405	60.8	122
			Narrow	7112	60.2	118
		Flat	Wide	7071	60.2	117
		No Lens		7693	60.8	127
MPS8-LW	3500K	Curve	Wide	8087	68.8	118
			Narrow	8189	65	126
		Flat	Wide	8144	65	125
		No Lens		8402	68.8	122
	4000K	Curve	Wide	8190	68.8	119
			Narrow	8293	65	128
		Flat	Wide	8248	65	127
		No Lens		8510	68.8	124
MPS8-ML	3500K	Curve	Wide	9111	80.2	114
			Narrow	9298	75.4	123
		Flat	Wide	9250	75.6	122
		No Lens		9466	80.2	118
	4000K	Curve	Wide	9227	80.2	115
			Narrow	9417	75.4	125
		Flat	Wide	9368	75.6	124
		No Lens		9587	80.2	120

MPS

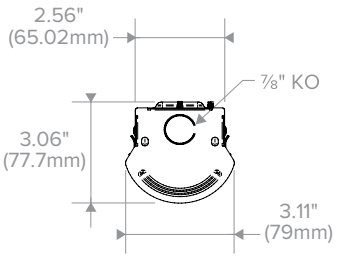
MULTIPURPOSE LINEAR

DELIVERED LUMENS (CONTINUED)

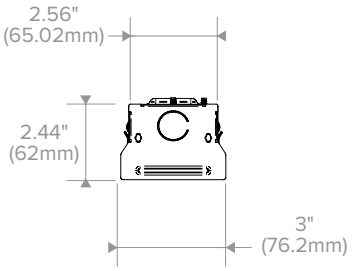
STANDARD EFFICACY PERFORMANCE TABLE						
FIXTURE	COLOR	LENS	DISTRIBUTION	LUMENS	INPUT WATTS	LPW
MPS8-HL	3500K	Curve	Wide	11520	99	116
			Narrow	11562	98.8	117
		Flat	Wide	11481	98.8	116
		No Lens		11969	99	121
	4000K	Curve	Wide	11667	99	118
			Narrow	11710	98.8	119
		Flat	Wide	11628	98.8	118
		No Lens		12122	99	122
MPS8-VL	3500K	Curve	Wide	13537	108.2	125
			Narrow	13350	108.2	123
		Flat	Wide	13275	108.2	123
		No Lens		14065	108.2	130
	4000K	Curve	Wide	13710	108.2	127
			Narrow	13521	108.2	125
		Flat	Wide	13444	108.2	124
		No Lens		14245	108.2	132
MPS8-XL	3500K	Curve	Wide	16091	133	121
			Narrow	15757	133.6	118
		Flat	Wide	15626	133.8	117
		No Lens		16718	133	126
	4000K	Curve	Wide	16296	133	123
			Narrow	15958	133.6	119
		Flat	Wide	15826	133.8	118
		No Lens		16932	133	127

DIMENSIONS

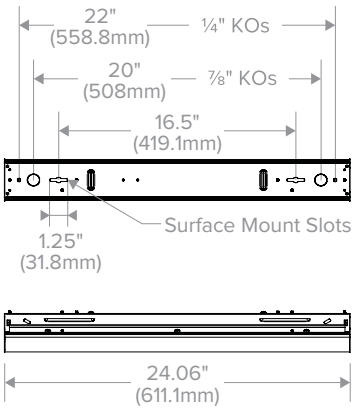
MPS END View - Curve Lens



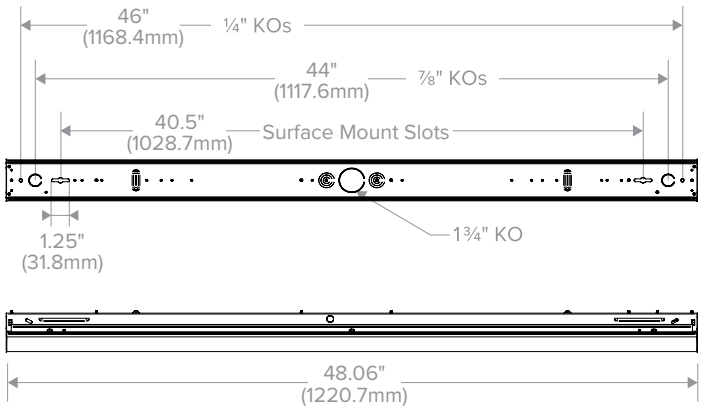
MPS END View - FLAT Lens



MPS 2' Dimensions



MPS 4' Dimensions

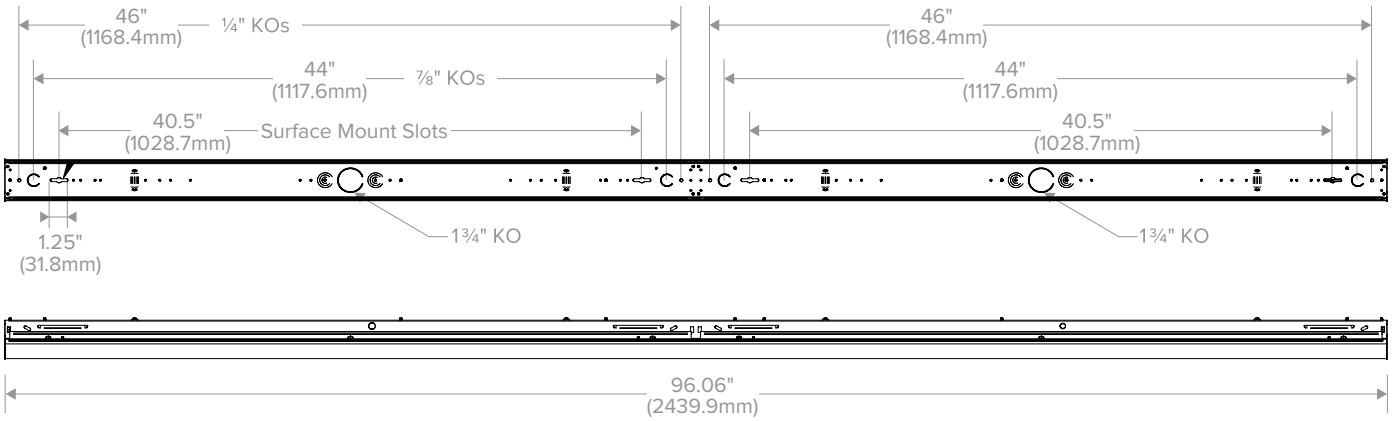


MPS

MULTIPURPOSE LINEAR

DIMENSIONS (CONTINUED)

MPS 8' Dimensions



PHOTOMETRY

MPS4-40ML-CN-EDU

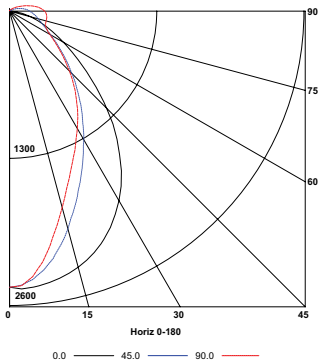
LUMINAIRE DATA

Test No.	**19735**
Description	**MultiPurpose Linear, Narrow, LED 4ft, Frosted Linear Prismed Lens**
Delivered Lumens	**4742**
Watts	**37.70**
Efficacy	**126**
Mounting	**Surface**
Spacing Criterion	**0° = 1.18 90° = 1.77**

ZONAL LUMEN SUMMARY

Zone	Lumens	% Luminaire
0–30	1542	32.5
0–40	2326	49.1
0–60	3518	74.2
0–90	4385	92.5
0–180	4742	100

POLAR GRAPH



MPS4-40ML-CW-EDU

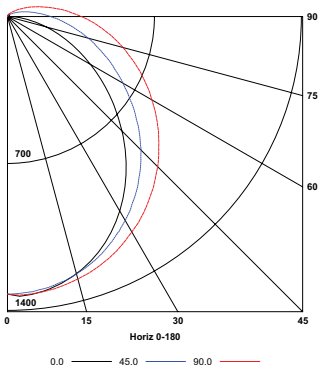
LUMINAIRE DATA

Test No.	**19600**
Description	**MultiPurpose Linear, Wide, LED 4ft, Frosted Linear Prismed Lens**
Delivered Lumens	**4615**
Watts	**40.10**
Efficacy	**115**
Mounting	**Surface**
Spacing Criterion	**0° = 1.20 90° = 1.33**

ZONAL LUMEN SUMMARY

Zone	Lumens	% Luminaire
0–30	1029	22.3
0–40	1688	36.6
0–60	3019	65.4
0–90	4248	92
0–180	4615	100

POLAR GRAPH



PHOTOMETRY
IES
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IES
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Columbia LIGHTING

MPS

MULTIPURPOSE LINEAR

DATE: LOCATION:

TYPE: PROJECT:

CATALOG #:

PHOTOMETRY (CONTINUED)

MPS4-40ML-FW-EDU

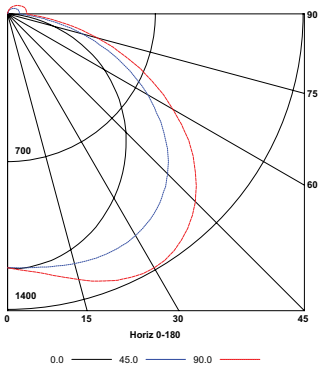
LUMINAIRE DATA

Test No.	**19652**
Description	**MultiPurpose Linear, Wide, LED 4ft, Frosted Linear Prismed Lens**
Delivered Lumens	**4685**
Watts	**37.80**
Efficacy	**124**
Mounting	**Surface**
Spacing Criterion	**0° = 1.24 90° = 1.67**

ZONAL LUMEN SUMMARY

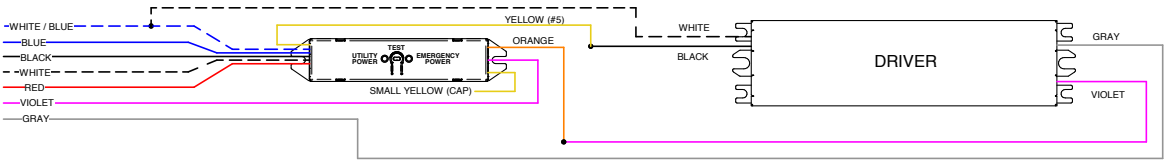
Zone	Lumens	% Luminaire
0–30	1026	21.9
0–40	1756	37.5
0–60	3324	70.9
0–90	4435	94.7
0–180	4685	100

POLAR GRAPH



ADDITIONAL INFORMATION

DTS WIRING DIAGRAM (0–10V DIMMING DRIVER SHOWN)



WHITE/BLUE	Emergency Neutral
BLUE	Emergency Line
BLACK	Utility Line (Unswitched Hot)
WHITE	Utility Neutral
RED	Switched Hot
VIOLET	Dimming
GRAY	Dimming

IES

PDF

DTS Integration Guide

HUBBELL Lighting

SECTION 26 52 00 - EMERGENCY POWER SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

A. Emergency system to lighting fixtures.

B. Related Requirements:

1. Section 26 05 13: Basic Electrical Materials and Methods.

1.02 DEFINITIONS

A. CIS: Central Inverter System.

1.03 DESIGN REQUIREMENTS

A. Emergency systems shall be supplied from storage batteries with charging unit with a minimum of 90 minutes back-up capacity for lighting systems by the furnishing of an CIS. This system shall be separate and independent. System shall be installed in accordance with requirements of all codes and regulations.

1.04 SUBMITTALS

A. Submit a materials list for this system with catalog cuts, technical data and manufacturer's specifications of all system components including batteries. With submittal, include evidence furnished batteries provide a true 10-year life by furnishing a copy of a test performed by a recognized test laboratory according to Bellcore TR-766.

1.05 QUALITY ASSURANCE

A. The manufacturer shall have been producing inverter system equipment for at least five consecutive years.

B. Systems shall undergo full load burn in testing at the factory.

C. Systems shall be listed by UL, or another Nationally Recognized Testing Laboratory (NRTL).

D. A manufacturer’s technical representative shall be available for system start-up, warranty work, and service calls.

1.06 WARRANTY

A. Manufacturer shall provide a two year material warranty and a 10 year material warranty for battery cells.

B. Installer shall provide a two year labor warranty.

PART 2 - PRODUCTS

2.01 COMPONENTS

A. CIS:

1. General: The system shall be furnished with following features:

a. System shall automatically protect itself against damage from overloads and short circuits while powered from either utility AC or during emergency inverter operations. System shall automatically disconnect load when battery voltage drops below approximately 85 percent of nominal battery voltage.

b. Batteries of system shall be maintenance-free type with lead calcium grids and shall be provided with a 10-year manufacturer’s warranty. Batteries shall have sufficient capacity to power inverter at full rated load for a minimum of 90 minutes for lighting loads, without battery voltage dropping below 85 percent of nominal battery voltage. Battery manufacturer's data sheets shall be provided indicating recommended charge rates, operating conditions and warranty years. Batteries shall be connected and installed in accordance with recommendations of battery manufacturer, and shall be individually labeled with make and model identification. Secure batteries to withstand seismic vibrations. Batteries shall be replaceable in field.

c. System shall be enclosed in a heavy gage, commercial grade steel cabinet, including hinged and lockable doors. Locks shall be keyed to Corbin No. 60 keys.

2. CIS shall be furnished with following additional features:

a. A microprocessor shall oversee inverter, and provide programmable functional self-test according to NFPA 101 to ensure optimal system and sub-system performance. If abnormal conditions or failure occur, warning messages shall be issued and alarms shall be sounded so that timely action maybe taken to alleviate problem or repair system. If inverter becomes inoperable, microprocessor shall be capable of shutting down components to prevent further damage.

b. The unit shall include a standard RS232 diagnostic interface module that sends a detailed unit status report when:

1) A self-test is performed.

2) An alarm condition exists.

The status report shall be sent to two user defined locations. These locations can be preprogrammed at factory, programmed on site by customer, or remotely programmed by factory once system is installed.

The standard RS232 self/diagnostic module shall allow for remote monitoring and troubleshooting of any abnormal conditions. The Ethernet connection shall be provided with a dedicated LAN connection to the communication room.

c. System shall be self contained, UL924 listed, designed to provide no-break power to operate specified lighting load for 90 minutes upon power loss or brown out of utility voltage.

d. The system's operation is to be fully automatic. It shall use a linear transformer, with boost tap and surge protection devices. Inverter shall be of Pulse Width Modulated (PWM) design, and shall provide true "no-break" power to load at all times. During normal operation, charger maintains battery bank at full capacity. The three on-board microprocessors continuously monitor charger settings and system's overall readiness. System consists of circuitry including an automatic, multi-rate, software controlled charger; continuous self-diagnostics monitoring 265 various parameters, and programmable system testing capabilities. System shall incorporate 30 individual alarms and nine systems logs. Logs and Alarms are to be automatically recorded and readily displayed through microprocessor controlled User Interface Display (UID). System shall also include a RS232 Serial port for remote communications.

The system's automatic overload and short circuit protection in normal and emergency operations shall consist of 150 percent momentary surge capability, 120 percent overload for five minutes, and 110 percent overload for 10 minutes. System protection shall also include a low battery voltage disconnect, AC input circuit breaker, a DC input fuse and switch, and an AC output fuse. System shall supply a digitally generated sinusoidal output waveform (PWM) with less than 5 percent total harmonic distortion at rated linear load. A boost tap transfer protection circuit shall maintain desired output voltage during low voltage "brownout" situations, without continuously switching to batteries; thereby preserving battery capacity.

e. Start Up and Maintenance: Microprocessor shall contain commission data including unit size, serial number, order number, and battery configuration. Software shall be furnished to assist in installation of equipment, brownout selection, and functional self-test.

f. Unit shall be furnished with three normally on output circuit breakers with alarm, and three normally off circuit breakers with alarm. Provide a descriptive circuit designation schedule.

g. CIS shall be Spectron LSN by Dual-Lite, Illuminator by Myers Power Products, or District approved equal.

PART 3 - EXECUTION

3.01 INSTALLATION, SYSTEM SHIPPING, START-UP AND TESTING

A. Shipping: System shall be shipped separately from batteries. Batteries shall be shipped to Project site directly from battery supplier and shall remain in their sealed cartons until opened and examined in presence of the Project Inspector. Batteries shall be shipped to Project site not more than 30 days before system start-up.

B. Start-Up: System start-up shall be performed by a technical representative of manufacturer, in the presence of the Project Inspector, with loads connected, and shall include testing and adjusting to assure proper operation of system functions. System start-up shall include follow-up visits. Following start-up, maintain system on a normally OFF input circuit until Substantial Completion.

C. Testing: Before Substantial Completion, conduct in the presence of the Project Inspector, a complete performance testing of system. Testing shall include operating system in emergency mode for at least 90 minutes for CIS, with loads connected, while monitoring battery voltage, output voltage and output frequency. Power factor of load shall be measured to ascertain compatibility with system. Furnish and operate necessary test equipment.

D. Equipment shall be anchored in accordance with CBC seismic requirements.

3.02 BATTERIES

A. Batteries shall be complete with necessary connectors and accessories, fully charged, and ready for service.

B. Documentation for 10 year manufacturer’s warranty for all batteries shall be delivered to Architect.

3.03 SERVICE MANUALS

A. Service Manuals: Submit service manuals to OAR including following:

1. A detailed explanation of operation of system.

2. Instructions for routine maintenance.

3. Detailed instructions for repair of major components of system.

4. Pictorial parts list and parts numbers.

5. Pictorial and schematic electrical drawings of wiring systems, including operating and safety devices, and major components.

6. Programming Instructions.

7. Program listing.

8. Final test report.

9. Installation Instructions: Submit manufacturer's written installation instructions.

3.04 TRAINING

A. Before Substantial Completion, provide the services of a manufacturer's representative on the Project site to instruct persons designated by the Owner in the operation and maintenance of the system. Instruction time shall not be less than four hours. Provide training video and training materials to designated owner’s personnel.

3.05 PROTECTION

A. Protect Work of this section until Substantial Completion.

3.06 CLEANUP

A. Remove rubbish, debris, and waste materials and legally dispose of off Project site.

END OF SECTION

DIVISION 27
COMMUNICATIONS

SECTION 27 05 36 - CABLE TRAY FOR COMMUNICATION SYSTEMS

PART 1 - GENERAL

1.1 SCOPE

A. Work Included: All labor, materials, appliances, tools, equipment, facilities, transportation and services necessary for and incidental to performing all operations in connection with furnishing, delivery and installation of the work of this Section, complete as shown on the Drawings and/or specified herein. Work includes, but is not necessarily limited to the following:

1. Examine all other Sections for work related to those other Sections and required to be included as work under this Section.
2. General Provisions and Requirements for electrical work.

1.2 SUBMITTALS (ADDITIONAL REQUIREMENTS)

A. Submit Product Data Sheets for all cable trays, all related components, and NEMA VE1.

1.3 SUBMIT CABLE TRAY SUPPORT DETAILS.

A. Provide Reproducible Floor Plan Shop Drawings, with the same scale as the Contract Floor Plan Drawings. The Drawings shall show the proposed Cable Tray Layout Plan views. An elevation view shall be provided at each riser or change in horizontal elevation in the cable tray. The Shop Drawing Plans shall show all building elements, expansion/seismic joints, air ducts, piping and components that cross the path of the cable tray, along with separation of the cable tray from the crossing components.

PART 2 - PRODUCTS

2.1 CABLE TRAY

A. Material and installation shall comply with NEMA - "VE1" latest edition, Cable Tray Systems', NEC., California Title 24 and Title 8. As manufactured by Globe Tray, Chalfant, P-W Industries or equal.

B. Cable tray shall include two longitudinal side rails, ladder type, with transverse 6 inches rung spacing welded to side rails. Rungs shall have a minimum cable-bearing surface of 0.75-inches. Rungs shall not extend below bottom of side rails. Splice plates shall be locking bolt type to connect tray sections together without decreased tray strength. Provide expansion/ deflection fitting at each building seismic and expansion joint crossing.

C. Trays shall be steel or aluminum. Steel trays shall be hot dip galvanized after fabrication ASTM A 123 with ANSI type 304 and 316 stainless steel hardware. Aluminum trays shall be extruded from 6063-T6-aluminum alloy with 5052-H32-aluminum alloy hardware.

D. The complete cable tray system and supports shall be designed for the following minimum uniformly distributed working load but not less than indicated on the Drawings, with a 1.5 minimum safety factor, when supported as a single span. In addition, the cable tray shall support 200 pounds concentrated at span midpoint without permanent distortion.

1. Cable tray wider than 12-inches or deeper than 6 inches, live loading 200 pounds per linear foot.

2. Cable tray 12-inches or less in width and 6 inches or less in depth live loading 100 pounds per linear foot.

E. Provide ladder type "elbows", "tees", horizontal "crosses", expansion connectors, reducer sections, connectors, straight sections, curved sections, fittings, supports, hangers, blind ends, risers and accessories to provide a complete installation of the cable tray shown on the Drawings. Provide trapeze brackets and individual threaded hanger suspension rods in any combination required to support the cable tray system. Provide all materials and labor necessary for a complete installation.

F. Cable tray runs shall be minimum 6-inches deep by 12-inches wide, but not less than indicated on Drawings. Dimensions are outside dimensions of the cable tray rails.

G. Similar cable tray parts and hardware shall be interchangeable with each other. The cable tray system shall be free of sharp edges, burrs or projections that can damage cable insulation.

PART 3 - EXECUTION

2.2 CABLE TRAY

A. Cable Trays shall be seismically anchored and supported to the building structure to prevent horizontal or lateral movement with 1.0-gravity acceleration, including specified live load conductor capacity, complying with State of California Seismic Codes. Support hangers from the building structure shall provide a 2.0 weight carrying safety factory including specified live cable weight. Cable tray hangers shall be provided with a spacing to insure the maximum cable tray deflection with the specified live cable loading does not exceed 0.75-inches between supports and hangers. In no case shall cable tray support or hanger spacing be greater than 12-feet on center.

B. Punching or drilling of structural side members shall not be performed except for splice plate bolt-holes.

C. Provide expansion adapters where cable trays cross a building expansion joint, and to comply with Tray Manufacturer's recommendation for the Cable Tray Thermal Expansion Requirements.

D. All Cable Trays including non-connected tray sections shall be made electrically continuous. Provide grounding jumpers minimum equivalent to #8AWG, where required to provide continuity.

E. Grounding for Cable Trays shall comply with Article 318-6 of NEC.

F. Provide curved "radius" cable trays at each "horizontal" or "vertical" change in direction of the cable tray. Provide "tee" and "crosses" at each intersection of Cable Trays. Provide "blind ends" at the end of each cable tray "run".

G. Provide removable fire blocking "bag style" at Cable Tray penetrations of fire barriers.

END OF SECTION

SECTION 27 08 00 - COMMISSIONING OF COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

A. The Requirements of this Section apply to all Sections of Division 27.

B. This Project will have selected building systems commissioned. The complete list of equipment and systems to be commissioned is specified in Section 019100 General Commissioning Requirements. The Commissioning process, which the Contractor is responsible to execute, is defined in Section 019100 General Commissioning Requirements. A Commissioning Agent (CxA) appointed by the College will manage the Commissioning process.

1.2 RELATED WORK

A. Section 010001 General Requirements

B. Section 010002 General Requirements

C. Section 019100 General Commissioning Requirements.

D. Section 013323 Shop Drawings, Product Data, and Samples.

1.3 SUMMARY

A. This Section includes Requirements for Commissioning the Facility Communications Systems, related subsystems and related equipment. This Section supplements the General Requirements specified in Section 019100 General Commissioning Requirements.

B. Refer to Section 019100 General Commissioning Requirements for more details regarding processes and procedures as well as roles and responsibilities for all Commissioning Team members.

1.4 DEFINITIONS

Refer to Section 019100 General Commissioning Requirements for definitions.

1.5 COMMISSIONED SYSTEMS

A. Commissioning of a system or systems specified in Division 27 is part of the construction process. Documentation and testing of these systems, as well as training of the College's Operation and Maintenance Personnel in accordance with the Requirements of Division 27, is required in cooperation with the College and the Commissioning Agent.

B. The Commissioning shall include the systems listed in Section 019100 General Commissioning Requirements.

1.6 SUBMITTALS

A. The Commissioning process requires review of selected Submittals that pertain to the systems to be commissioned. The Commissioning Agent will provide a list of submittals that will be reviewed by the Commissioning Agent. This list will be reviewed and approved by the College prior to forwarding to the Contractor. Refer to Section 013323 Shop Drawings, Product Data, and Samples for further details.

B. The Commissioning process requires Submittal review simultaneously with engineering review. Specific Submittal Requirements related to the Commissioning process are specified in Section 019100 General Commissioning Requirements.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 CONSTRUCTION INSPECTIONS

Commissioning of Communications systems will require inspection of individual elements of the communications system construction throughout the construction period. The Contractor shall coordinate with the Commissioning Agent in accordance with Section 019100 and the Commissioning Plan to schedule communications systems inspections as required to support the Commissioning Process.

3.2 PRE-FUNCTIONAL CHECKLISTS

The Contractor shall complete Pre-Functional Checklists to verify systems, subsystems, and equipment installation is complete and systems are ready for Systems Functional Performance Testing. The Commissioning Agent will prepare Pre-Functional Checklists to be used to document equipment installation. The Contractor shall complete the checklists. Completed checklists shall be submitted to the College and to the Commissioning Agent for review. The Commissioning Agent may spot check a sample of completed checklists. If the Commissioning Agent determines that the information provided on the checklist is not accurate, the Commissioning Agent will return the marked-up checklist to the Contractor for correction and resubmission. If the Commissioning Agent determines that a significant number of completed checklists for similar equipment are not accurate, the Commissioning Agent will select a broader sample of checklists for review. If the Commissioning Agent determines that a significant number of the broader sample of checklists is also inaccurate, all the checklists for the type of equipment will be returned to the Contractor for correction and resubmission. Refer to Section 019100 General Commissioning Requirements for submittal Requirements for Pre-Functional Checklists, Equipment Startup Reports, and other Commissioning Documents.

3.3 CONTRACTORS TESTS

Contractor tests as required by other Sections of Division 27 shall be scheduled and documented in accordance with Section 010000 General Requirements. All testing shall be incorporated into the Project schedule. Contractor shall provide no less than 7-calendar days' notice of testing. The Commissioning Agent will witness selected Contractor tests at the sole discretion of the Commissioning Agent. Contractor tests shall be completed prior to scheduling Systems Functional Performance Testing.

3.4 SYSTEMS FUNCTIONAL PERFORMANCE TESTING:

The Commissioning Process includes Systems Functional Performance Testing that is intended to test systems functional performance under steady State conditions, to test system reaction to changes in operating conditions, and system performance under emergency conditions. The Commissioning Agent will prepare detailed Systems Functional Performance Test procedures for review and approval by the Resident Engineer. The Contractor shall review and comment on the tests prior to approval. The Contractor shall provide the required labor, materials, and test equipment identified in the test procedure to perform the tests. The Commissioning Agent will witness and document the testing. The Contractor shall sign the test reports to verify tests were performed. See Section 019100 General Commissioning Requirements, for additional details.

3.5 TRAINING OF PERSONNEL

Training of the College Operation and Maintenance Personnel is required in cooperation with the College Representative and the Commissioning Agent. Provide competent, Factory Authorized Personnel to provide instruction to Operation and Maintenance Personnel concerning the location, operation, and troubleshooting of the installed systems. Contractor shall submit Training Agendas and Trainer resumes in accordance with the Requirements of Section 019100. The instruction shall be scheduled in coordination with the College Representative after submission and approval of formal Training Plans. Refer to Section 019100 General Commissioning Requirements and Division 27 Sections for additional Contractor Training Requirements.

END OF SECTION

SECTION 27 11 00 — COMMUNICATIONS EQUIPMENT ROOMS

PART 1 - GENERAL

1.1 GENERAL

A. Build-out (installation of racks, cabinets, cable runway, cable management, etc.) of Instructional Building #2, Building-Entry, BDF and IDF shall be provided by the Cabling Contractor.

B. Backboards, conduits, sleeves, power and grounding in the Instructional Building #2, Building-Entry, BDF and IDF shall be provided by the General and Electrical Contractor.

1.2 SECTION INCLUDE

A. Installation of freestanding and wall-mount Equipment Racks

B. Installation of Cable Management — Vertical and Horizontal

C. Installation of wall-mounted 110 Termination Blocks

D. Installation of Backbone UTP Protection Panels and Units

E. Installation of Category 6 UTP Patch Panels

F. Installation of Category 6 UTP Patch Cables

G. Installation of Fiber Optic Patch Panels

H. Installation of Fiber Optic Patch Cables

I. Installation of Grounding

J. Installation of Overhead Cable Runway

K. Installation of Voice Cross-connects

1.3 SYSTEM REQUIREMENTS

A. General: Coordinate the features of materials and equipment so they form an integrated system. Match components and interconnections for optimum future performance.

B. Expansion Capability: Unless otherwise indicated, provide spare conductor pairs in backbone cables, and
provide spare positions in cross-connects and terminal strips to accommodate 20% future increase in active services.

1.4 MOUNTING ELEMENTS

A. Pathways: Comply with Section 270528 Pathways for Communications Systems.

B. Backboards: 0.75-inch, ACX interior-grade, fire-retardant-treated plywood painted with two coats of fire- retardant white paint.

C. All free standing racks and cabinets shall be seismically securely to Zone-4 Requirements to the concrete floor using minimum .25-inch hardware or as required by local codes.

D. Racks shall be placed with a minimum of 36 inches clearance from the walls on three sides of the rack. When mounted in a row, maintain a minimum of 36 inches from the wall behind and in front of the row of racks and from the wall at one end of the row.

E. All racks and cable runways shall be grounded to the telecommunications grounding bus bar in accordance with Grounding System Requirements.

F. Rack-mount screws not used for installing patch panels and other hardware shall be bagged and left with the rack upon completion of the installation.

G. Wall-mounted termination block fields shall be mounted on 4 feet by 8 feet by 0.75-inch ACX void free plywood. The plywood shall be mounted vertically 12 inches above the finished floor. The plywood shall be painted with two coats of white fire retardant paint. Wall-mount termination block fields shall be installed with the lowest edge of the mounting frame 18 inches from the finished floor.

PART 2 – PRODUCTS

2.1 TWO-POST RACKS

A. Two-post racks shall have power distribution and cable management for server and networking applications in IT environments.

B. ICT Contractor shall provide, install, ground and seismic brace 2-post racks in the BDF and IDF’s.

C. The unit shall conform to TIA-610 Standard for, Racks, Panels and Associated Equipment and accommodate industry standard 19-inch rack mount equipment.

D. The unit shall be designed with four vertical posts to allow rack mount equipment installation utilizing four vertical mounting rails.

E. The unit shall provide 45U of equipment vertical mounting space (IU—1.75-inch or 44.45mm).

F. The vertical mounting rails shall be adjustable to allow different mounting depths.

G. The unit shall include at least 50 sets of mounting screws, caged nuts, bolts and cup washers, and caged nut installation tool for the mounting of equipment inside the unit.

H. All weight bearing components shall be constructed from steel no less than 0.9mm (20 gauge).

I. All metal parts shall be painted using a powder coat paint process.

   l. Racks shall be black over a brushed aluminum finish.

J. Plastic materials shall comply with Underwriters Laboratory Specification 94 with V-1 rating (UL94 V-1) or better.

K. Provisions shall be provided for all rack-mounted equipment to be earthed or grounded directly to the frame.

L. Unit shall include a grounding kit containing terminated green/yellow jumper wires and associated hardware.

M. Units shall be equipped with vertical and horizontal wire management.

N. Racks will require two PDU brackets per cabinet.

O. Freestanding modular aluminum units designed for telecommunications terminal support and coordinated with dimensions of units to be supported.

P. Material:

1. Approximate Module Dimensions: 84 inches high by 19 inches wide by 3 inches channel depth.
2. Racks shall be all high strength, lightweight 6061-T6 aluminum extrusion construction.
3. Racks shall be equipped with two top angles or top bars and heavy-duty assembly hardware.
4. Racks shall have EIA hole pattern on front and rear.
5. Racks shall assemble as 19 inches with no additional hardware.
6. Racks shall have EIA Channel: 3 inches x 1.265 inch x 0.25 inch thick flange.
7. Racks shall have Base Angles: 3.5 inches by 6 inches by 0.125 inch thick (pair).
8. Racks shall have Top Angles: 1.5 inch by 1.5 inch by 0.25 inch (pair).
9. Racks shall have Top Bars: 1.5 inch by 0.25 inch (pair).
10. Racks shall have a weight capacity of 1000 lbs. Weight must be evenly distributed.
11. Racks shall be black over a brushed aluminum finish.
12. Racks shall provide floor and ceiling access for cable management and distribution.
13. Racks shall provide pre-drilled base for floor attachment of rack.
14. Racks shall be seismic/earthquake braced.
15. Racks shall be black in color.
16. Contractor shall provide cable runway elevation kit,

K. Manufacturer:

1. Chatsworth Products, Inc. p/n# 55053-703
2. Or Equal

2.2 HEAVY DUTY EQUIPMENT SHELF FOR 3-INCHES CHANNEL

A. Shelves, black in color, shall be installed at the bottom of freestanding racks. These 20-inches deep, 200 lb. rated shelves are needed to support UPS units.

B. Manufacturer:

1. Chatsworth Products, Inc.
2. Or Equal

2.3 CABLE RUNWAY (LADDER RACKING)

A. Cable runway support shall be installed in Telecommunications Rooms as shown on the Drawings. Size: 18 inches wide.

B. Classified by Underwriters Laboratories (UL) as suitable for equipment grounding.

C. Cable Runway shall be used for voice and, or data and video communications cabling only. No electrical wiring shall be placed on runway with voice and data cabling.

D. Wall angle supports shall be steel angles. Ends to be smooth without hooks or projections. Brackets shall be able to support an end load of 600 lb. with a safety factor of 1.65.

E. Elbows, Tee’s, 90degree bends and crosses: All horizontal and vertical 90 degree elbows, tee’s, 90 degree bends and crosses shall be made with right angle couplings which clamp to the runway without the need for drilling or cutting.At all horizontal 90-degree bends, tees, and crosses, provide adjustable junction splice kits for large radius cable bends.

F. Where cables transition from runway to termination equipment or racks, provide cable radius managing waterfall attachments.

G. Seismically supported by end wall supports, angular wall support and communications equipment racks.

H. Protective End Caps on all exposed cable runway ends.

I. Black baked enamel finish.

J. Manufacturer:

1. Chatsworth Products, Inc.
2. Or Equal

2.4 WIRE MANAGEMENT

A. Materials

B. All equipment racks shall be equipped with vertical and horizontal wire management organizers. All horizontal wire managers shall be heavy duty painted black metal units designed specifically to connect to equipment frames. All vertical wire managers shall be aluminum with a black finish. All wire managers shall be secured to the frames and shall provide a clear and unobstructed pathway in which to route the cables.

1. The Vertical cable manager shall be constructed of metal backbone with pass through holes and plastic cable management fingers.
2. The cable management fingers shall be molded out of plastic and incorporate bend radius control throughout the entire length.
3. The panel shall have a metal door that will be capable of opening to the left or right when mounted.
4. The panel shall be capable of mounting to EIA standard channel, deep channel and telco style racks.
5. Vertical wire managers shall be double-sided 4.4 inches wide by 7 feet tall. Vertical wire mangers shall have evenly 1 RMU spaced wire rings designed to maintain jumper, patch, or cross-connect wire in place.
6. Vertical wire managers shall be designed to extend past the frame to allow placement of equipment in any position within the rack. When mounted between equipment frames, they shall be designed to direct cables into either frame and shall be securely mounted to both units.
7. Vertical wire managers shall be equipped with rigid aluminum Switch Gate Door/Cover with reversible access that conceals cable.
8. Vertical wire managers shall be provided black in color.

C. Horizontal Wire Managers (Equipment Racks)

1. The in-frame horizontal managers shall be 2 RMU in height and shall extend from side rail to side rail.
2. Double-sided design and pass-through slots for easy organization of front and rear cables.
3. Include cable guide fingers at 1.75-inch intervals for proper cable bend radius and organization of patch cords.
4. Flanged pass-through slots to route cables to the back.
5. Include Snap-on, hinged door/cover.
6. Black in color.

D. Horizontal Wire Managers (Wall-Mount Brackets)

1. Shall be 2 RMU in height and shall extend from side rail to side rail.
2. Single-sided design.
3. Include cable guide fingers at 1.75-inch intervals for proper cable bend radius and organization of patch cords.

4. Include Snap-on, hinged door/cover.
5. Black in color.

E. Cable Management for Wall Racks

1. Cable management rings shall be installed onwall-mount racks.
2. Black polymer-blend material that is UL Rated for use in plenum spaces.
3. Flexible material holds bundles secure while also allowing easy entrance of additional cables.
4. Internal diameter 3-inches.
5. Kit includes six rings and mounting hardware

F. Manufacturer:

1. Chatsworth Products, Inc.
2. Or Equal

2.5 PLYWOOD BACKBOARD

A. The General Contractor shall provide and install all MPOE and Telecommunications Room backboards.

B. Provide 0.75-inch (19.05 mm) ACX void-free, fire rated plywood as noted on construction documents.

C. All walls noted on Construction Documents must be covered with 0.75 inch (19.05 mm) thick by 8 feet-0 inches (2438.4 mm) high ACX plywood, painted with two coats of insulating fire- retardant white paint.

D. Backboards shall be mounted vertically, starting 6 inches (152.4 mm) above the finished floor, and secured to the walls.

E. All backboards are to be constructed of 4 feet (1219.2 mm) by 8 feet (2438.4 mm) plywood.

F. All plywood panels must be mounted in contact with one another, leaving no gaps between sheets.

G. All exposed edges must be chamfered. Screws, bolts, washers and/or nuts are to be counter sunk to be flush with the surface of the plywood,

2.6 WALL-MOUNTED 110 WIRING BLOCKS

A. Application: Shall be used to terminate voice station and voice backbone cable.

B. Compliance: Comply with ANSI/TIA-568-B.1 and ANSI/TIA-568-B.2 Category 5 Specifications Requirements and associated Addendums, ANSI/TIA-606-B Labeling Standards.

C. All voice station cable terminations shall be made on wall-mounted 110 wiring blocks with C4 connectors.

D. Intra-building voice backbone cable terminations shall be made on wall-mounted 110 wiring blocks with C5 connectors.

E. All blocks shall be UL listed.

F. Characteristics: The 110 Wiring Blocks shall:

1. Facilitate cross-connection and/or interconnection using either cross-connect wire or patch cords.
2. Be manufactured using fire retardant molded plastic with the base consisting of horizontal index strips for termination up to 25-pairs of conductors.
3. Support termination of 22, 24 and 26 AWG solid conductor.
4. Be available in S0-, 100- and 300-pair sizes. Sizes specified within Drawings contain access opening for rear to front cable routing to the point of termination.

5. Have termination strips on the base to be notched and divided into 4-pair and/or 5- pair increments.
6. Have clear label holders with the appropriate colored inserts available for the wiring blocks. The insert labels provided with the basis of circuit size (1-, 3-, 4- or 5-pair) and shall not interfere with running, tracing or removing jumper wire/patch cords.
7. Have bases available in 19-inch (482.6 mm) panels and high-density frame configurations for rack or wall mounting with cable management hardware.
8. Have connecting blocks used for either the termination of cross-connect jumper wire or patch cords. The connecting blocks shall be available in 2-, 3, 4- and S-pair sizes. All connecting blocks shall have color- coded tip and ring designation markers and be single piece construction.
9. Be capable of accommodating a minimum of 200 repeated insertions without resulting in permanent deformation.

G. Manufacturer:

1. AMP
2. Panduit
3. Leviton
4. Or Equal

2.7 PROTECTOR PANELS AND UNITS

A. Application: Inter-building and entrance cable protection will be Vendor's protector panel equipped with protector units. Protector panels shall meet NEC Article 800, Part C Requirements. Protector panels shall provide protection for communications equipment and circuits exposed to voltage surges and sneak currents. The protector panel shall be equipped with 110-style terminations in and out.

B. Protector units shall be UL 497 listed for primary circuit protection. Protector units shall provide protection for communications equipment and circuits exposed to voltage surges and sneak currents. The protector units shall be equipped with solid state surge arrestors for sneak current protection.

C. Manufacturer:

1. Circa
2. Marconi
3. Or Equal

2.8 UTP CATEGORY 6 PATCHPANELS

A. Application: Use to terminate all horizontal data station cabling.

B. Compliance: Listed as complying with ANSI/TIA-568-B.1 and ANSI/TIA-568-B.2 Category 6 Specifications Requirements and associated Addendums, ANSI/TIA- 606-B Labeling Standards.

C. Characteristics: Patch panels shall:

1. Be available in 48-port high-density configurations.
2. Modular Patch Panels shall be of a metal design with snap in four position and six position molded faceplate frames.
3. Patch panels shall be available with labels.
4. Patch panel modular jack assemblies shall be color coded as specified within Section 17140-3.3.
5. Be mountable in freestanding equipment rack.
6. Be labeled above the RJ4S module.
7. Be 2 RMU in height and shall extend from side rail to side rail.

D. Manufacturer:

1. AMP
2. Panduit
3. Ortronics
4. Or Equal

2.9 UTP CATEGORY 6 PATCH CABLES

A. UTP Patch Cables. Patch cables for unshielded twisted pair cable shall be Category 6 rated and shall be equipped with factory-attached connectors to interconnect equipment mounted on the racks of the distribution frame and to connect computer stations to outlet locations.

B. Patch cords may also be used for patching applications; not to exceed 20 feet. Quantity required for 100% port population at both ends with 10% spare.

C. Contractor shall provide:

1. BDF/IDF Patch Cords — 6-inches in length, Category 6 and colored according to the following:

a. Green for instructional network
b. Blue for non-instructional network
c. White for everything else
d. Number of each color to be confirmed with Owner or District Representative.

2. Workstations — 10 feet in length, Category 6, black in color.

D. Manufacturer:

1. AMP
2. Panduit
3. Ortronics
4. Or Equal

2.10 FIBER PATCH PANELS

A. Manufacturer: Ortronics or District approved equal.

B. Provide panel for maintenance and cross connecting of fiber optic cables.

C. Panel shall be constructed of 0.125-inch minimum aluminum and shall have connectors which interface the inside plant fiber optic jumper cable with the outside plant fiber optic cable.

D. Panels shall be equipped with engraved laminated plastic nameplates above each connector.

E. Rack-mounted fiber patch panels shall be equipped to terminate or splice the incoming inter-building fiber and any required backbone or interconnect cables.

F. Each cable must be properly dressed.

G. These units will terminate the fiber optic cables, provide a place for jumper cables and will provide room to terminate additional optics.

H. Panel shall provide capacity for minimum of 12 fiber optic strands. Larger capacity patch panels shall be determined at site walk.

I. Panel shall be 100% populated with type LC couplers and adapter plates.

J. All connectors and couplers will be type LC.

K. The fiber optic patch panel connections shall provide 0.4 dB or less insertion loss.

2.11 FIBER OPTIC PATCH CABLES

A. Manufacturer: Superior Essex, or District approved equal.

B. Fiber Optic Patch Cables shall be Multimode or Single Mode patch cords pre-made to connect fiber optic equipment with fiber optic cross connects, interconnects and outlets.

C. The patch cords (jumpers) shall be impact-resistant, duplex fiber cables with LC connectors, of the same performance characteristics as the Single Mode fiber backbone being connected.

D. These fiber optic patch panel connections shall provide 0.4 dB or less insertion loss and provide connection between the Active LAN devices and the Fiber Optic patch panel. Quantities for 100% fiber strand population at both ends plus 10% Spares.

E. Contractor shall provide:

1. IDF Patch Cords — 1 Meter in length, LC connectorized, Multimode and Single Mode, duplex, fiber optic patch cord.
2. MDF/BDF Patch Cords — 3 Meter in length, LC connectorized, Multimode and Single Mode duplex, fiber optic patch cord.

2.12 GROUNDING SYSTEM

A. The facility shall be equipped with a Telecommunications Bonding Backbone (TBB). This backbone shall be used to ground all telecommunications cable shields, equipment, racks, cabinets, raceways, and other associated hardware that has the potential to act as a current carrying conductor. The TBB shall be installed independent of the building's electrical and building ground and shall be designed in accordance with the recommendations contained in the ANSI/TIA- 607 Telecommunications Bonding and Grounding Standard.

B. The TBB shall adhere to the recommendations of the ANSI/TIA-607 standard, and shall be installed in accordance with industry best practice.

C. The General Contractor shall be responsible for having a licensed Electrical Contractor provide and install the TBB to the building service entrance ground.

D. The main entrance facility shall be equipped with a Telecommunications Main Grounding Bus bar (TMGB). The Site MPOE and each Telecommunications Room shall be provided with a telecommunications ground bus bar (TGB). The TMGB shall be connected to the building electrical entrance grounding facility. The intent of this system is to provide a grounding system that is equal in potential to the building electrical ground system. Therefore, ground loop current potential is minimized between telecommunications equipment and the electrical system to which it is attached. Installation of building ground systems shall be the responsibility of the Electrical Contractor.

E. All racks, cable runway, metallic backboards, cable sheaths, etc. entering or residing in the MPOEs and Building Telecommunications Rooms shall be grounded to the respective TGB or TMGB using a minimum #6 AWG stranded copper bonding conductor and compression connectors. Bonding of cable sheaths and equipment within these rooms shall be the responsibility of the Cabling Contractor.

F. All wires used for telecommunications grounding purposes shall be identified with a green insulation. Non- insulated wires shall be identified at each termination point with a wrap of green tape. All cables and bus bars shall be identified and labeled in accordance with the System Documentation Section of this Specification.

G. Manufacturer:

1. Chatsworth Products, Inc.
2. Or Equal

PART 3 - EXECUTION

3.1 EQUIPMENT RACKS, SHELVES AND SERVER RACKS

A. Coordinate all work for final mounting locations of all equipment.

B. Provide and install all cable runways as defined on Telecommunications Drawings and Specifications.

C. Provide and install 324-inch fire rated plywood backboards within Telecommunications Room as identified within Telecommunications Drawings and Specifications.

D. Provide and install all equipment racks and cabinets

E. Provide seismic anchoring of all racks and cabinets to meet compliance.

F. Provide and install all vertical and horizontal wire managers.

G. Provide and install required rack-mounted patch panels and wall-mounted 110 termination hardware.

3.2 CABLE MANAGEMENT

A. Provide and install two vertical wire management panels to each 19-inch x 7-feet equipment rack installed.

B. Provide and install one 2U horizontal wire management panel for each UTP patch panel and fiber optic enclosure installed.

3.3 UTP PATCH PANELS

A. Provide and install 48-port, Category 6 patch panels within Telecommunications Rooms.

B. Contractor shall verify and provide exact quantities required.

3.4 FIBER OPTIC PATCH PANELS

A. Provide and install fiber optic patch panels within the building MPOE and Building Telecommunications Rooms.

B. Provide and install necessary adapter and blank panels.

3.5 VOICE TERMINATION BLOCKS

A. Provide and install 110 type termination blocks with wiring troughs within Telecommunications Rooms.

B. Provide lightning protection termination terminals for all outside plant/underground cable installed.

C. Contractor shall verify and provide quantities required.

3.6 CROSS CONNECTS

A. Provide all cross-connect (1 pr. hook-up) wire required in the Instructional Building #1 MPOE and TRs.

B. Backbone cable to backbone cable, cross-connect all pairs.

C. Backbone to voice station cable and emergency telephone cable, cross-connect one pair per station.

3.7 CABLE RUNWAY (LADDER RACKING)

3.8 Provide and install all ladder rack as defined within the Telecommunications Drawings.

3.9 Provide and install all required mounting/supporting hardware required.

3.10 TIE WRAPS

3.11 Provide and install Velcro cable ties to manage and secure all installed cables within MPOEs and Telecommunications Rooms.

3.12 GROUNDING

3.13 The Electrical Contractor shall provide and install the Telecommunications grounding system to each MPOEs and Telecommunications Rooms.

3.14 Provide and install grounding bus bars within MPOEs and Telecommunications Rooms as identified on the Telecommunications Drawings.

3.15 The Cabling Contractor shall provide and install grounding within BDF and IDF Rooms as follows.

1. Inter-building cable sheaths shall individually bonded to the TGB.
2. Each rack shall be individually bonded to the TGB.
3. Each cable runway section shall be bonded together with ground straps.
4. Cable runway strapped system shall be bonded to the TGB.
5. Ground all equipment within Telecommunications Room with a minimum #6 AWG conductor.

END OF SECTION

SECTION 27 20 00 - ELECTRONIC NETWORK SYSTEMS INFRASTRUCTURE

PART 1 - GENERAL

1.1 SCOPE

A. Work Included: All labor, materials, appliances, tools, equipment necessary for and incidental to performing all operations in connection with furnishing, delivery and installation of the work of this Section, complete, as shown on the Drawings and/or specified herein. Work includes, but is not necessarily limited to the following:

1. Examine all other Specifications Sections and Drawings for related work required to be included as work under Division 26.
2. General Provisions and Requirements for electrical work.

B. Provide Electronic Network Systems Infrastructure for the following systems:

1. Computer Data Networks
2. Telephone and Intercom Voice Communications
3. Other special systems described in the Contract documents.

1.2 SUBMITTALS (ADDITIONAL REQUIREMENTS)

A. Drawings Submittals

1. Drawings shall be submitted on reproducible sepias and AutoCAD® Version 2.2 (or later revision) data files on CD/DVD-ROM disk, WINDOWS®-XP or Version-7 or Version-8 format.
2. Submit redrawn Building Floor Plan for each building area, same scale as the Contract Drawing.
3. Plans shall show walls, doors, windows, furniture, infrastructure, outlets and network systems equipment locations. Show point-to-point interconnecting cables, pathways, conduit, conduit sizes, circuit types, along with circuit identification names, numbers and quantities between all components.
4. Provide scaled Elevation Drawings of each equipment rack, terminal blocks, terminal backboard and terminal room/closet showing location and arrangement of each equipment component, outlet and cable training provisions, with estimated weight of each complete assembly.
5. Submit block wiring diagrams showing major system components, outlets, equipment racks, terminal blocks, signal loss with interconnecting circuit conductors, splices, portable patch cords and connectors. Riser type diagram shall be provided if the building has more than one floor level, with information shown on riser diagram corresponding for each respective floor

B. Submit Manufacturer's standard catalog data for each component. The submittal shall be arranged in the order of the Specification and shall list the Specification paragraph number, the name, the proposed model and Manufacturer for each item as well as a reference indicating the specific piece of data which can be easily located in the brochure. The Manufacturer's data sheets shall be marked to indicate the specific item being proposed in cases where the sheet covers several types or sizes of items. The

data sheet shall completely describe the proposed item. Where modification to the equipment is necessary to meet the operational Requirements of the Contract Documents, the brochure shall include complete Mechanical and Electrical Shop Drawings, detailing the modification. The brochure shall include a listing of the outlet rough-in Requirements for every device and equipment item. The applicable symbol which illustrates that rough-in item on the job plans shall be drawn on the proposal, opposite the description of the rough-in to facilitate locating the data by Field Personnel. Submit elevation and dimensional information.

C. Performance Calculation:

1. Provide engineered calculations showing the Passive Cable System Signal Attenuation losses of the proposed installed system. The intent is not to require calculations for every system segment, port and outlet. The intent is to require engineered calculations for proposed typical worst case port to port head end to farthest distance outlet and patch port to outlet signal attenuations.
2. Provide calculations for a minimum of 50 complete channel/circuit paths. The calculations shall include attenuation insertion losses for each system component including individually itemized cable-fiber/wire; outlet, termination, connector, electronic component (if any), coupler and patch cord along the entire path from the head end equipment to the end use outlet.
3. The calculations shall serve as the basis for verifying the system performance with the system testing specified in the Contract Documents.

D. Provide proposed nameplate and outlet identification/color coding system. Indicate proposed identification naming sequence and methods, itemized for review.

E. Submit Manufacturer Certified Test Reports showing test documentation for the proposed material that the material meets or exceeds the performance standards defined in the Contract Documents. The testing and results shall reflect worst case performance based on a minimum of ten samples. Tests shall be certified by a Nationally Recognized Independent Test Lab (i.e., ETL, UL, etc.). The Manufacturer shall certify in writing the material has been manufactured and tested to comply with the Requirements defined in the Contract Documents.

F. Submit three samples of each of the following, fully assembled with 24-inches of cable type connected:

1. Copper wire outlet and connector, with each type of specified inserts.
2. Copper cables and patch cords, each type.
3. Fiber optic cables and patch cord each type.
4. Mechanical splice - fiber optic.
5. Fusion splice - fiber optic.
6. Fiber optic outlet and connector each type.
7. Fiber optic cable connector each type of termination, with interconnection coupler.
8. Patch panel each type.
9. Coverplate each type.

1.3 APPLICABLE STANDARDS

A. Individual component Production/Manufacturer Testing and Labeling.

1. The equipment shall be UL listed, labeled, and approved for the application shown in the Contract Documents.
2. ETL (USA) each network systems infrastructure component. Third party testing, documentation and certification for performance compliance of each component with the UL, ANSI, TIA and EIA applicable Standards specified in the Contract Documents.

B. The complete system material, equipment, testing, installation, workmanship and installed performance shall comply with the Mandatory Requirements and the Guideline/Recommendation Requirements of the following latest published version, supplements, latest revision including Addendums and TSB. Both the mandatory and advisory criteria shall be included as Requirements of the Contract Documents:

1. TIA-526 Optical Power and loss measurements – multimode and single mode fiber.
2. ANSI/TIA/EIA-568C Commercial Building Telecommunications Standards.
3. ANSI/TIA/EIA-569B – Commercial Building Standards for Telecommunications Pathways.
4. ANSI/TIA/EIA-570A Residential Telecommunications Standard.
5. ANSI/TIA/EIA-598B Optical Fiber Cabling Color-Coding.
6. ANSI/TIA/EIA-606A Administrative Standard for Commercial Telecommunications Infrastructure.
7. ANSI/TIA/EJA-607 Commercial Buildings Grounding and Bonding Requirements for Tele- communications.
8. FCC – FYU/FT6.
9. ISO/IEC 11801
10. National Electrical Code (NEC) and California Electrical Code (CEC) including Articles 770 and 800 with ETL verified testing and local code jurisdictions.
11. NECA/NEIS, National Electrical Contractors Association, National Electrical Installation Standards:
    a. 301 – Standard for Installation and Testing for Fiber Optic.
    b. 568-Standard for Installing Building Telecommunications Bonding and Grounding.
    c. 607-Telecommunications
12. Manufacturer's recommendations for the respective equipment.

C. Network Performance

1. The entire completed Electronic Network Systems Infrastructure shall be tested and provide electronic data/network and telephone/voice multi-channel communications latest revisions, standards and addendums for the following protocols:
    a. IEEE 802.3/ETHERNET latest revisions.
2. Twisted pairs copper wire (100 meter path length unless indicated otherwise)
    a. 10Mbps 10Base-T, 100Mbps 100Base-Tx;
    b. 1000Mbps (1Gbps) 1000 Base-Tx;
    c. 10,000 Mbps (10Gbps) 10Gb Base-Tx.
    d. IEEE-802.3 for Power Over Ethernet (POE) and Power Over Ethernet-

Plus (POE Plus).

3. Fiber optic, 550 meter communications pathway distance, OM4 standard multimode and OS2 single- mode.

   a. 10Mbps 10Base-F1, 100Mbps 100Base-FX,
   b. 1000Mbps 1000Base-Lx-Sx
   c. 10,000 Mbps (10Gbps) for fiber optics
   d. Single Mode path length performance increase Requirement to 3000 meters.

4. IEEE 802.5/TOKEN RING.
5. APPLETALK (Phone-net).
6. FDDI - Distributed data interface on fiber or copper wire, 100Mbps.
7. 100VG – Any LAN
8. TIA/EIA serial and Bi-directional RS-232 and RS-485, including Star-Hub repeaters.
9. ANSI - TPPMD 55Mbps, 155Mbps and 622Mbps Asynchronous Transfer Mode - ATM.

D. The Complete Telephone/Voice Infrastructure System shall be suitable for the telephone/voice analog and digital communications and VoIP protocols. The system shall be compatible with the telephone/voice equipment installed as part of the Contract.

E. Installation of All Infrastructure Equipment, Devices, Splices, Terminations, Cables, Outlets, etc. shall comply with Manufacturer's recommendations.

1.4 EQUIPMENT QUALIFICATIONS

A. Equipment

1. The Supplier of the equipment shall be the Factory Authorized Distributor and service facility for the brands of equipment and material provided.
2. Network systems infrastructure equipment and materials shall all be the product of one of the individual same Manufacturers as follows. Typical unless specifically described otherwise:

   Belden – 10GX Series; or CommScope-Systimax X10D Series; or AMP/Tyco NetConnect Series; or Ortronics/Legrand – NetClear Series; or Siemon – ConvergeIT Series.

B. Installation Certification

1. Work and material for cables, cable terminations, outlets and related components for infrastructure systems shall be performed by Certified Installers. The Installer shall be certified by the respective Product Manufacturers.
2. The Manufacturers of the indicated work and material shall provide an Installer education/training and certification program for the supplied products.
3. The Installers performing the Contract Work for the indicated products shall have attended and successfully completed each of the respective Manufacturer's installation training education programs for the specified products.
4. Submit six copies of the Manufacturer's Certifications for each installer performing the work. The submittal shall be approved by the Owner's Representative prior to initiating any related Contract Work.

5. Contract material installed and work performed by Installers not complying with these Requirements shall be removed. Removal of work and material not in compliance with these Requirements shall done at the Contractor's expense, without any additional cost to the Contract and without any additional Contract completion due date extensions. New material and work required to replace the non-complying removed work and material shall be provided at the Contractor's expense, without any additional cost to the Contract and without any additional Contract completion due date extensions.

C. Extended Material and Performance Warranties

1. In addition to the Warranty Requirements described elsewhere in the Contract Documents, provide the following extended material and performance warranties. The warranty period shall be for not less than 15-years from the Contract Notice of Completion.
2. Warranty scope includes materials and performance for network cables and terminations, network workstation plug-in outlets, and patch panel plug-in outlets, cable splices and connectors.
3. Repair or replace the defective material with new material at the Project premise, to comply with the performance standards outlined in the Contract Documents during the warranty period.
4. Submit seven copies of proposed warranty statements, with Shop Drawing submittals.

1.5 ABBREVIATIONS

Abbreviation	Terminology
ACR	Attenuation to Cross Talk.
AHJ	Authority Having Jurisdiction.
Backbone	Circuit interconnections between MDF and IDF patch panel locations. dB
	Decibel.
dBm	Decibel referenced to a milliwatt.
Demarc	Demarcation location where operational control change occurs or ownership change occurs.
ft	Feet.
GHz	Gigahertz.
Gbps	Gigabits per second.
Horizontal Connection, and/or workstation outlet Horizontal wiring	Circuit interconnections between individual location to respective IDF or MDF equipment rack patch panel.
IDF	Intermediate Distribution Frame (horizontal or vertical cross connect) for an individual building area/ floor. km
	Kilometer-lkm.
kPSI	1000 pounds per square inch.
m	Meter = 39.37 inches.
Mbps	Megabits per second.
MDF	Main Distribution Frame (central/main cross connect) for

multi-building site or for a single individual building.

MHz ..... Megahertz.
MIC..... Micrometer
mm ..... Millimeter = 10^{-3} meter.
NEXT..... Near end cross talk.
nm ..... Nanometer = 10^{-9} meter.
pF ..... Picofarad = 10^{-12} farad.
Provide..... Furnish, install and connect.
RTDE..... Equipment rack mount fiber optic termination distribution enclosure, with fiber optic patch panel.
RMSE ..... Equipment rack mount fiber optic enclosure, splice only (without patch panel).
STP ..... Shielded individual twisted pairs copper wire.
ScTP ..... Shield Screened Twisted Pairs copper wire.
Trunking-Cable..... Individually insulated twisted pair copper wire cable, consisting of 24-pair or more of conductors inside a common cable jacket. Terminate and connect to common terminal-block location at each end of the trunking-cable.
um ..... Micrometer = 10^{-6} meter.

USE..... Universal Splice Enclosure.
UTP..... Unshielded twisted pairs copper wire.
VoIP..... Voice communications Over Internet Protocol.
WGNA..... . Wide Band Gigabit Networking Alliance.
Workstation or ..... Spaces remote from the MDF/IDF terminal
Workstation location room/closet, where user equipment interacts and connects with the electronic systems infrastructure equipment connection outlet device.
WMIC..... Wall Mount fiber optic cable Interface Cabinet.

1.6 MATERIALS AND METHODS

A. Material and Labor not complying with the Contract Documents shall be removed by the Contractor from the Project Site. Material and labor complying the Contract Documents shall be provided.

B. All the cost to remove deficient work and material, provide work and material complying with the Contract Documents and the direct, indirect, incidental damages and Contract delays resulting from complying with these Requirements shall be the sole responsibility of the Contractor and shall be included in the bid price.

C. System Performance Requirements

1. The work, performance and type of materials provided as part of the Contract shall comply with the following ANSI/TIA/EIA-568C and related standards for all Electronics Network Systems Infrastructure work and materials described in the specifications and shown the Drawings:

   a. Computer/data network systems: Category-6
   b. Telephone/intercom voice systems: Category-6

2. The Electronic Network Systems Infrastructure system shall be based on “star-

topology"; for MDF to IDF backbone connections and workstation outlet to MDF/IDF horizontal connections.

PART 2 - PRODUCTS

2.1 FIBER OPTICS CABLES

A. General

1. Operating temperature range - 20 degrees centigrade through +60 degrees centigrade. Cables shall be flame retarding.
2. Electronic network systems infrastructure cables that are not installed inside conduit raceways. Electronic network systems infrastructure cables that are installed in concealed spaces including plenums and non-plenums; access floors, ceiling spaces, walls, floor, etc., and/or installed without continuous raceways. The cable insulation and jacket shall be listed and labeled "Limited Combustible Cable" (LC or LCC) and shall comply with the latest published revision of all of the following Additional Requirements.

    a. Limited combustible "FHC-25/50" per UL-2424.
    b. NEC/CEC;CMP, additional listing/labeling where the install location is an environmental air plenum, fiber optic "FHC-25/50-CMP and/or OFNP/OFCP".
    c. NFPA-90A; ceiling cavity plenums, wall cavity spaces and raised floor cavity plenums, limited- combustible.
    d. NFPA-5000; defines combustible material including wire and cable.
    e. NFPA-75 computer rooms and electronic equipment room.
    f. NFPA-13; spaces containing "limited combustible loading".

3. Cables shall qualify as 100% recyclable materials disposal, RoHS Regulation complaint.
4. All fibers in a multi-fiber cable shall be fully operational within the performance characteristics specified prior to and after the cable is installed. The use of spare fibers in the cable to compensate for defective fibers is not permitted. Defective cables shall be removed and replaced with fully functional cables at no additional cost to the Contract.
5. Cables shall be UL listed, complying with National Electrical Code, ETL tested and certified to comply with Specified Requirements. ANSI/TIA/EIA-568C including related Standards, Amendments and TSB.
6. Each fiber shall be individually identified with factory color-coding or factory imprinted label. The outer cable jacket shall be imprinted with date, Manufacturer's model and catalog number, along with Agency listing identification.
7. Fiber optic cable shall be a product of the same Manufacturer, including portable patch cables.
8. Cables installed in raceways or conduits below grade, through in-grade manholes or pullboxes shall be rated for installation in water/wet locations.
9. Provide overall outer jacket enclosing all fibers inside jacket. Cables containing less than seven fiber strands shall be provided with a color coded outer jacket (red or orange).
10. Multimode (62.5/125)

a. Fiber optic cables optical fibers, (62.5/125) graded index multimode optical glass fibers, 62.5 micron fiber core and 125 micron fiber cladding, 0.275 numerical aperture. Optical fibers shall be 100 kpsi proof tested, with maximum 0.7 micron flaw size for dual operation at 850nm and 1300nm wave lengths.

b. Minimum bandwidth: @ 850nm - wave length 160MHz per km length
@ 1300nm - wave length 500MHz per km length

c. Maximum attenuation: @ 850nm-wave length 3.4 dB @ 1km length
@ 1300nm-wave length 1.0 dB @ 1km length

d. Laser-optimized "OM2" optical multi-mode standards.

11. Multimode (50/125)

a. 50/125 fiber optic cables optical fibers, graded index multimode optical glass fibers, 50.0-micron fiber core and 125-micron fiber cladding, 0.2 numerical apertures. Optical fibers shall be 100 kPSI proof tested, with maximum 0.7 micron flaw size for dual operation at 850nm and 1300nm wave lengths.

b. Minimum bandwidth:
@ 850nm-wave length 3500Mhz per km length @ 1300nm-wave length500Mhz per km length

c. Maximum attenuation:
@ 850nm-wave length 3.0db @ 1km length @ 1300nm-wave length1.0db @ 1km length

d. Laser-optimized "OM4" optical multi-mode standards.

12. Single mode:

a. Fiber optic cables optical fibers, (8.3/125) single mode optical glass fibers, 8.3-micron core fiber and 125-micron fiber cladding, 0.11 numerical apertures. Optical fibers shall be 100-kPSI proof tested, with maximum 0.7-micron flaw size. For operation at 1310nm and 1550nm wave lengths.

b. Maximum attenuation:
@ 1310nm- wave length 0.5 dB @ 1km length
@ 1550nm- wave length 0.4 dB @ 1km length

c. Maximum dispersion
@ 1310nm- wave length 2.8 ps/nm km length
@ 1550nm- wave length 18.0 ps/nm km length

d. Laser-optimized "OS1"/OS2" optical single mode standards.

B. Loose Tube Gel-filled Cables

1. Multiple, loose tube buffer tubes, gel-filled. Each buffer tube shall contain the same quantity of optical fibers, but not more than twelve optical fibers in each buffer tube.
2. Buffer tubes shall be cabled around a central dielectric strength member. The central strength member shall be centered along the length of the cable.
3. Aramid yarn, non-optical, strength fibers shall extend continuously along the length of the cable.
4. The cable interstitial spaces shall be flooded to inhibit water migration, with non-

flammable water blocking gel.

5. Each optical fiber shall be individually UV cured acrylate coated, 250-micron diameter coating over fiber cladding.
6. A seamless black polyethylene outer layer jacket shall envelope the entire cable.
7. The cable shall be fungus resistant, UV resistant, and moisture resistant for installation indoors with or without an enclosed raceway and outdoors in underground enclosed raceway/conduit and manholes/ pullboxes continuously flooded with water.

C. Indoor/Outdoor Cables

1. The cable shall be fungus resistant, UV resistant, moisture resistant for installation indoors with or without an enclosed raceway and outdoors in underground enclosed raceway/conduit and manholes/ pullboxes continuously flooded with water, and in conduits exposed to the sun.
2. Each optical fiber shall be primary coated with 500 micron uniform acrylate tight buffered and with elastomeric uniform 900-micron diameter tight buffered, secondary coating. Aramid yarn strength member elements shall be tensioned and symmetrically and uniformly distributed around the fibers, along the length of the cable.
3. An overall cable jacket uniformly extruded directly around and mechanically interlocked with the optical fibers/strength members. The extruded jacket shall form internal helical cusped ridges that interlock with the optical fibers and strength members. The interlocking jacket shall not allow cable fibers to move axially within the cable jacket.
4. Cables containing more than twenty-four optical fibers shall be constructed with sub-cable fiber bundles. Each sub-cable bundle shall contain equal quantities of optical fibers, with a separate PVC jacket around each sub-cable. Sub-cable and sub-cable jacket construction shall match the Overall Cable Requirements and Jacket Requirements.
5. The cable shall be UL listed and comply with NEC and NFPA Requirements for each installation location shown in the Contract Documents. ETL tested and certified to comply with or exceed Specified Requirements.

   a. NEC – OFNR (Vertical Riser Type Locations) OFNP (UL FHC-25/50 LC Plenum Type Locations and locations where not continuously enclosed inside conduits for entire cable length).
   b. NEC – OFNG (Where continuously enclosed inside conduits for entire cable length).

D. Tight Buffered Cables

1. Each optical fiber shall be coated, 900-micron diameter uniform coating, with uniform tight buffering over the coating, uniform dielectric strength member surrounding the buffering coating and an overall jacket around each optical fiber assembly.
2. Individual multiple optical fiber assemblies shall be symmetrically arranged around a central dielectric strength member. The central strength member shall be centered along the length of the cable.
3. A dielectric strength member shall surround the fiber assemblies.
4. An outer dielectric jacket shall envelope the entire cable.
5. The cable shall be UL listed and comply with NEC and NFPA Requirements for

each installation location shown in the Contract Documents. ETL tested and certified to comply with or exceed Specified Requirements.

a. NEC - OFNP (UL FHC-25/50 LC Plenum type locations and locations where not continuously enclosed inside conduits for entire cable length).

2.2 COPPER WIRE CABLES (TWISTED PAIRS)

A. General

1. Conductors shall be copper wire, individually insulated and color coded, with multiple conductors arrange in twisted pairs.
2. An overall non-conductive jacket shall encase the copper wires and any shielding (where shielding is specified) shall also be encased by the jacket.
3. Cables shall be UL listed, complying with NEC National Electrical Code, National Fire Protection Agency and NFPA Requirements for each installation location shown. ETL tested and certified to comply with or exceed Specified Requirements.

    a. NEC – MPP/CMP, FHC-25/50 (Plenum type locations and locations where not continuously enclosed inside conduit).
    b. NEC – MPR/CMR (Vertical riser type locations).
    c. ANSI/TIA/EIA-568C; including related Standards, Amendments and TSB.

4. Electronic network systems infrastructure cables that are not installed inside conduit raceways. Electronic network systems infrastructure cables that are installed in concealed spaces including plenums and non-plenums; access floors, ceiling spaces, walls, floor, etc., and/or installed without continuous raceways. The cable insulation and jacket shall be listed and labeled “limited combustible cable” (LC or LCC) and shall comply with the latest published revision of all of the following Additional Requirements.

    a. Limited combustible “FHC-25/50” per UL-2424.
    b. NEC/CEC;CMP, additional listing/labeling where the install location is an environmental air plenum, copper wire “FHC-25/50-CMP”.
    c. NFPA-90A; ceiling cavity plenums, wall cavity spaces and raised floor cavity plenums, limited- combustible.
    d. NFPA-5000; defines combustible material including wire and cable.
    e. NFPA-75 computer rooms and electronic equipment room.
    f. NFPA-13; spaces containing “limited combustible loading”.

5. Cables shall qualify as 100% recyclable materials disposal, RoHS regulations complaint.
6. Cables installed in air plenums, air-handling spaces and cables installed without raceway or conduit shall also be UL listed and labeled for installation in air plenums.
7. Cables installed in raceways or in conduits below grade, or through in-grade manholes and pullboxes, shall be rated for installation in water/wet locations.
8. The outer cable jacket shall be imprinted with date, Manufacturer’s model and catalog number and Agency (AHJ) listing identification.
9. Copper wire Electronic Network Systems Infrastructure cable shall be a product of the same Manufacturer, including portable patch cables.

10. The outer jacket of cables with less than nine pair of conductors shall be color-coded. The jacket color shall be different for each system type; multimedia; telephone/voice; computer/data network; and fiber cable jackets.
11. 300-volt RMS insulation material for each data conductor shall be the same material; shall be the same electrical characteristics and shall be the same dielectric constant, for all data conductors contained within the respective common cable jacket, along the entire installed length of the cable. Data cables employing differing insulation materials for individual data conductors contained within a common cable jacket are not acceptable and shall not be provided.
12. Propagation and “Skew” Rate

    a. Skew rate (nominal velocity of propagation delay) between any twisted pair in a combination of 4-twisted pair conductors grouped in the same cable, shall not exceed 35-nano seconds between any wire pair contained in the conductor group, and as required by the cable Category rating, over a cable length of 328-feet (100 meters), for all frequencies up to the cable maximum frequency rating.
    b. Nominal velocity of propagation, exceeding 70% of the speed of light.

13. Large capacity feeder cables and trunking-cables

    a. Copper wire cables with more than 24-twisted pairs of conductors shall be constructed with 25- pair binder groups of conductors. The cable binder groups shall be enclosed in colored binders and assembled to form a single cable. The twisted pair/binder groups shall be enclosed with multi-layer dielectric protective sheaths underneath a cable jacket enclosing the entire cable assembly. A corrugated metal 100% shield shall be provided under the cable jacket enclosing all conductors.
    b. Cables shall be wet location rated and listed for installation in conduit, where the conduit is in a wet environment and/or high-temperature environment, including:

    · Underground conduit.
    · Inside manholes and pull boxes.
    · Outdoor conduit exposed to weather and/or sunlight.

    c. ANSI/TIA/EIA Category rating of cable assembly shall be Category-5E, trunking-cable.

B. Category-6 Computer/Data Enhanced Cables – [ScTP] [UTP]

1. Category-6 cables shall be tested and shall pass the ANSI/TIA/EIA Test recommendations for Category- 6.
2. Operation Characteristics:

a.	Wire size	23AWG solid copper (23AWG stranded copper for portable patch cables)
b.	Quantity of twisted pairs	As indicated but in no case less than 4-twisted pairs
c.	Impedance	100 OHM □ 15%, 1-500Mhz
d.	Maximum Signal Attenuation	2.1dB @ 1Mhz Per 328-feet 3.8dB @ 4Mhz (100 meters) 5.9dB @ 10Mhz 7.5dB @ 16Mhz 8.4dB @ 20Mhz 10.5dB @ 31.25Mhz 15.0dB @ 62.5Mhz 19.1dB @ 100Mhz 27.6dB @ 200Mhz 31.1dB @ 250Mhz 34.3dB @ 300Mhz 40.1dB

@ 400Mhz 45.3dB @ 500Mhz

e. Mutual Maximum Capacitance of Any Pair 4.4nF/100m

f. Worst Pair "NEXT" Loss Per/328-feet (100 meters) 67.0dB @ 1Mhz 67.0dB 4hz 67.0dB @ 10Mhz 67.0dB @ 16Mhz 67.0dB @ 20Mhz 67.0dB @ 31.25Mhz 65.6dB @ 62.5Mhz 42.3dB @ 100Mhz 58.0dB @ 200Mhz 56.5dB @ 250Mhz 55.3dB @ 300Mhz 53.5dB @ 400Mhz 52.0dB @ 500Mhz

3. ScTP, all the wires in the cable shall be enclosed in a common, 100% metallic foil shield with copper "drain" wire, shield and drain wire located under the cable jacket.

2.3 FIBER OPTIC FIBER SPLICES

A. General

1. Fiber optic cable splices shall be UL listed, complying with National Electrical Code, ETL tested and certified to comply with or exceed Specified Requirements, ANSI/TIA/EIA–568C including related Standards, Amendments and TSB.
2. Fiber optic splices shall be the product of the same Manufacturer.

B. Mechanical Splice

1. Mechanically splice each fiber with a splice suitable for use with the type of fiber optic fibers. Re- enterable and reusable splice. Splice shall be recommended as compatible with the optical fibers by the Manufacturer. Splice shall not require the use of adhesives. Splice shall provide integral strain relief.
2. Performance Requirements after installation:

    a. Operating temperature range minus 20-degrees centigrade through plus 60-degrees centigrade.
    b. Loss variation over temperature range, 0.05dB or less at specified wave lengths.
    c. Insertion loss, 0.3dB or less at specified cable wave lengths.
    d. Reflection (return loss), -40dB at specified cable wavelengths.

C. Fusion Splicing

1. Fusion splicing shall be performed with equipment providing the following features:

    a. Cleaving and cleaning optical fiber.
    b. Integral splice optimization verification system with local injection and detection.
    c. Projection screen optics and fiber core alignment system.
    d. Fiber cleaning/stripping.
    e. Cleaning fiber ends and fusing of fiber together with an electric arc.

2. Fusion splice insertion loss as measured at the completion of the splice shall be less than 0.1dB at specified cable wave lengths.

2.4 FIBER OPTIC FIBER CONNECTORS AND INTERCONNECTION COUPLERS

A. General

1. The connectors and interconnection couplers shall be compatible, maintain the same Performance Category rating and be compatible with the corresponding fiber optic cable type attached to the connectors.
2. Fiber optic cable connectors and interconnection couplers shall be UL listed, complying with National Electrical Code, ETL tested and certified to comply with or exceed Specified Requirements. Connectors and couplers shall comply with ANSI/TIA/EIA-568C, related Standards, Amendments, TSB, and TIA/EIA-Fiber Optic Connector Intermateability Standard (FOCIS) documentation.
3. Fiber optic connectors and couplers shall be the product of the same Manufacturer.
4. Shall be UL listed and comply with UL94V-0.
5. Color code connectors for fiber optic cables to match the respective fiber optic strand/jacket color.

B. Fiber Optic Fiber Connectors

1. LC – Small Form Factor (SFF) termination connector

   a. Ceramic oxide 1.25mm ferrule. Mechanical durability not less than 500-mating cycles. Insertion loss of mated connector shall be less than 0.3dB at specified wavelengths.
   b. Strain relief boot, long boot type unless indicated otherwise, short or angled boot type to match the connector installation application. Provide duct cover cap for each connector.
   c. Locking type to automatically align mating fibers in the fiber cable and prevent accidental rotation and pullout.

2. ST type bayonet termination connector

   a. Ceramic aluminum oxide 2.5mm ferrule, multi-cure ultra violet or heat cured epoxy bonded, for multimode or single mode to match cable fiber. Insertion loss of each mated connector shall be less than 0.3dB at specified wavelengths.
   b. Strain relief boot, long boot type unless indicated otherwise, short or angled boot type to match the connector installation application. Provide dust cover cap for each connector.
   c. Locking type, to automatically align fiber cable and prevent accidental pullout.

3. SC – Square/Subscriber termination connector

   a. Ceramic oxide 2.5mm ferrule.

   Insertion loss of mated connectors shall be less than 0.3dB at specified wavelength.

   b. Strain relief boot, long boot type unless indicated otherwise, short or angled boot type to match connector installation application. Provide dust cover cap for each connector.

c. Push-pull snap and lock type to automatically align mating fibers in the fiber cable and prevent accidental rotation and pullout.

4. "FSD" fixed shroud duplex type termination connector

C. FIBER OPTIC FIBER INTERCONNECTION COUPLERS

1. Interconnection couplers shall be “like-to-like” compatible, and shall provide "plug-in" coupling of two fiber optic cable connectors terminated with fiber optic fibers front-to-rear "in-line" together. The coupler shall provide interlocking, automatic optical self-alignment of two mating fiber optic connectors.
2. The centerline to centerline spacing of the interconnection couplers shall allow removal and insertion of portable patch cords, fiber cable connectors for both “single” and “duplex” type fiber adapter connectors without interfering with adjacent connectors.
3. Patch panel mounted interconnections couplers shall be factory pre-mounted to a modular nominal 0.09- inch thick metal panel, couplers aligned and anchored on the plate.

   a. The metal panel shall be predrilled for Standard EIA mounting in high-density 19-inch wide metal patch panel frames.

4. Interconnection couplers in workstation outlets shall be installed in outlet boxes with cover plates.
5. Provide removable dust caps for the front side of each coupler.

2.5 COPPER WIRE OUTLET CONNECTORS

A. General

1. Connectors shall comply with FCC part-68 Subpart F for gold plating.
2. Connectors shall be UL listed and shall comply with UL94V-0.
3. Provide a removable blank dust cover for each plug-in outlet insert. The dust cover shall protect the insert from contamination until a workstation or patch cord is "plugged" into the outlet.
4. Copper wire outlet connectors shall be color coded to distinguish telephone/voice separately from computer/data. The outlet cover plate shall be engraved to identify telephone/voice, computer/data and other infrastructure outlets separately.
5. Copper wire outlet connectors shall be UL listed, complying with National Electrical Code, ETL tested and certified to comply with or exceed Specified Requirements, ANSI/TIA/EIA-568C including related Standards, Amendments and TSB.
6. Copper wire outlet connectors shall be the product of the same Manufacturer.

B. Universal Outlet Connector (for twisted pair Copper Wire Premise/Workstation Wiring and copper wire patch panels).

1. General

   a. Connections for twisted pairs copper conductors shall provide a universal outlet connector between the building premise copper wire, and plug-in workstation locations. Patch panel/ equipment plug-in connectors. The connector components shall assemble with "snap-in" spring loaded

retainers to prevent dislocation during insertion or removal of external plug-in devices.

b. The contacts shall be gold plated with a 250 insertion/withdrawal cycle rating.

c. Unless specifically noted otherwise the universal outlet connector shall comply with ANSI/TIA/ EIA-568C; related Standards, Amendments and TSB.

d. Operational characteristics shall match or exceed and shall be compatible with the respective twisted pair's cable.

e. A metal ground shield with EMI/RFI metal ground clip shall be provided where shielded cable is connected to the universal outlet connector for each universal outlet connector assembly.

f. Each universal outlet connector shall consist of three major components.

1) Universal edge connector assembly.
2) Plug-in adapter inserts.
3) Connector housing.

g. Provide snap-in blank removable insert covers for connector installed without plug-in adapter inserts.

2. Universal edge connector:

a. Insulated assembly shall connect to the premise copper wire. The connectors shall be multiple plug type connector contacts, one contact (total of eight contacts) for each individual premise wire connection interconnected to the individual wire terminations.

b. Connector shall provide insertion of individual insulated copper wire, gas tight, 110-style punch down/displacement termination, for 22-26 AWG insulated premise wire.

c. The edge connector assembly shall provide termination of eight separate wire conductors, twisted or untwisted pairs, solid or stranded, shielded or unshielded, with color codes and numbered identification of each contact. Integral cable/conductor strain relief to prevent pullout of terminated premise wire conductors.

3. Plug-in adapter inserts:

a. Plug-in adapter inserts shall be internally factory connected to the universal edge connector assembly to adapt the universal connector to the specific outlet type configuration (i.e. "RJ" style computer/data, telephone/voice, (multimedia) modular jacks, etc.).

b. Inserts shall be certified for shielded or unshielded wire, to match premise wire type connected to the universal edge connector.

c. Inserts shall provide correct pin-to-pin connections, electrical and mechanical matching characteristics for the specific equipment connected to the respective outlet.

d. Inserts for different infrastructures shall be color coded with different colors from each other, for system identifications.

e. Plug-in adapter insert type:

1) Computer/data network systems:

a) ANSI/TIA/EIA-568C, female modular jack 8-position/contact "RJ-45" style.

2) Telephone/intercom voice systems:

a) ANSI/TIA/EIA-568C female modular jack 8-position/contact RJ-45" style.

3) Multimedia audio/video TV (baseband only):

a) ANSI/TIA/EIA-568C female modular jack 8-position/contact RJ-45 style.
b) Each multimedia audio/video outlet location provides a Balun to match the circuit impedance of the premise wiring to the multimedia outlet signal type.

4) Intrusion detection/access control systems:

a) ANSI/TIA/EIA-568C female modular jack 8-position/contact RJ-45 style.
b) Each intrusion detection system outlet location provides a Balun to match the circuit impedance of the premise wiring to the intrusion system outlet signal type.

4. Connector housing:

a. Connector housing shall contain the universal edge connector assembly and the plug-in adapter inserts in a rigid assembly. Connector housing shall provide integral cable strain relief for the premise wiring connection.
b. The connector housing shall mount to a metal panel, metal device cover plate or plastic device cover plate with spring loaded snap-in retainers. Nominal depth of connector housing behind the mounting panel and/or device cover plate shall not exceed 1.625-inch including Premise Wiring Termination Depth Requirements.

C. Coaxial Cable Connectors

1. General

a. BNC type connectors, for coaxial cable premise/workstation wiring and coaxial cable patch panel equipment.
b. Unless noted otherwise, the BNC connectors shall comply with ANSI/TIA/EIA-568C and related Standards, Addendums and TSB.
c. Brass body and male contact. Beryllium copper or bronze female contact. Bayonet coupling with threaded or cam-locking mating connection.

2. Operational characteristics shall match or exceed and shall be compatible with the respective coaxial cable. 75-OHM, operational frequency range 0-4500MHz.

2.6 FIBER OPTIC FIBER DISTRIBUTION ENCLOSURES

A. General

1. Fiber optic fiber distribution enclosures shall be UL listed, complying with National Electrical Code, ETL tested and certified to comply with or exceed Specified Requirements, ANSI/TIA/EIA–568C including related Standards, Amendments and TSB.
2. Fiber optic fiber distribution enclosures shall be the product of the same Manufacturer.

B. Equipment Rack Mount Fiber Optic Termination Distribution Enclosure - RTDE

1. The RTDE enclosure shall mount in an EIA standard 19-inch wide enclosed or open frame equipment rack assembly. The RTDE enclosure shall be metal, painted finish, Manufacturers standard color.

2. The RTDE shall provide the following self-contained functions internal to the RTDE assembly.

   a. Fiber cable termination.
   b. Fiber cable "pig-tail" splicing.
   c. Fiber cable patch panel.
   d. Fiber cable management, training and strain relief.
   e. Individual fiber and patching port identification numbers, color-coding of incoming trunk and out-going distribution fiber ports.
   f. Plug-in fiber optic interconnection couplers for port to port patching with portable fiber optic patch cords.

3. Fiber splice drawers:

   a. Horizontal sliding metal drawers adjustable to approximately 30-degree angle when fully open, and removable for easy access. Each drawer shall contain two fiber optic splice trays with tray holders.
   b. Drawers shall stack vertically one above the other in the RTDE and allow sufficient slack in all fiber cables for removal of the drawer and splice trays.
   c. Provide one sliding drawer and two splice tray assemblies for each group (twenty-four individual fibers or fewer fibers per group) of fiber optic fibers terminated in the equipment rack, but in no case provide not fewer than two sliding drawers with splice tray assemblies in each RTDE.

4. Fiber cable patch panel

   a. Metal panel shall provide a patch port for each fiber consisting of metal panel mounted fiber optic interconnection couplers for each fiber optic fiber indicated to be terminated at the RTDE.
   b. The fiber optic fiber interconnection coupler shall be provided to match and be compatible with the fiber cable connectors. Quantity shall match quantity of terminated fibers, unless indicated otherwise on the equipment rack schedules.
   c. Nominal panel thickness 0.09 inches.

d. Provide a minimum of sixteen unused spaces for additional couplers in the patch panel.

5. Nominal height of the RTDE shall not be exceeded, as follows:

Quantity of Patch Ports	Quantity of Splice Drawers	Nominal Height
24	2	11-inches
48	2	11-inches
72	3	14-inches
144	6	28-inches

C. Equipment Rack Mount Fiber Optic, Splice only (for use only where fiber patch panel is not required) enclosure
- RMSE

1. The RMSE enclosure shall mount in an EIA standard 19 inch wide enclosed or open frame rack assembly. The enclosure shall be metal, painted finish, Manufacturer's standard color.
2. The RMSE shall provide the following self-contained functions internal to the RMSE assembly:

a. Fiber cable splicing for "thru splicing" of fiber optic cables where the cables do not terminate in the equipment rack.
b. Fiber cable management, training and strain relief.

3. Fiber splice drawers

a. Horizontal sliding metal drawers adjustable to approximately 30-degree angle when fully open and removable for easy access. Each drawer shall contain two fiber optic splice trays with splice tray holders.
b. Drawers shall stack vertically one above the other in the RMSE and allow sufficient slack in all fiber cables for removal of the drawers and splice trays.
c. Provide one sliding drawer and two fiber optic splice tray assemblies for each group (24- individual fibers or fewer fibers per group) for fibers optic fiber routed through but not terminated in the equipment rack, but in any condition provide not fewer than two sliding drawers with splice tray assemblies in each RMSE.

4. Nominal height of the RMSE shall not be exceeded, as follows:

Quantity of Thru Splices	Quantity of Splice Drawers	Nominal Height
24	2	4-inches
48	2	4-inches
72	4	8-inches
96	4	8-inches

2.7 COPPER WIRE PATCH PANELS

A. General

1. Copper wire patch panels shall be UL listed, complying with National

Electrical Code, ETL tested and certified to comply with or exceed Specified Requirements, ANSI/TIA/EIA-568C including related Standards, Amendments and TSB.

2. Copper wire patch panels shall be the product of the same Manufacturer.

B. Equipment Rack Mounted Patch Panel

1. Standard EIA 19-inch wide metal panel, Manufacturers standard color. Pre-punched for copper wire outlet connectors. Panel shall mount on an EIA standard 19 inch wide enclosed or open frame equipment rack assembly. Nominal 24-copper wire outlet connectors in a horizontal row, quantity of rows as required for total quantity of connectors. Provide not less than two spare empty rows for future copper wire outlet connectors.

2. The patch panel shall provide the following self-contained functions.

   a. Copper wire cable termination including conductor/ shield termination and strain relief.
   b. Plug-in copper wire outlet connectors for port to port patching with copper wire portable patch cords.

3. Patch panel height shall be based on the quantity of copper wire outlet connectors described plus the specified space for future outlets and shall not exceed the following dimension height:

Outlet Quantity	Nominal Patch Panel Height
1-24	3.5 inches
25-48	7 inches
49-72	10.5 inches
73-96	14 inches

4. Horizontally mounted, cable support metal bracket shall be provided for each 24-outlet/connector groupings. The brackets shall be bolted to the equipment rack located at the backside of the patch panel; the brackets shall support and provide strain relief for each incoming copper wire cable connecting to the patch panel.
5. The copper wire connector installed in the patch panel shall be the same configuration, Manufacturer and type as the corresponding copper wire connector provided in the remote workstation outlet locations connecting to the respective patch panel outlet, unless indicated otherwise.
6. Each multimedia, audio/video/TV multimedia and intrusion detection/access control outlet. Provide a Balun, to match the circuit impedance of the premise wiring and to the outlet signal type.

2.8 TELEPHONE/VOICE TERMINAL BLOCKS

A. General

1. Terminal blocks Type 110, shall consist of wiring blocks, connecting blocks, direct wire/patch cord cross connection and designation strips. Arrange in unitized, modular, vertical mounting sections, for telephone/voice.
2. Completely 100% front accessible for cross connections, terminating conductors, training, and fanning of cables. Rear access for any reason shall not be permitted.

3. Telephone/voice terminal blocks shall be UL listed, complying with National Electrical Code, ETL tested and certified to comply with or exceed Specified Requirements. Telephone terminal blocks and connections performance shall comply with ANSI/TIA/EIA-568C and related Standards, Addendums and TSB and shall comply with and be listed under UL 1863. Category rating shall match the cables connecting to the patch panel.
4. The telephone/voice terminal blocks shall provide cross connection of telephone/voice four pair premise copper wiring from telephone/voice handset outlets to multiple copper wire telephone/voice feeder cables and external free standing telephone equipment.
5. Each full height vertical section terminal block assembly shall terminate a minimum of 900 pairs (including specified spares for future construction phases) of telephone/voice conductors, plus associated cross connection wiring and patch cords in a nominal 20-inches wide by 90-inches high space. Provide multiple vertical sections of terminal block assemblies adjacent to each other, total quantity as required for quantity of telephone/voice conductor pairs and telephone/voice feeder cable pairs shown on the Drawings and Requirements, plus specified spares.
6. Each telephone/voice terminal block vertical section assembly shall provide 15% or 100 (whichever is the larger quantity) of spare unused conductor pair terminals for future telephone/voice connections.
7. Provide a common ground bus in each terminal block section with a minimum of six ground conductor termination positions, #10AWG through #6AWG.
8. Terminal blocks shall be the product of the same Manufacturer.

B. Wiring Blocks

1. One piece molded, die-electric thermoplastic blocks. The wiring block shall support and secure all the components of the terminal block assembly, and provide cable/conductor training and organization.
2. Fire retardant complying with UL 94V-0.
3. Standoff type support legs for mounting to backboard with pre-drilled anchor holes.
4. Non-conductive electrically quiet front assembly.
5. Horizontal index strip rows, for termination of not less than 25-conductor pairs on each row. Color coded and marked in groups of four pairs or five pairs to match connecting cables.
6. Removable retainers at the ends of each horizontal connecting block index strip row, shall support cross connect wires at corner turns.
7. Distribution rings shall retain cross connect wire horizontal routing between terminations.
8. A full width, horizontal trough between each 100 pair wiring block shall provide a path for patch cord training and retention.

C. Connecting Blocks

1. Connecting blocks shall provide gas tight conductor electrical connections with conductor insulation displacement punch down slots, for insertion onto the telephone/voice wiring block index strips.
2. Connecting blocks shall electrically connect one-to-one between each conductor terminated at the wiring block index strips, and each cross connect/patch cord conductor terminated/connected to the opposite front side of the connecting block.

3. Both sides of the connecting blocks shall terminate telephone/voice UTP 22-26AWG stranded or solid copper wire individually insulated conductors. The front side of the connecting blocks shall also provide "plug-in" connections for portable patch cords, 110 style "plug-in" connectors.

4. Connection blocks shall be 4-pair insulated copper conductor type.
5. Provide insulated, removable termination caps for each connector block.
6. Connector blocks shall be marked to indicate tip and ring conductors and to indicate polarization.

D. Designation Strips

1. Designation strips shall provide retention of interchangeable labels. The labels shall show circuit identification of each terminated conductor pair.
2. The designation strips shall mount on the center and outside positions of the wiring block.

E. Telephone/Voice Cross Connection

1. The cross circuit connection between incoming and outgoing feeder cables and telephone voice outlet wiring shall be provided in the terminal block assembly.
2. The cross connection wiring shall terminate incoming and outgoing circuit conductors between respective connecting blocks.

a. Direct connect cross connection shall provide internally wired one-to-one conductor twisted pair cross connection. Provide cross connection of each 4-pair telephone/voice outlet cable to corresponding 4-pairs of the telephone/voice feeder cable and cross connection of feeder to feeder cables, as applicable.
b. Patch panel cross connect, 110-terminal connector style, plug-in. Provide two twisted pair, 110- connector type portable patch cords.
c. Prewired 50 pin-amphenol connectors:

1) Provide factory prewired 50-pin amphenol connectors for connection from telephone/ voice terminal blocks to the telephone switch equipment and Telephone Utility Company outside telephone service lines.
2) Provide 50-pair ANSI/TIA/EIA-568C and related Standards, Addendums and TSB cables, connected to 50-pin amphenol connectors at one end (telephone equipment connection) and connected to the respective telephone/voice terminal wiring blocks at the other end.
3) The 50 pin amphenol connectors shall group together and be positioned at the top of the respective terminal block section near the ceiling.
4) The pin-to-pin conductor assignments shall conform to the Telephone Switch Manufacturer's Requirements.

5) The amphenol connector/cable assemblies shall connect to and extend the telephone/ voice outlet premise wiring from telephone/ voice terminal block to the telephone switch equipment. The amphenol connector/cable assembly shall connect to and extend the Telephone Utility Company outside telephone service lines to the telephone switch equipment.

d. Prewired "RJ" style modular jacks

1) Provide factory prewired eight position/contact plug-in "RJ" style jacks for patch panel portable patch cord cross connects, located on the front side of the terminal blocks.
2) The pin-to-pin conductor assignments shall conform to the Telephone

Switch Manufacturer's Requirements.

2.9 EQUIPMENT RACK

A. General

1. An equipment grounding bus, nominal 19-inches long, UL labeled as a ground terminal bus, shall be provided on each equipment rack. The ground bus shall be bolted to the rack main metal frame member with 1-inch standoff non-insulating bolts. Provide a minimum of ten drilled and taped bolt holes in the ground bus with ground lug bolts, for connection of equipment grounding conductors to the ground bus, size to accept ground conductors #14-#4AWG.
2. Vertically mounted, cable management metal rings (aluminum or stainless steel) shall be provided full height, continuously along the front and rear of each vertical rail of the equipment rack. The rings shall be bolted to the equipment rack. The rings shall train and dress portable patch cords connecting between outlet connectors located in the equipment rack or in adjacent equipment racks.
3. Provide horizontal cable management panels with multiple cable training rings on each panel (not less than five rings for each panel). Management panels (for up to 24-outlet grouping) nominal 19-inches wide by 1.75-inches high by 3-inches deep and/or (for up to 48-outlet groupings) 3.5-inches high by 3 inches deep, for EIA rack installation. Rings shall provide horizontal routing and support by grouping portable patch cords connecting between patch ports in the same equipment rack or adjacent racks. Patch cords shall be grouped and bundled with “Velcro” tie wraps and shall not overlap patch fields or rack mounted equipment. The cable management panels shall be installed on both the front and rear of the equipment racks mounted both above and below horizontally between groups of patch ports as follows:

    a. One cable management panel (front and rear of rack) for each group of forty-eight or less copper wire outlets for patch ports.
    b. One cable management panel (front and rear of rack) for each group of 48-fiber optic outlet patch ports.

4. The entire rack assembly including any support arms shall comply with Seismic Earthquake Requirements for install location structural standards.

    a. The assembly shall provide support for the weight of the equipment installed on the rack, but in no case less than 500-pounds of equipment, plus the weight of the rack and connecting cables. A
    2.0 time’s safety factor shall be included in the equipment rack assembly structural design.

5. Provide Plug Strip Surge Protection Device with RF Suppresser (SPD) and Power Distribution Units (PDU). Horizontal strip, mounted in each equipment rack. Each unit shall contain not less than six “plug-in” on the rear of the SPD and not less than two plug-in on the front of the SPD protected outlet plugs.

    a. Provide two SPD/PDU units in each equipment rack, to supply “dual-corded” equipment.

6. Provide pre-drilled mounting holes the entire length of equipment vertical mounting frames, EIA-310D- 19 inch (nominal) wide standard spacing for indicated equipment. Racks shall provide 17.75-inches (nominal) equipment horizontal mounting space between vertical rails.

7. Provide all floor standing equipment racks with wall bracket support arms extending from the stationary portion of the rack to adjacent wall. Provide "dual-rail arm" cable “runway tray”, horizontally from each equipment rack, to the wall directly behind the equipment rack

a. The tray shall extend from and bolt to the top of the equipment rack “fixed” top rail.

b. The tray side rail arms shall be a minimum of 6-inches deep, with "ladder" type rungs spanning horizontally between the side rail arms. The rail arms shall be parallel with each other. The rail- to-rail arm spacing shall be the same as the equipment rack width.

8. The rungs shall be spaced not more than 6-inches on center between the side rails, along the length of the side rail arms. The rungs shall have a minimum cable-bearing surface of not less than 0.75-inches, lengthwise along the tray.

a. The runway tray shall support a minimum of 200 pounds per linear foot live conductor/cable loading, with not more than 0.25-inches deflection at mid-span.

b. Provide a continuous horizontal support “C” channel along the wall behind the equipment racks and bolt the dual-rail arm cable runway tray to the channel at the wall. The channel elevation on the wall above the finish floor shall support the runway tray horizontally (0.2-inches), from the equipment rack to the wall.

c. Equipment racks shall be UL listed, complying with National Electrical Code, ETL tested and certified to comply with or exceed Specified Requirements, ANSI/TIA/EIA-568C including related Standards, Amendments and TSB.

d. The wall mounted horizontal support channel shall be securely through bolt to wall structural member, a minimum of 16-inches on center. The horizontal support channel shall extend a minimum of 6-inches past each side of the runway tray. Support channels as manufactured by Unistrut-P1001C Series; or B-Line; or Kindorf.

9. Provide a copper ground – bus for equipment bonding, in each equipment rack.

10. Equipment racks shall be Manufacturer’s standard rust inhibitor primer. Manufacturer’s standard color finish paint over primer, unless noted otherwise.

B. Swing Gate Open Equipment Rack Style:

1. Combination wall and floor mounted rack frame nominal 78-inches of usable equipment vertical space for mounting equipment into the rack. The equipment mounting portion of the rack shall be a hinged gate frame assembly. The rack shall provide access to the rear of the installed equipment, the wall behind the rack assembly and wall mounted terminal blocks, when hinged open.

2. The gate assembly shall hinge open not less than 90 degrees from the closed (normal position) on a fixed frame combination floor/wall mounted support structure. A positive latching mechanism shall lock the gate in the fully open and fully closed positions. The rack construction shall allow opening the swing gate, with the installed equipment depth, without obstruction. The fixed stationary portion of the swing gate rack assembly shall be supported from both the fixed floor bracket and wall located behind

the rack with adjustable length “dual rail arm” wall brackets. The arms shall provide field adjustment (approximately 24-inches) of the equipment rack spacing from the wall behind the rack. Provide a minimum of two support arms for each swing gate equipment rack.

3. The rack assembly shall be constructed of extruded metal; aluminum gold irradiates finish, or hot dip galvanized steel. Bolted or welded assembly. Hardware shall be stainless steel.
4. Provide steel caster rolling wheel support on the bottom rail of the moveable swing gate frame. The wheel shall provide additional support, but not the main support, of the moving gate assembly and rack mounted equipment along the floor travel "outside arc" of the gate in the open or closed position. The vertical height of the wheel assembly shall be adjustable □3 inches.
5. Swing gate equipment racks as manufactured by B-Line; or Saunders; or Hendry.

C. Floor Standing Equipment Rack Fully Metal Enclosed Style:

1. Floor mounted self-supporting rack, nominal 80-inches high by 24-inches deep, by 24-inches wide. Internal bolted or welded hot dip galvanized steel or gold irradiate finish aluminum, support frame. Metal enclosed with screw attached removable metal panels. Manufacturer's standard finish color.
2. The front and rear of the rack shall be a full height hinged door, opening not less than 90 degrees from the closed position. The doors shall be readily removable with positive latching mechanism to lock to the doors in fully open or fully closed positions. Doors shall be pad-lockable. Rack shall provide a minimum of 4-inches of clear space between front door and internal mounting face for rack mounted

equipment. Smoke/grey impact resistant, tamper resistant see-through windows in the doors, front and rear. Hardware shall be stainless steel.

3. Provide six 120-volt 60Hz AC motor direct drive air ventilation, "muffin" style, nominal 4-inches square, exhaust air fans. Flush mount fans in the top of each equipment rack. The fans shall be low speed, low noise type with wire guards to prevent accidental contact with the fan blades. The fan motor shall be high impedance, self-protecting type motors. Provide "SO" cord with plug caps to connect from the fans to the 120 volt plug-strip in the equipment rack.
4. Provide cooling air intake louver with a removable 19-inches wide air filter and air filter holder, mounted in the bottom of the rack front nominal 6-inches high.
5. Floor standing metal enclosed equipment racks as manufactured by Stantron; or BUD; or equal.

D. Fixed Position Floor Standing Open Frame Equipment Racks:

1. Floor mounted self-supporting rack, nominal 78-inches of usable mounting frame height for equipment.
2. Bolted or welded hot dip galvanized steel or gold irradiate finish aluminum support frame. Hardware shall be stainless steel.
3. Open frame rack construction, fixed, non-swing gate.

    a. “Two-post” style for equipment racks not designated as containing UPS equipment nor server equipment.
    b. “Four-post” style for equipment racks designated as containing UPS equipment and/or server equipment.

4. Open frame equipment racks as manufactured by B-Line; or Saunders; or Hendry.

E. Floor Standing Modular Frame Equipment Racks

1. Provide a modular frame equipment rack, bolt together modular rack system with all accessories for a completely assembled equipment rack unit. The rack system, when configured for specific equipment, shall support and organize network servers, keyboards, printers, tape drive units, RAID units, CRT's, UPS units, telephone switching equipment, desk top work spaces, etc.
2. Nominal overall dimensions 31-inches deep by 72-inches wide by 84-inches high. Left/right or right/left orientation as indicated on Drawings. Minimum weight capacity of the entire rack assembly shall be 1500 pounds.
3. Manufacturer's standard finish painting, crème white color for metal surfaces. Horizontal flat support surfaces shall be post-formed, laminate top finish, white color.
4. "8L-01/8L-02" vertical support upright assemblies; shall be slotted the full height to "hook-on", lock in and support adjustable height (in 1-inch increments), modular components, with integral floor support "feet". Open back frame - "LF31". Minimum of three vertical support and open back frames in each complete assembly.
5. Provide vertical (on upright supports) and horizontal (on modular "hook-on" components) wire management raceways integral to the assembly.
6. Network server configuration - equipment rack unit:

   a. "LE28" computer tower "roll-out" horizontal floor shelf; nominal 47-inches wide by 24-inches deep. Shelf shall pull out on "ball-bearing" rails, with 23-inch extension for access to computers. Provide one tower shelf for rack unit. Minimum weight capacity 750 pounds. Mount at floor.
   b. "LE25"-computer tower horizontal shelf with □12 inch end panels and two shelf support brackets; nominal 47-inches wide by 22-inches deep, fixed mounted. Provide one tower shelf for rack unit. Minimum weight capacity 500 pounds. Mounting height □30-inches.
   c. "LB32" horizontal work surface; nominal 24-inches wide by 27-inches deep. Provide one work surface assembly for each rack unit. Minimum weight capacity 300 pounds. Install on left or right side of rack as shown on Drawings. Mounting height □28-inches.
   d. LF10/LF11/W162 - General equipment shelf; nominal 72-inches wide by 15-inches high by 16.7 inches deep, with two horizontal shelf surfaces, full width of rack, □ 10-inches nominal vertical height between shelves and five vertical shelf dividers. Minimum weight capacity 300 pounds. Provide one general equipment shelf assembly for each rack unit. Mount at top of rack.
   e. "LA-09" - Keyboard platform. Retractable keyboard platform with auxiliary mouse pad and up- down 15 degree adjustable tilt and adjustable 360 degree swivel. Nominal 23-inches wide by 11 inches deep. Provide three keyboard platforms for each rack unit. Install below, upper tower computer shelf and work surface.

F. Plug Strip Surge Protection Device (SPD).

1. General

   a. Self-contained unit combining plug-in receptacle strip and SPD. Rated 20-amp, nominal 120- volt +10%, 60Hz, AC, 2400 watts full continuous load. Internal 20-amp resettable overload protection circuit breaker. Red illuminated on-off switch. 9-foot, 12AWG three-

conductor grounded, high abuse heavy duty jacketed AC, line cord with NEMA 5-20P cap.

b. Multi-outlet receptacles, suitable for use with the following types of plug in loads; data processing equipment, audio/video equipment, test instruments, medical equipment, photo graphic equipment and “switching type” power supplies.

c. Protected 120-volt outlets shall be NEMA 5-15R 15-amp, or 20-amp NEMA 5-20R AC 60Hz receptacles, as applicable for connected equipment loads. Provide not less than eight protected outlet plugs on each unit. Each individual or group of two receptacles (duplex) shall be connected to separate protected load isolated filter banks.

d. Each duplex shall be isolated from the other output receptacles, minimum isolation of 25dB at 1MHz line to line, line to neutral, line to ground and neutral to ground.

e. Non-blocking plug-in locations/orientation, for plug-in self-contained “power-brick”, equipment power supplies.

f. As manufactured by Liebert; or TRIPP LITE.

2. Operation

Self-contained RFI and EMF shielded housing with mounting slots for temporary mounting of the unit. Protected outlet receptacles shall supply over current protected and filtered, electrical line voltage power to the connected equipment. Line noise RFI and EMI interference filtering suppression, surge protection device and spike protection shall occur in all three modes of operation line to ground, line to neutral and neutral to ground rated as follows:

a. 13,000 amp, 210 joules (watt-seconds) peak withstands capacity.

b. Surge response time less than 5-nano seconds.

c. 140-volt AC RMS initiate spikes suppression 330 volt maximum let through.

d. RFI and EMI Suppression-Provide spectrum analysis test dB attenuation reports showing RFI filtering over specified frequencies.

e. Diagnostic indicator lights located on the SPD housing shall provide alarm alert for each of the following conditions:

1) Loss of AC power.
2) Damage, malfunction in the SPD circuits.
3) Improper AC electrical outlet wiring.

f. Standards Testing, Listing and Certification Compliance:

1) IEEE 587 A and B compliance.
2) UL 1449 surge suppressers.
3) UL 1363 temporary power taps.
4) UL 1283 electromagnetic interference filters.

3. Rack Mounted SPD

a. SPD units installed in equipment racks shall comply with all of the same Performance Requirements including as follows.

1) EIA/TIA – Equipment rack horizontal mount style (19-inches or 24-inches as applicable).

2) Minimum of two front mounted outlets and not less than six rear mounted outlets.
3) Position in each equipment rack as directed by Owner's Representative.
4) Provide two SPD units in each equipment rack, for "dual-corded" network equipment.

G. Power Distribution Unit (PDU)

1. General

a. Self-contained unit combining main circuit breaker, multiple plug-in individual circuit breaker branch protection load receptacles, PDU metering status monitoring and network communication. All PDU components self-contained in a NEMA-1 metal enclosure.
b. Non-blocking plug-in locations oriented for plug-in self-contained "power-brick" equipment supplies.
c. Standards Testing

1) UL 60950-1 Information Technology Equipment.
2) CAN/CSA-C22.2 No.60950-1-03 Information Technology Equipment.
3) FCC, Title 47, Part 15 Subpart B for Class B operation as defined by ANSI Standard C63.4.
4) ROHS Complaint.
5) ISTA Procedure 1A and 2A.

d. Provide two PDU units in each equipment rack, to supply two SPD units in each equipment rack.
e. Shall be a product of the same Manufacturer as the SPD unit. As manufactured by Liebert; or TRIPP LITE.

2. System Description

a. Remote monitoring and/or control capabilities for power distribution at each load/equipment rack level. For data/network equipment line voltage plug-in and SPD line voltage plug-in electrical distribution.
b. PDU shall meter and monitor electrical attributes of an individual Rack PDU, including real-time remote and local display of monitoring of aggregate and branch electrical parameters (status, thresholds, alarms) including voltage, ampere, and kW. Rack equipment PDU and Branch load monitoring and control.
c. Self-contained metering and communications

1) Local display ampere-meter demand load meter to monitor plug-in demand load and total PDU load.

2) Digital Fast Ethernet LAN RJ-45 communications port for Ethernet SNMP and IP network monitoring of electrical status. Multi-user site-wide software license, compatible with PC- computer and IP-WEB HTTP protocols.
3) Provide network array-interface for connection of multiple PDU units positioned in the same location.

d. Nine foot input power (heavy duty high abuse) cord with appropriate conductors and input NEMA plug-in connection. Provide input overload protection with Hydraulic-Magnetic main input circuit

breaker. Provide load output NEMA plug-in branch connection with overload circuit breaker protection for each load receptacle.

e. Equipment rack mounting horizontal position form factor.

3. Electrical Power ratings shall be as follows and as additionally indicated on Drawings. Refer to Drawings for twist-lock verses straight-blade configurations.

   a. Single main input circuit breaker 30 amp, 208/120 volt 3-phase 5-wire "WYE" grounded 60Hz AC.
   b. Branch load circuit breakers with a single plug-in receptacles for each load circuit breaker. Balance loads on each circuit phase.

      1) Three 20 amp 1-pole circuit breaker and three NEMA 5-20R receptacles. Also provide matching caps.
      2) One 30-amp 2-pole circuit breaker and one NEMA 14-30R receptacle. Also provide matching cap.
      3) Additional circuits and receptacles as indicated on Drawings.

4. Provide heavy duty high abuse flexible copper wire 300-volt insolated 15-feet long jacketed electrical cord. Connect from PDU to wall-outlet receptacle with same electrical rating as PDU. Rated for PDU voltages and amperes.
5. PDU units installed in equipment racks shall comply with all of the same Performance Requirements including:

   a. EIA/TIA – equipment rack horizontal mount style (19-inches or 24-inches) as applicable.
   b. Position in each equipment rack as directed by Owner's Representative.

6. Provide two Category-6A 4-pair UTP 15-foot long portable patch cable connects, PDU to respective network patch panel port.

2.10 WALL MOUNT FIBER OPTIC CABLE INTERFACE CABINET (WMIC)

A. General

1. Metal (14 gauge) enclosure, with full height hinged metal door. Door shall be pad-lockable. Nominal size 12-inches deep by 18-inches wide by 36-inches high. Enclosure shall mount directly on the wall.
2. WMIC shall be UL listed, complying with National Electrical Code, ETL Tested and Certified to comply with or exceed Specified Requirements, ANSI/TIA/EIA-568C including related Standards, Amendments and TSB.
3. Interface cabinets shall be the product of the same Manufacturer.

B. The WMIC shall provide the following self-contained functions internal to the WMIC enclosure.

1. Fiber cable splicing for "through splicing" of non-UL listed fiber optic cables, where the cables do not terminate in the building.
2. Fiber cable management, training and strain relief.
3. Transition from non-UL flame spread listed fiber optic cable, to UL flame spread listed fiber optic cables where the cables terminate in the building.

C. Cable routing rings shall organize optic fibers in a 360 degree loop inside the WMIC housing and provide cable strain relief.

D. Fiber Optic Splice Trays

1. Provide fiber optic cable splice trays.
2. Tray holders shall provide mounting and support for each splice tray.
3. Provide two splice trays for each group (24 or less fibers per group) fiber optic fibers routed through the WMIC, but in no case provide not less than four splice trays in the WMIC.

2.11 UNIVERSAL SPLICE ENCLOSURES - USE

A. General

1. The universal splice enclosure shall provide splicing for multiple cables containing multiple, network copper wire conductors or fiber optic fibers.
2. The enclosure with the connecting cables installed shall be water tight, continuously submersible in up to 10-feet depth of water without leaking water into the enclosure interior.
3. The enclosure with splices shall be completely re-enterable to allow access to the interior splices, adding cables, and removing cables, without compromising the water tight integrity of the enclosure.
4. The universal splice enclosure assembly shall be UL listed.
5. The USE shall be UL listed, complying with National Electrical Code, ETL tested and certified to comply with or exceed Specified Requirements, ANSI/TIA/EIA-568C including related Standards, Amendments and TSB.
6. USE shall be the product of the same Manufacturer.

B. Fiber Optic Splices

1. Provide fiber optic splice trays inside the USE. Each splice tray shall provide space for up to 12 splices in lieu of 24-splices on the tray.
2. A splice tray holder shall rigidly anchor splice trays inside the USE, with sufficient slack cable, to allow individual removal of each splice tray.
3. Provide one splice tray for each 12-fibers passing through the USE, but not less than eight splice trays in the use enclosure.

C. Copper Wire Splices

2.12 SPLICE TRAY FIBER OPTIC FIBERS

A. General

1. Trays shall be suitable for installation in USE, WMIC, RMSE and RTDE enclosures.
2. The trays shall be the product of the same Manufacturer as the respective enclosures.
3. Splice trays shall be UL listed, complying with national Electrical Code, ETL tested and certified to comply with or exceed specified Requirements, ANSI/ TIA/EIA-568C including related Standards, Amendments and TSB.

B. Splice Trays

1. A metal or non-metal splice tray shall provide space for up to 24-splices of individual fiber cable single mode and multimode optical fibers. The trays shall provide individual splice holder inserts for each splice to adapt the tray for mechanical or fusion splices, with or without splice sleeves.
2. The tray shall incorporate integral fiber tie down clamps, fiber routing rings, provide strain relief and two full 360-degree fiber loops around the tray perimeter with sufficient slack fiber for removal of the tray for access and splicing of the fiber cable. The tray shall insure the minimum bending radius of the optical fibers is not violated.
3. Provide a removable clear plastic tray top cover for each tray, to protect and isolate the fibers.

2.13 WORK STATION OUTLETS

A. General

1. Engrave outlet cover plates with the port number corresponding to the port number at the respective terminal block, patch panel, or head-end equipment.
2. The outlet cover plates shall be factory pre-punched and formed to accommodate the installed outlet connector with attachment screws.
3. Workstation outlets shall be UL listed, complying with National Electrical Code, ETL tested and certified to comply with or exceed Specified Requirements, ANSI/TIA/EIA-568C including related Standards, Amendments and TSB.
4. Workstation outlets shall be the product of the same Manufacturer.

B. Computer/Data Workstation Copper wire Outlets

1. The outlets shall be the same configuration and type as the corresponding connector provided in the copper wire patch panel outlet, unless noted otherwise.
2. ANSI/TIA/EIA-568C, and related Standards, Addendums and TSB.
3. The copper wire outlet connectors for twisted pair wire connections in computer workstation outlets shall be universal outlet connector RJ-45 type.

C. Telephone/Voice Handset Twisted Pair Wire Connection Work Station Outlets

1. The copper wire outlet connectors provided in telephone/voice handset outlets, shall be universal outlet connector type, unless noted otherwise, ANSI/ TIA/EIA-568C and related Standards, Addendums and TSB.

    a. RJ-45 type
    b. RJ-11 type

D. Fiber Optic Workstation Outlets

1. The fiber optic outlet connectors workstation outlets shall be fiber optic fiber interconnection couplers, installed in universal outlet connectors. Provide one coupler for each fiber connecting to the outlet, but in no case less than the following for each outlet and as shown on the Drawing:

    a. Computer workstation data network two couplers and fiber connectors.
    b. Data network server - four couplers and fiber connectors.

2. The universal outlet connector housing and cover plates shall be the same as copper wire outlet connectors, except with adapters for fiber optic interconnection couplers, for the fiber optic fibers plug- in connectors.
3. The centerline-to-centerline spacing of the inter-connection couplers shall provide for "plug-in" insertion of “single or duplex” fiber connectors.
4. Color-code and identify the "in"-receiving and "out"-transmitting position for each interconnection coupler.

E. Outlet Boxes

1. General for Low Voltage Outlets Requirements

    a. Shall be UL approved and labeled for Life-Safety Appliances.
    b. UL listed and label for low voltage CEC/NEC class-2 wiring and devices.
    c. Shall be adjustable to fit into the wall/ceiling and attach into the wall/ceiling thickness at each install location.
    d. Provide cable “Strain-Relief” attachment and “Sharp-Edge” protection for each outlet cable connections.

2. Wall mounted

    a. Flush or surface wall mounted outlet box and size as indicated on the Drawings, but in no case less than 4.69-inches by 4.69-inches by 2.125-inches deep.
    b. Two gang wide extension ring for outlet box to extend outlet flush with finish surface, or as noted on the Drawings.
    c. Two gang wide cover plate, or as noted on the Drawings.

3. Pedestal Mounted "Poke-Thru".

    a. Shall combine a computer/data and a telephone/ voice copper wire universal outlet connector in a duplex outlet in the pedestal/poke-thru outlet.

4. Inside flush floor boxes and other locations where indicated in the Contract Documents.

5. Low Voltage Outlets in Fire rated walls and ceilings

    a. Provide metal outlets for low voltage devices installed (recessed into) in fire rated walls or fire rated ceilings.
    b. Provide metal outlet box enclosed type, for each outlet location. Provide UL labeled and listed “Fire-Wrap” complete coverage protection on the exterior of each outlet box. The combined outlet box and “Fire-Wrap” protection shall be equal or greater than the respective wall or ceiling fire-rating location.

6. Low Voltage Outlets in Non-Fire Rated walls and ceilings

    a. Outlets for low voltage devices installed (recessed into) walls or ceilings, only where the wall/ ceiling is not fire-rated.

b. Provide the following for each outlet location

1) Metal outlet box, enclosed type. All locations where one or more conduit(s) are required to connect to the outlet, then only metal outlet box shall be provided.
2) Or device mounting bracket with trim ring, without (backless) enclosed outlet box. Do not use bracket-trim/ring configuration where conduit connection to the outlet with conduit is required, provide metal outlet boxes. Shall provide attachment for low voltage device(s), cover plates and low voltage wire strain relief.

7. Low Voltage outlet installed into accessible suspended ceiling with removable ceiling panels.

a. Support outlet independent of ceiling supports and ceiling.
b. Provide a minimum of three independent hanger wires for each outlet. Attach hanger wires to building structure above ceiling and to outlet.

8. Low Voltage Outlets in existing walls and existing ceilings

a. Outlets installed (recessed into) existing walls or (recessed into) existing ceilings. Cut and patch to match existing surfaces for outlet installation.
b. Provide “cut-in” retrofit mounting-attachment into existing ceiling/wall construction. Shall be UL rated for retrofit into “old-work”.
c. Provide the following for each outlet location,

1) Metal outlet box, enclosed type. Required for all Fire rated construction locations. Also permitted for non-Fire rated construction locations.
2) Or device mounting bracket with trim ring. Permitted only for non-Fire rated construction locations only where no conduit connection to the outlet is required. Do not use in Fire rated construction locations. Do not use where conduit connection to out-let is required.

d. Where the existing wall/ceiling existing fire rating is indeterminate, Contractor shall assume the existing fire rating is not less than 2-hours. Provide metal outlet box and Fire-Wrap for each recessed outlet box.

F. Multi-outlet Raceway Work Station Outlets

1. Copper wire outlet:

a. Where copper wire connection is indicated for the workstation outlet, provide one universal outlet connector for each outlet.
b. Each universal outlet connector shall be single connector housing type.
c. Provide a rectangular cutout and metal device plate in the raceway sized to Outlet Manufacturer's recommendations. The workstation copper wire outlet shall mount a modular faceplate kit with outlet bezel and faceplate sized to match the workstation outlet.

d. Offset the location of outlets for electronic network systems 6-inches in the raceway from other outlets, do not "stack" outlets one above the other in the raceway.

2. Fiber optic outlet:

G. Combination Outlets

1. Infrastructure outlet connectors shown at the same location for either wall box outlet locations and floor box outlets locations.
2. The outlet connectors shall be installed in a common outlet box with a common cover plate in the respective wall location or floor location.
3. In infrastructure patch panels install the connectors in the respective patch panels.

2.14 PORTABLE PATCH CORDS

A. General

1. Provide portable patch cords for all copper wire and fiber optic cable infrastructure outlets:

   a. For interconnecting electronic network equipment to electronic network workstation outlets.
   b. For interconnecting equipment rack patch panel outlet patch locations with each other.
   c. For interconnecting patch panel outlets equipment rack mounted hubs, switches, routers, telephone equipment, A/V equipment, access control and intrusion detection equipment etc.

2. Patch cords shall be factory assembled tested and certified with factory terminated plugs at each end. Field terminated portable patch cords shall not be permitted. Terminated plugs shall incorporate integral bending radius limiting molded “boots” and strain relief. Patch cord assemblies shall be rated for "heavy duty", “high-abuse” service.
3. Patch cords shall be UL listed, complying with National Electrical Code, ETL tested and certified to comply with or exceed Specified Requirements. ANSI/EIA/T1A-568C, related Standards, Addendums and TSB.

   a. NEC - OFNG/OFN for fiber optic portable patch cords.
   b. NEC - MPP/CMP/CMR/CMG/MPG for copper wire twisted pair portable patch cords.
   c. NEC - CATV for coaxial cable portable patch cords.

4. Patch cords which are not installed shall be delivered to the Owner in cardboard boxes. The patch cords shall be neatly bundled and tied together. Mark each box with quantity and type of cords contained in the box.
5. Patch cords shall comply with the same Cable Communication Performance Requirements, Protocol Requirements and Testing Requirements as the respective infrastructure cables and outlets to which the patch cords are intended to be connected (plug-in). Patch cords shall be the product of the same Manufacturer.
6. The outer jacket of each portable patch cord shall be imprinted with date, Manufacturer’s model and catalog number and AHJ listing identification.
7. Provide a permanent, visible, factory applied identification number on each end of each patch cord. The identification number shall be the same on each end. However, the

numbers shall increase sequentially on each patch cord and shall be unique and not duplicated on other patch cords. Permanently apply the identification numbers on the cable jacket or connectors.

B. Twisted Pairs, Copper Wire Portable Patch Cords

1. Twisted Pairs portable patch cords, general:

a. "Male" eight-position modular "RJ" male style jacks install on each end of the patch cord cable. The jack shall be provided with a rear "fin" to prevent the plug tab from snagging when pulled backwards through adjacent wiring.
RJ-45 style “male” jack, typical unless noted otherwise.
b. Patch cord cable shall be UTP and ANSI/EIA-Category rating, shall match respective premise wiring, 4-pair twisted, stranded copper individually insulated wires, thermoplastic jacket over all the wires and shield.
c. Connectors shall comply with FCC 68.5 and Part 68 Subpart F.
d. Connectors UL listed and shall comply with UL-94V-O.
e. Contacts gold plated with not less than a 750 insertion/withdraw cycle rating.

2. Portable patch cord quantities and lengths for connecting port-to-port equipment rack patch panels

a. Patch cord quantity: Provide one complete patch cord assembly for each copper wire equipment workstation outlet patch port in the equipment rack patch panels. One-to-one straight through pin-to-pin wiring. Provide additional spare patch cords, quantity equal to 25% of the total quantity of patch cords provided for copper wire computer workstation outlets in the equipment rack patch panels. Cable jacket color shall be blue:
b. Provide the following lengths of copper wire patch cables for copper wire equipment rack patch panel outlets.

1) 2-feet long - 10% of total quantity
2) 4-feet long - 30% of total quantity
3) 6-feet long - 30% of total quantity
4) 10-feet long - 20% of total quantity
5) 16-feet long - 10% of total quantity

3. Portable patch cord quantities and lengths - for connection from equipment workstations to equipment workstation outlets, located remote from equipment racks.
a. Patch cord quantity: Provide one complete patch cord assembly for each copper wire work- station outlet located remote from the equipment rack patch panels. Provide additional spare patch cords, quantity equal to 15% of the total quantity of patch cords provided for each copper-wire computer workstation outlets. Cable jacket color shall be blue:
1) Infrastructure network outlet segments the pin-to-pin patch cord wiring configuration and jacks shall be compatible with the equipment protocol communications interface, and the respective workstation outlet.

2) Provide the following lengths of copper wire patch cables for equipment copper wire infrastructure network workstation outlets. The patch cords shall provide internal cross-over wiring to conform the pin-to-pin connections required between the equipment workstation outlet and the equipment protocol communications interface installed in the respective work-station equipment: 8-feet long - 30% of total quantity15-feet long - 70% of total quantity

4. Portable patch cord quantities and lengths for connection from electronic equipment rack patch panel ports to equipment installed in equipment racks, such as HUB's, servers, switches, router, telephone and concentrator equipment ports. Cable jacket color shall be white.

   a. Patch cord quantity: Provide one complete patch cord assembly for each copper wire outlet port located in electronic equipment. Provide additional spare patch cords, quantity equal to 25% of the total quantity of the equipment rack equipment ports.

      1) The pin-to-pin patch cord wiring configuration and jacks shall be compatible with the respective equipment and patch panel outlets as applicable.

   b. Provide the following lengths of copper wire patch cables for outlet ports located in electronic equipment installed in equipment racks. The patch cords shall provide quantity of conductors, wiring shall conform the pin-to-pin connectors and jack/ connectors to the ports in the equipment mounted in the equipment racks.

      1) 4-feet long - 15% of total quantity
      2) 6-feet long - 30% of total quantity
      3) 10-feet long - 35% of total quantity
      4) 16-feet long - 20% of total quantity

5. Portable patch cord quantities and lengths for connection of equipment requiring customized pin-to-pin wiring configurations and/or customized port connector configurations. Cable jacket color shall be tan.

   a. Patch cord quantity: Provide one complete patch cord assembly for each outlet port install as part of the Contract and not identified in any other patch cord descriptions. The patch cords shall be customized and configured to comply with the respective Manufacturers recommendations.
   b. Provide one patch cord for each port-to-port connection length as required for actual installation condition.

      1) Provide 100% spare but not less than one spare patch cord for each custom configuration.

C. Telephone/Voice Copper Wire Portable Patch Cords-110 style

1. 110 style jacks for plugging into the 110 style connecting blocks located in the telephone/voice terminal blocks.
2. Patch cords shall be UTP 4-pair twisted, 24AWG stranded copper individually insulated wires with a thermoplastic jacket over all the wires. Cable shall be ANSI/TIA/EIA-568C.
3. Patch cord quantity and length - telephone/voice terminal block:

a. Provide one complete patch cord assembly for each copper wire telephone/voice outlet connecting to the telephone/voice terminal block. Provide additional spare patch cords, quantity equal to 25% of the total quantity of patch cords provided for telephone/voice 110 patch cords.

b. Provide the following lengths of copper wire patch cables for telephone/ voice 110 style connecting block portable patch cords.

1) 3-feet long - 25% of total
2) 5-feet long - 50% of total
3) 15-feet long - 25% of total

D. Coaxial Cable Portable Patch Cords

1. BNC type connectors on each end of each patch cord. Shall be compatible with patch panel outlets, workstation outlets and respective equipment rack electronic equipment.
2. Patch cord quantity: Provide two complete patch cord assemblies for each coaxial cable outlet.

a. One patch cord for workstation outlet located remote from the equipment rack patch panel, 15- feet long each patch cord.
b. One patch cord for equipment rack (IDF/MDF) patch panel each outlet location, 10-feet long each patch cord.
c. Provide 15% additional spare patch cords of each patch cord length.

E. Fiber Optic Portable Patch Cords

1. General

a. Provide fiber optic fiber connectors installed on each fiber end of the patch cord cable. The fiber optic portable patch cord shall be “single” with one fiber strand type, for each patch cable. The connector shall be mechanically and optical compatible with the respective connecting patch panel couplers and network work equipment couplers.
b. The entire patch cord assembly total insertion loss shall be less than 1.0dB at the specified operating wavelengths.
c. Operating temperature range 30-degrees centigrade through +60 degrees centigrade. Cables shall be flame retarding.
d. Each fiber shall be individually identified with factory color-coding and factory imprinted label. The outer cable jacket shall be imprinted with date, Manufacturer's model and catalog number, along with agency listing identification. The cable jacket color shall be yellow.
e. All fiber optic patch cord cable shall be a product of the same Manufacturer.
f. Optical fiber shall be coated, 900 micron diameter uniform coating, with uniform tight buffering over the coating, uniform dielectric strength member surrounding the buffering coating and an overall jacket around each optical fiber assembly.
g. A dielectric strength member shall surround the fiber assemblies.
h. An outer dielectric jacket shall envelope the entire cable.
i. The cable shall be UL listed and comply with NEC and NFPA Requirements for each installation location shown in the Contract

Documents.

j. Patch cord quantity and length
   1) Patch cord quantity: Provide one complete patch cord assembly for each fiber optic patch panel outlet in the equipment rack.
   2) Provide one complete patch cord assembly for each computer workstation fiber optic outlet remote from the patch panel.
   3) Provide additional spare patch cords, quantity equal to 25% of the total quantity of patch cords provided.

k. Provide the following quantities and lengths of fiber optic patch cords.
   1) 3-feet long - 20% of total
   2) 6-feet long - 35% of total
   3) 10-feet long - 30% of total
   4) 20-feet long - 15% of total

2. Multimode patch cords

   a. Patch cord cable shall be fiber optic cable with equal or better characteristics as the premise fiber optic cables.

2.15 CIRCUIT PROTECTORS

A. General

1. The circuit protectors shall be UL listed, complying with National Electrical Code, ETL Tested and Certified to comply with or exceed Specified Requirements, ANSI/TIA/EIA-568C including related Standards, Amendments and TSB.

B. Circuit Protectors

1. Cables containing non-dielectric electrical conducting components entering from the exterior of the building shall be provided with individual circuit protectors combining both lightning circuit protection and SPD circuit protection on each circuit conducting component, as required in CEC Articles 770 and 800.
2. Install circuit protectors in the respective backboard/equipment rack where copper wire conductors terminate, connect each protector to room/closet ground bus equipment with #10AWG green insulated bond/ground copper conductors.

PART 3 - EXECUTION

3.1 NETWORK CABLE TESTING AND COMMISSIONING (ADDITIONAL REQUIREMENTS)

A. General

1. In addition to the testing recommended in ANSI/TIA/ EIA-568C and related Standards, Amendments and TSB. End-to-End test 100% of all individual optical fiber, individual copper wire conductors, each outlet and each connector in all terminated and unterminated cables, portable patch cord, outlets and patch panels provided in the Contract, shall be tested after installation as a complete channel pathway installation, splicing outlets and termination is completed, including the following end-to-end tests on

each installed individual circuit; Each circuit wire and fiber map and length

a. Each circuit insertion Loss
b. Each circuit NEXT (Pair-to-Pair) Loss
c. Each circuit NEXT Loss (Power Sum) PS
d. Each circuit ELFEXT Loss (Pair-to-Pair)
e. Each circuit ELFEXT Loss (Power Sum) PS
f. Each circuit return Loss (RL)
g. Each circuit propagation delay Each circuit propagation delay-skew

2. The test equipment and (Tester) shall comply with the Accuracy Requirements for Field Testers as defined in the ANSI/EIA/TIA Standards for the specific cable type. The Tester including the appropriate interface adapter shall meet the Specified Accuracy Requirements. The Tester shall be within the calibration period recommended by the Vendor in order to achieve the Vendor-specified measurement accuracy. The Tester shall be calibrated to extend the reference plane of the Return Loss measurement to the permanent link interface. The Contractor shall provide proof that the interface has been calibrated within the period recommended by the Vendor.

3. The Pass or Fail condition for the channel pathway link-under-test is determined by the results of the required individual tests (ANSI/EIA/TIA) Any Fail result yields a Fail for the link-under-test. In order to achieve an overall Pass condition, the results for each individual test parameter must Pass. A Pass or Fail result for each parameter is determined by comparing the measured values with the ANSI/EIA/ TIA test limits for that parameter. The test result of a parameter shall be marked with an asterisk (*) when the result is closer to the test limit than the accuracy of the field test. The Field Test Equipment Manufacturer shall provide documentation as an aid to interpret results marked with asterisks.

4. Provide all test equipment, Certified Testing Personnel, and setups. Shall comply with ANSI/EIA/TIA and Equipment Manufacturer’s recommendations and standards of practice.

5. Provide six copies of all test reports, bound in three ring binders. Provide three digital CD/DVD ROM copies. Organize test reports into rows-and-columns spread-sheet format, with data common groupings by IDF and NDF location. Submit to Owner’s Representative.

6. The Contractor shall repair or replace equipment, cables, outlets, connectors, splices, terminations, etc. identified during testing as not complying with the Contract Documents, without additional cost to the Contract. Retest all replaced or repaired components at Contractor's expense.

B. Twisted Pair Copper Wire Testing

1. Channel insertion loss (dB).
2. Channel near-end cross-talk NEXT loss (dB).
3. Channel equal-level far-end cross-talk ELFEXT (dB).
4. Channel return loss (dB).
5. Channel power sum PSACR (dB).
6. Channel propagation delay, propagation speed, and delay skew.
7. Channel wire map and circuit length.
8. Channel ring-out test for continuity and correct point-to-point matching terminals.
9. Channel DC resistance and capacitance.
10. Channel attenuation-to-cross-talk ratio ACR.

C. Coaxial Cable Testing

1. Channel full specified frequency spectrum attenuation insertion loss (dB).
2. Channel wire mapping, ring-out and circuit length.
3. Channel propagation delay and propagation speed.
4. Channel impedance and continuity for center conductor and shields.

D. Fiber Optic Cable Testing, Optical Testing for Each Specified Wave-Lengths for Both laser and LED sources.

1. Channel link insertion losses (dB) OLTS
2. Channel loop-back attenuation (dB).
3. Channel signature Optical Time Domain Reflectometer – OTDR, for installation characterization testing (event and attenuation resolution dead zone at specified wave lengths, shall be less than 10-feet).
4. Channel continuity and correct point-to-point matching terminals.
5. Channel propagation delay and propagation speed.
6. Channel fiber optic mapping, circuit length, and tracing.

3.2 FIBER OPTIC CABLE TYPE

A. General

1. Cables shown as fiber optic type shall comply with the following installation locations.
2. Provide matching compatible outlets and terminate all fiber optic cables into matching fiber optic connectors.
3. Fiber optic cable installed in indoor locations without enclosed raceway or conduit.

    a. Provide non-metallic, flexible corrugated continuous inner duct-raceway and install fiber optic cable in the innerduct.
    b. Innerduct shall be heavy duty, plenum-rated, Limited-Combustible (LC) type UL FHC – 25/50, orange color. Support innerduct 36-inches on center, independent of ceiling supports and independent of other equipment supports.
    c. Innerduct size shall be selected to insure percentage-fill with fiber optic cables shall not exceed 30%, but in no case less than 1.25-inch diameter innerduct.

B. Provide loose tube gel filled or indoor/outdoor type fiber optic cable for any of the following installation location conditions.

1. Inter building (between buildings)
2. In a conduit or raceway located underground below grade.
3. In an exposed outdoor conduit or raceway not located underground or below grade.
4. Do not install loose tube gel filled type fiber optic cable inside a building or exposed on a building without providing Rigid Steel (RGS) conduit raceway for the loose tube gel filled fiber optic cable along the entire length of the cable inside the building or on the building.

C. Provide tight buffered or indoor/outdoor type fiber optic cable for any of the following installation location conditions.

1. Intra-building (inside a building) where raceway continuously encloses the cable and the raceway is not located underground, below grade.
2. In an exposed outdoor conduit or raceway not located underground or below grade.

D. Provide plenum rated type fiber optic cable for any of the following installation location conditions in building spaces.

1. Any building space air plenum (supply or return) when a conduit or enclosing raceway is not provided for the entire cable length. Additionally, Cables shall be rated Limited-Combustible (LC) type UL FHC- 25/50.
2. All building space locations where the cable is installed without a conduit or the cable is not fully enclosed in a raceway along the entire cable length in a building. Additionally, Cables shall be rated Limited-Combustible (LC) type UL FHC-25/50.
3. Building spaces and/or cavities that are 100% fully protected with fire sprinklers, including fire sprinklers located above in ceiling cavities and fire sprinklers located below in access floor cavities. Cables installed in these locations shall be rated with one or more of the following additional characteristics.
   a.
   b. Limited–Combustible (LC) UL FHC-25/50 plenum rated cable.
   c. Or plenum rated cable without the UL FHC-25/50 Limited-Combustible (LC) rating.

E. Optical Fiber Quantity:

1. The minimum fiber quantities in each fiber optic cable shall be as follows, but in no case less than indicated on the Drawings.

2. Between main IDF (SUB-MDF) in separate buildings and the MDF main terminal rack fiber optic patch bay for the entire site/campus.

   a. Twenty-four optical fibers, multimode plus six optical fibers, single mode.

3. Between satellite IDF terminal rack fiber optic patch bays and the main terminal rack IDF (sub-MDF) patch bay located in the same building.

   a. Twenty-Four optical fibers, multimode plus six optical fibers, single mode.

4. Between a terminal rack patch bays (IDF or MDF):

   a. To an individual workstation outlet located inside the same building - two multimode optical fibers, (typical only for locations where fiber is specifically shown on the Drawings for the specific work station outlet).
   b. To each network file server outlet location whether or not shown on the Drawings, four optical fiber, and multimode.

5. Between a terminal rack-patch bay and individual multimedia network (television/video/audio) workstation outlets and/or intrusion/access program display devices located inside the same building - two optical fibers, multimode.
6. Other locations as indicated on the Drawings or described in the Contract Documents.

3.3 COPPER WIRE CABLE TYPE

A. General

1. Cables shown as copper wire type shall comply with the following installation

conditions, unless noted otherwise on the Drawings.

2. Provide matching compatible outlets and terminate all copper wire cables into matching copper wire connectors.

B. Cable Types and Quantities - Cable types and quantities shall be as follows unless specifically noted other-wise on the Drawings. The following minimum type and quantity of copper wire cables from each individual workstation/device outlet, to the respective terminal equipment patch panel/bay, (unless specifically noted otherwise), but in no case less than what is shown on the Drawings and in no case less than one 4-pair cable to each outlet “Jack” position:

1. Two Category-6A, UTP 4-pair cable:

   a. Each network workstation outlet location.
   b. Each network “wireless-access-point” outlet location.

2. One Category-6A UTP 4-pair cable, for each telephone handset (instrument) workstation outlet location.
3. Trunking-Cables shall be Category-5E.
   a. 100-pair between buildings main IDF (SUB-MDF) and campus main MDF.
   b. 50-pair inside building between SUB-IDF to buildings main IDF (SUB-MDF).
4. Other locations as indicated on the Drawings or described in Contract Documents.

C. Provide plenum rated copper wire cable for any of the following installation location conditions in building spaces.

1. Any air plenum (supply or return) when a conduit or enclosed raceway is not provided for the entire cable length. Additionally, cables shall be rated Limited-Combustible (LC) type UL FHC-25/50.
2. All building space locations where the cable is installed without a conduit or the cable is not fully enclosed in a raceway along the entire cable length in the building. Additionally, cables shall be rated Limited-Combustible (LC) type UL FHC-25/50.
3. Building spaces and/or cavities that are 100% fully protected with fire sprinklers, including fire sprinklers located above in ceiling cavities and fire sprinklers located below in access floor cavities. Cables installed in these locations shall be rated with one or more of the following additional characteristics.

   a. Limited–Combustible (LC) UL FHC-25/50 plenum rated cable.
   b. Or plenum rated cable without the UL FHC-25/50 Limited-Combustible (LC) rating.

D. OSP Insulated Copper Wire Cables

1. Outside – Plant (OSP) CEC/NEC rated, UL listed, labeled and approved insulated copper wire cable assemblies. Moisture barrier resistant and UV resistant cable jacket. Non-flammable, water blocking, non-conductive gel internally filled infrastructure cable assembly.
2. Provide rated insulated copper wire OSP type cable for any of the following copper wire infrastructure cable install locations.

   a. In underground conduit or in conduit under the building.
   b. In conduit exterior to the building, or in conduit exposed outdoor on the building.
   c. Outdoor aerial with aerial messenger wire cable carrier.

3. Except for aerial install locations, install all OSP cable in continuous conduit pathways, end-to-end.

3.4 CABLE INSTALLATION

A. General

1. Cables connecting to equipment racks and terminal blocks shall be installed with not less than 6-feet of slack cable between the equipment rack/terminal block and terminal backboard. The slack cable shall be coiled and supported on the backboard and/or cable tray.
2. Cables in terminal closets and terminal rooms shall be trained, dressed and racked on the plywood backboards. Provide cable, metal support arms and re-enterable type cable support rings not less than 12-inches on center mounted onto the plywood along the entire length of all cables.
3. Provide separate routing paths on plywood backboards for fiber optic cables, computer data and copper wire cables and telephone/voice copper wire cables and multimedia, audio/video, TV cables. Provide separate routing paths on plywood backboards for shielded copper wire cables and unshielded copper wire cables.
4. Cables shall be routed parallel to floors and walls. Do not route cables diagonally on backboards.

5. Spare cable slack

    a. Provide 25-feet of cable slack where unterminated cables are specified at terminal backboards.
    b. Provide a minimum of 18-inches of slack cable in each workstation outlet box and outlet locations.
    c. Provide 10-feet of cable slack in ceiling above each work station outlet.
    d. Provide 24-inches of slack in each cable at patch panel locations.
    e. Coil and "Velcro" wrap slack cable.

6. Provide “horizontal wiring” cables installed from individual equipment locations and workstation out- lets to respective MDF/IDF terminal closet/room patch panel. Cables shall be continuous without cutting or splices.
7. Provide “backbone” cables installed from each IDF location to respective MDF/Sub-MDF location terminal closet/room patch panels. Cables shall be continuous without cutting or splices.

B. Cable Pulling Lubrication

1. Cable pulling lubricants shall be specifically approved by the Cable Manufacturer. The following lubricants shall be used where approved by the Cable Manufacturer.

    a. Slip X -300, American Colloid Co.
    b. Bishop #45, Bishop Electric.
    c. MacLube CA51, MacProducts.
    d. Minerallac H2B,- Minerallac Electric.
    e. Winter grade #7437-PC, General Machine Products.
    f. Gel-lube 7/5, Cable associates.
    g. Polywater, A, C, G - American Polywater.

2. Lubricants shall be continuously applied as cable enters raceway.

C. Cable Installation:

1. Do not pull conductors until factory test reports have been submitted and reviewed.

2. Minimum bending radius of fiber optic cables shall not be less than the following. Maximum pulling tension shall not exceed the following. In no case shall the Manufacturer's recommendations be violated.

Cable Type	Cable Fiber Quantity	Minimum Bend Radius	Maximum Pulling Tension
Loose Tube	2-84	9 inches	600 pounds
Loose Tube	86-192	10 inches	600 pounds
Tight Buffered	2-12	5 inches	400 pounds
Tight Buffered	14-24	7 inches	600 pounds
Tight Buffered	26-28	11 inches	1100 pounds
Tight Buffered	48-72	12 inches	1200 pounds

3. The minimum bending radius for copper wire cables shall be 10 times the cable outside diameter. The maximum pulling tension and minimum bending radius shall not violate Manufacturer's recommendations.
4. Cables installed in manholes and pullboxes on terminal backboards shall be installed on wall mounted cable support racks.
5. Provide a full 360-degree loop of cable around manhole and pullbox interiors.
6. The attachment of pulling devices directly to the cables shall be with individual split mesh basket grips. Direct connection for pulling cables to cable fibers and copper wires shall not occur. Securely tape cable ends to prevent moisture or pulling compound from penetrating cable.
7. The attachment of the pulling device to the cable basket grips shall be made through a swivel connector.
8. The Contractor shall ensure that the cables are fed straight into the raceway taking care to avoid short bends, sharp edges and cable "cross-overs".
9. All lashings used for temporary bunching of the individual cables shall be removed before the cables enter the raceway.
10. Cables shall be "pulled through" or pulled from a "center of run pull" without splices or terminations and minimize cable rolling tension. Lead-out the cables at all manholes, pullboxes and conduits taking care to feed them in again by hand for the next portion of the cable run.
11. For each cable pull where a cable direction change is required, flexible feed-in tubes, pullout devices, multi-segmented sheaves etc. shall be used to insure proper cable pulling tensions and side wall pressures. Cables shall not be pulled directly around a short right angle bend. Any device or surface the cable comes in contact with when under pull-in tension shall have a minimum radius 50% greater than the final specified minimum installed cable bending radius. The maximum possible size radius sheaves and feed-in tubes, usable in the available working space, shall be provided in all situations, to insure the minimum possible cable side-wall pulling pressure. Do not use devices with multi-segment "roller" type sheaves.
12. Cable lengths over 50 feet shall be machine pulled not hand pulled into and through all raceways. Cables shall be pulled in a continuous, smooth operation without jerking or stop-start motion after initiation of pull. Maximum cable pulling speed shall be less than 50 feet per minute. Minimum cable pulling speed shall be greater than 15 feet per minute.
13. Cables shall be pulled straight into or out of the raceway without bends at the raceway entrance or exit. Pull in cable from the end having the sharpest bend (i.e., bend shall be closest to reel). Keep pulling tension to minimum by liberal use of lubricant, hand turning of reel, and slack feeding of cable into duct entrance. Employ not less than one man at reel and one at manhole or pull-hole during this operation. Cables shall be pulled directly from cable reels.
14. Cables shall be trained or racked in trenches, vaults, manholes and pull boxes with

consideration given for the minimum specified bending radius of the cable and the possibility of cable movements due to load cycling. The cables shall be racked and supported in such a manner that adequate space is allowed for splicing and the cables shall always be fanned out from the duct or conduit so as not to cross other ducts, conduits or cables. To prevent damage from falling objects or personnel entering the manhole the cables shall not pass directly under the manhole opening.

15. Cable shall be supported in manholes, pull boxes and vaults a minimum of 18-inch on center with cable racks. Provide hot dip galvanized, T-slot racks and support arms. Secure cables to racks with porcelain supports for each cable on the racks. Loosely lash cables to racks. Splices shall be directly supported, on racks. Do not install cables more than one feeder on the same rack hook.
16. Cables shall be routed the long way around manhole, pull-hole, etc. with not less than a full 360-degree loop around the perimeter walls unless noted otherwise.
17. Existing conductors shall be protected at all times when Contract work occurs in the same area, including but not limited to pullboxes, vaults manholes, cable trenches etc. Provide temporary electrical insulating blankets and barriers over existing conductors to reduce the possibility of accidental mechanical damage to existing conductors.
18. Where cable tray is provided, all cables shall be routed and trained on the cable tray. The cables shall enter the cable tray and route along the tray prior to entering any equipment racks or computer works station outlets.
19. A dynamometer to measure pulling tension shall be used on all cable runs in excess 200-feet or with more than 180 degrees in bends. The actual pulling tension value shall be calculated and recorded for each pull.
20. Bends shall not be made in cable splices or terminations.
21. The portions of cables installed without raceways or cable tray supports shall be installed with metal “J- hook” cable supports.

    a. The “J-hooks” shall provide multi-tiered “J” shaped hooks, with wide flat cable support base (0.5 inch wide minimum) and smooth rounded corners. Specifically designed for copper wire and fiber optic infrastructure cable support as manufactured by Erico Inc.
    b. The individual “J-hook” attachment to the building structure shall be metal, “beam clamp”, “hanger rod”, clevis hanger styles as applicable for each attachment location.
    c. Install “J-hooks” not more than 48-inches on center along the entire cable length and within 6 inches of each cable change in direction. Locations of “J-Hooks” and tension of cables shall insure between 4-inches and 6-inches of cable sag between adjacent hooks. Secure cables to “J- hooks” with re-enterable cable tie wraps. “J-hook” supported cables, bundle cables together with re-enterable tie wraps not less than 12 inches on center along the entire cable length.
    d. Each J-hook shall not support more than 12 individual cables. Provide multiple “tiered” J-hooks for additional cable quantities at each location.
    e. “Bridle rings” shall NOT be used to support cables.
    f. Cables shall not lie directly on nor attach to ceilings, ceiling hangers, lighting fixtures, air ducts, piping, or equipment.

22. Re-enterable cable tie wraps shall be, “limited-combustible” and air plenum rated, reusable, color coded. Chemically and mechanically compatible with the respective cables and install locations. Shall allow multiple open-close operations for securing cables.
23. Electronic network cables containing non-dielectric components shall be installed with a minimum separation from other electrical power conductors and equipment as follows:

Equipment Type	Minimum Separation

a.	Lighting fixtures	12 inches
b.	Electric motors, electric solenoids, electric Heaters	40 inches
c.	Transformers 48 inches	
d.	Circuits over 100 volts to ground, in metallic raceways	5 inches
e.	Circuits over 100 volts to ground, in non-metallic raceway or without any raceway	12 inches
f.	Circuits over 100 volts to ground, suspended on overhead pole lines	48 inches

D. Movement, Storage, and Handling of Cable:

1. Reels of cable shall not be dropped from any height, from trucks or other transporting equipment.
2. Lift and move cable reels using following methods:

    a. Crane or boom type equipment-insert shaft (heavy rod or pipe) through reel hubs and lift with slings on shaft, with spreader or yoke to reduce or avoid sling pressure against reel head.
    b. Forklift type of equipment may be used to move smaller, narrower width reels. Fork tines should be placed so that lift pressure is on reel heads, not on cable, and shall reach all the way across reels so lift is against both reel heads.
    c. Reels may be moved short distances by rolling. Reels shall be rolled in the direction indicated by arrows painted on reel heads. Surfaces over which the reels are to be rolled shall be solid clear of debris, and also clear of protruding stones, humps, etc. which might damage the cable if the reel straddles them.

3. Storage of reels of cable:

    a. Cable ends shall be sealed prior to shipment to prevent moisture entry into cable. Cable ends shall remain sealed at all times including during installation. Where ends seals are removed, reseal cable ends by stripping cable finishes back 2-inches down to insulation. Then apply four layers
    b. of an insulating tape criss-cross over the cable end and carry back at least 4-inches onto cable outer finish. Add a containing cover of two layers of vinyl electrical tape completely over the end seal.
    c. Cable reels shall be shipped with factory applied lagging (protective cover) left in place until removal is absolutely necessary. Additional covering such as tarpaulin, plastic sheeting, etc. shall be used if cable is to be stored outdoors.
    d. Store reels of cable on a firm surface, paved, or on planking to prevent settling into soft ground.
    e. Use fencing or other barriers to protect cables and reels against damage by vehicles or other equipment moving about in the storage area.

3.5 CABLE SPLICES

A. General

1. Splice(s) in cables shall occur only in the following locations:

    a. Pullboxes or manholes.
    b. Terminal backboard, closets or rooms.
    c. Equipment racks.
    d. Wall mounted interface cabinet.
    e. Do not splice cables in conduit, cable tray, raceways or plenums.

2. Polarity and color-coding shall be maintained consistent through splices, terminations and outlets for the entire electronic network system.
3. Cable splices in outdoor areas, manholes, pullholes shall be water tight, inside universal splice enclosures.

B. Fiber optic cable splices unless specifically indicated otherwise below, fiber optic cable splices between fiber optic cables fibers shall be fusion type splices.

1. Splices between loose tube gel filled fiber optic cable fibers shall be fusion type splices.
2. Splices between indoor/outdoor fiber optic cable fibers shall be fusion type.
3. "Pigtail" splices of tight buffered and indoor/outdoor fiber optic cable fibers to loose tube gel filled cables shall be fusion type splice.
4. Splices between tight buffered fiber optic cable fibers to indoor/outdoor fiber optic cables shall be fusion type splice or mechanical type splice.
5. Splices between tight buffered fiber optic cable fibers shall be mechanical type splice or fusion type splice.
6. "Pigtail" splices of tight buffered fiber optic cable fibers to tight buffered fiber optic cable fibers shall be mechanical type splice or fusion type splice.
7. Fiber optic splices shall be performed to maintain the data transmission rates specified for the entire respective system.

C. Copper Wire Splice

1. Copper wire extending from infrastructure workstation outlets to respective equipment rack patch panel outlets shall not be cut or broken and shall be continuous end to end.
2. Copper wire extending from telephone/voice workstation outlets to respective terminal blocks shall not be cut or broken and shall be continuous end to end.
3. Continuity of cable shields (where occurs), polarity and color coding shall be maintained across all splices.

4. Copper wire splices shall be performed to maintain the data transmission rates specified for the entire respective system.

3.6 CABLE TERMINATIONS

A. General

1. Infrastructure workstation outlets connecting to ports in patch panels and terminal blocks shall be grouped together in the patch panel and terminal block by outlet function, room location and building area location (i.e. Group #l Room #120 1st floor; Group #2 Room #200 east wing, etc.). Each group shall be identified with engraved (etched) nameplates indicating grouping identification and individual port numbers.
2. Polarity and color coding of cable connections at splices, terminations and outlets shall be consistently maintained throughout the entire electronic network system.
3. Terminate all cables onto respective outlets connectors, interconnection couplers and terminals. Terminations shall comply with Manufacturer's recommendations; ANSI/TIA/EIA-568C related Standards, Amendments and TSB.
4. Fiber optic cable fiber strands and copper wire cable conductors terminated at outlet locations shall be connected with a strain relief device attached to the cable jacket to prevent cable tension from being transmitted to the termination connectors.
5. Cable terminations shall be performed to maintain the data transmission rates specified for respective entire system.

B. Fiber Optic Terminations

1. Individual fiber optic fibers shall each be terminated with a fiber optic fiber connector. The connector for each fiber shall be "plugged" into separate fiber optic fiber interconnection couplers on the rear of each respective outlet.
2. Each fiber optic termination ferrule shall be inspected, after completion of the termination, visually with a fiber optic inspection microscope and an interferometer, to insure fiber “undercut”, “protruding” fiber, over polish and under polish of fiber termination ends does not exist in the finished termination ferrule.
3. Fiber optic cables terminated between two fiber optic patch panels located in separate equipment racks. The fibers shall be paired together (Duplex-Pair) for purposes of identification and connection transmit/receive pair. Each pair of connectors for fibers shall be "plugged" into separate, physically adjacent fiber optic fiber duplex-pair interconnection couplers at each patch panel. The horizontal/ vertical arrangement of paired patch panel fiber couplers shall match at both ends of the fiber cable.
4. Fiber optic cable fiber strands terminated at patch panels shall be installed with a minimum of 540 degrees of each fiber strand looped around the splice tray individual fiber ”training” rings.
5. Fiber optic cable connecting from infrastructure workstation outlet to a fiber optic patch panel.

    a. The connectors for fibers shall be "plugged" into separate, physically adjacent fiber optic fiber interconnection couplers.
    b. The patch panel coupler shall be color coded to identify the polarity of the transmitting and receiving optical fibers.

6. Fiber optic cable connections at workstation outlets.

    a. The connectors for fibers shall be "plugged" into separate physically adjacent fiber optic fiber interconnection couplers in the outlet.

C. Copper Wire Terminations

1. Where occurs, the shield on metal shielded copper wire shall be terminated and connected to the shield grounding connection at each termination point.
2. Twisted wire pairs shall not be untwisted for a length of more than 0.4-inch at any location and the cable jacket shall not be striped back not more than 0.5 inch any location including splices and terminations.
3. Unless specifically directed otherwise by the Owner's Representative, Pin assignment for wiring terminations shall comply with ANSI/TIA/EIA-568C type T568A or Type T568B as required for compatibility with the electronic network equipment. The termination type shall be consistent throughout the Project Contract area.
4. Copper wire termination's shall be performed to maintain the transmission rates specified for the respective entire system.

3.7 EQUIPMENT RACKS

A. General

1. Install, assemble, mount and connect devices and equipment in the respective equipment racks, bolted securely to the rack frame with stainless steel hardware. "Star" style lock washers shall be provided to insure an electrically continuous ground path between the equipment/devices and rack frames.
2. Provide blank metal filler panels to close unused equipment "front" mounting space in equipment racks, Manufacturer's standard finish color.
3. Provide a copper wire outlet connector in the respective equipment rack for each remote copper wire infrastructure workstation outlet and copper wire cable shown

connected to the respective equipment rack, plus the spare copper wire outlet connectors required in the Contract Documents. The copper wire outlet connectors in the equipment racks shall be provided in equipment rack mounted copper wire patch panels. In no case shall the quantity of equipment rack mounted copper wire outlet connectors be less than the quantity of cables indicated on the Drawings, plus required spaces/spares.

4. Provide fiber optic fiber connectors and fiber optic fiber interconnection couplers in the respective equipment rack for each remote fiber optic infrastructure workstation outlet, and fiber optics cable fiber shown connected to the respective equipment rack, plus the spare fiber optic fiber connectors required in the Contract Documents. The fiber optic fiber connectors and fiber optic fiber interconnection couplers in the equipment racks shall be provided in equipment rack mounted fiber optic fiber distribution enclosures (RTDE). In no case shall the quantity of equipment rack mounted fiber optic fiber connectors and fiber optic fiber interconnection couplers be less than the quantity of cables indicated on the Drawings, plus required spaces/spares.
5. Fiber optics cable fibers specifically shown as non-terminated "splicing-thru" in the equipment rack shall route through fiber optic splice only enclosures (RMSE), mounted in the respective equipment rack.
6. The maximum quantity of cable terminations, in each equipment rack mounted patch panels shall not exceed the following. To insure not less than 50% of the rack space remains available for equipment installation:

    a. 100% copper wire outlet connectors, 196 maximum per rack.
    b. 100% fiber optic fiber terminations, 144 maximum per rack.
    c. Combination of copper wire outlet connectors and fiber optic fiber terminations in the same rack; 48 maximum fiber optic fibers plus 144 maximum copper wire outlet connectors per rack. 18 maximum fibers plus 48 maximum copper wire in 30 inches high.
    d. In addition to the quantity of patch panel outlets for termination of incoming and outgoing cables, provide not less than an additional 15% of patch panel spare outlets of each type, in each equipment rack for future use.

7. Provide additional equipment racks, quantity of racks to ensure the maximum specified quantity of terminations in single rack are not exceeded and the quantity of cable terminations complies with the Requirements of the Contract Documents.
8. Terminal racks, equipment locations, patch panels, and cross connects shall be arranged to allow for natural cabling progression, minimize crossing of cables and allow easy access to each system component.
9. Equipment Rack Anchorage:

    a. Equipment racks installed on raised "access floor" systems, shall be supported and anchored with bolts that extend into the "structural" floor located below the "access floor".
    b. Securely anchor the support arms of swing gate racks to the wall structural support system.
    c. Securely anchor fixed support base of the racks to the floor.
    d. Mounting method shall support the total rack weight including installed equipment, but in no case less than 500 pounds with a 2.0 times safety factor.
    e. Attachments and anchorages shall comply with the Requirements for earthquake seismic rating at the install location.

10. Unless specifically noted, otherwise provide the following equipment rack types:

    a. Floor standing equipment racks containing patch panel locations, computer/data network HUBS/switches and computer data network concentrators, shall be

Swing Gate style equipment racks.

b. Floor standing equipment racks containing multimedia, audio/video, TV head end equipment, shall be Metal Enclosed equipment racks.

c. Wall mounted external to dedicated IDF/MDF terminal rooms/closets (i.e. inside individual classrooms), shall be Mini-Equipment racks.

11. Install ground bus, PDU/SPD, cable management rings, equipment, patch panel and patch panel out-lets, etc. in equipment racks.

12. Equipment rack terminology:

a. The location containing the main campus equipment rack location shall be identified as the Main Distribution Frame – (MDF).

b. The locations remote from the MDF containing satellite equipment racks shall be identified as Intermediate Distribution Frames (IDF).

c. A individual building located on a multi-building campus site with multiple equipment rack locations in the building, the building main rack location shall be identified as Sub-MDF (or building MDF) and the remaining equipment rack locations in the building shall be identified as IDF.

d. Floor Standing Equipment Racks

e. General:

f. Securely anchor racks to floor.

g. All incoming cables shall enter through the top or bottom of the racks.

h. The front of the racks shall maintain a minimum of 42-inches of clear working space.

i. Multiple floor standing racks shall be installed directly adjacent to each other (i.e. side by side), with not less than 6-inches (edge-to-edge) space between adjacent racks.

j. Cables entering racks shall enter into the top of the rack from overhead cable tray, or from wall along wall support arms to rack.

13. Floor standing metal enclosed equipment racks:

a. The rear of the rack shall maintain a minimum of 36 inches clear working space.

b. Provide a minimum spacing between adjacent (edge-to-edge) racks of not less than 6-inches.

14. Floor standing open (non-swing gate) equipment racks.

a. The rear of the rack shall maintain a minimum of 54-inches clear working space behind the rack frame rails for adequate installation depth of HUBS/switches equipment, for "walk" behind access to equipment and for cable terminations access.

b. Provide a minimum spacing between (edge-to-edge) racks of not less than 6-inches.

15. Floor standing modular frame equipment racks:

a. The rear of the racks shall abut against the wall, or as shown on the Drawing.

3.8 TELEPHONE/VOICE TERMINAL BLOCKS

A. The telephone/voice terminal blocks shall be assembled in vertical sections, for wall mounting. Install adjacent vertical sections with not less than 8-inch blank space between sections, for

cable training space.

B. Install terminal blocks on plywood terminal backboard with #8 x 1-inch wood screws. Minimum 6-inches on center, along each side of each terminal block.

C. Terminal block wire pair capacity:

1. The minimum wire termination capacity shall not be less than 600 pairs of telephone/voice conductors, at any telephone/voice terminal block.
2. The quantity of wire pair terminations provided at each terminal block shall be based on the following formula. However, under no case shall any terminal block wire pair capacity be less than the specified minimum.

   Total quantity of telephone/voice feeder copper wire pairs connected to the terminal board = QFP Total quantity of telephone/voice outlets connected to terminal board - QTO
   (QFP) x (QTO x 4) + (specified spares) = Minimum terminal block pair capacity.

3.9 MDF AND IDF CIRCUIT TERMINAL ROOMS AND CLOSETS

A. Terminal Backboard

1. A ¾-inch thick marine "A-C" grade plywood backboard shall fully cover each wall of terminal closets and terminal rooms, including all MDF and IDF rooms/closets. Provide backboard on the wall for equipment racks, incoming cable raceways and terminal blocks. Plywood shall extend continuous from the finish floor to 8-feet above the finish floor on all walls. "A" side of plywood shall be exposed.
2. Attach plywood to wall structural framing with mechanical fasteners a minimum 6-inches on center vertically on walls at each framing vertical member, and along the length of the wall, but not less than 16 inches on center horizontally along the length of the wall.
3. Paint plywood terminal backboards after installation and prior to mounting any equipment. One coat of wood paint fire resistant primer and two coats of fire resistant/intumescent, non-conductive finish coats of paint. Finish color matt/ flat white, acrylic enamel fire resistant/retardant latex paint.

B. Cable Tray

1. Locations with equipment racks, and/or terminal blocks are installed in the same room/closet (MDF or IDF).

   a. Provide a horizontal cable tray above the equipment racks and terminal blocks in each circuit terminal room and closet.
   b. Provide a horizontal cable tray continuous “loop” around the perimeter inside each MDF and IDF room, within 12-inches of the ceiling. Parallel with and adjacent to all walls in the room.

2. Ladder type cable tray 18 inches wide by 6 inches deep; length-end wall to end wall, of the closet or room.
3. Install the cable tray centered above all equipment racks, and around the room perimeter at ceiling/ walls and terminal blocks with ceiling and wall suspension system. Install trays not more than 36-inches above and not less than 12-inches above the top of the equipment racks.
4. Where multiple segments of cable trays occur in terminal closets and rooms, provide interconnecting cable trays between each segment located in the respective

room/closet.

C. Conductor Training and Support

1. Provide conductor/cable training and racking support distribution rings installed on backboards. As manufactured by Newton 3042 series, Saunders or equal.
2. Support rings shall be spaced a minimum of 10-inches on center along all cable/conductor routing paths on backboards and within 4-inches of each change in cable/conductor direction.
3. The capacity of support rings shall be equal to the weight and quantity of conductors/cables passing through the respective support ring plus 100% spare capacity for installation future conductors/cables. In no case shall support rings be smaller than 3 inches.
4. Attach support rings to backboards with not less than two 3/8-inch diameter by 1⅛-inch long threaded wood anchor bolts for each individual bracket.

D. Environment Space Monitoring (MDF and IDF)

1. In each room/closet provide one automatic environmental monitor. Self-calibrating, simultaneous monitoring and software programmable, with alarm set points. Shall measure and monitor ambient conditions and provide data-logging for conditions in the space for the following:

   a. One ambient temperature port and plug-in indoor sensor.
   b. One ambient humidity port and plug-in indoor sensor.
   c. One spare plug-in port for an external digital sensor.

2. Digital Fast Ethernet LAN RJ-45 communications port, with alarm alerting and communications software for remote monitoring of the ambient conditions via the LAN. Multi-user site wide software license, compatible with PC-computer and IP-WEB HTTP remote operations.
3. Local internal audio and visual alert annunciators, with local silence and reset.
4. 120 volt, 60Hz AC input power supply operation. Equipment rack mount self-contained unit housing configuration. Provide all interconnect cabling and connectors.
5. Provide the environmental unit in one of the equipment racks located in each of the respective spaces.
6. As manufactured by Avtech-Room Alert; or SensaTronic-Evironmental Systems; or IT Watch Dog- Climate Monitors.

3.10 GROUND (ADDITIONAL REQUIREMENTS)

A. Electronic Equipment MDF, IDF and Terminal Rooms and Closets

1. Terminal Equipment Ground Bus (TEGB) - Provide a wall mounted TEGB ground bus in each MDF location. Also provide a TEGB where two or more equipment racks and/or terminal blocks are provided in each IDF. The TEGB ground bus shall be copper ¼-inch by 2-inches (nominal) by 12-inches long (minimum). Install the TEGB on the wall with a minimum of two "stand-off" electrical insulators. Drill and tap the ground bus and provide bolted type ground lugs for connection of each ground conductors size #10AWG - #1AWG. Provide four spare unused ground lugs on the TEGB.
2. Provide 1.25-inch conduit with 1#1AWG copper insulated ground conductor from the TEGB homerun to the building main ground reference bus. Provide 1.25-inch conduit with 1#1AWG copper insulated ground conductor from the TEGB homerun to the

nearest building main structural steel member and to the nearest metal cold water pipe larger than 0.6-inch diameter pipe.

a. Provide the same ground connections from the equipment rack ground bus where only a single equipment rack occurs in the IDF location.

3. The ground conductor required from the TEGB to the building main ground reference bus may be looped and connected between separate TEGB ground bus locations if all of the following conditions are met.

a. The ground conductor is increased to 1.5-inch conduit with 1#2/0AWG copper insulated and the total end to end length does not exceed 300-feet.
b. The building exceeds two floors in height.
c. Not more than four TEGB buses are connected to the same "looped" ground conductor.
d. The TEGB ground conductor is continuous (not cut, spliced or broken) along its entire length.
e. The TEGB ground conductor is connected to the TEGB ground buses with a UL listed "Exothermic" welding process.

B. Equipment Racks:

1. Provide a separate 12AWG copper stranded green insulated ground conductor from each individual equipment element in the rack to the respective rack ground bus.
2. Provide a separate #8AWG copper insulated ground conductor from each equipment rack ground bus to the TEGB terminal equipment ground bus located in the same space.
3. Where only one equipment rack is installed, provide 1.25-inch conduit with 1#1AWG copper insulated ground homerun conductor from the equipment rack ground bus homerun to the building main ground reference bus and provide 1.25-inch conduit with 1#1AWG copper insulated ground conductor from the TEGB or single equipment rack ground bus (as applicable), to the nearest building main structural steel member and to the nearest metal cold water pipe larger than 0.6-inch diameter pipe.
4. Provide 1.25-inch conduit with 1#4AWG copper insulated ground conductor from each wall mounted fiber interface cabinet to the respective TEGB ground buses.
5. Provide a 1#10AWG copper insulated ground conductor connecting in a continuous loop to all miscellaneous cable trays and metal support equipment located in the terminal closet or room and connect to the TEGB ground bus.

C. Telephone/Voice Terminal Blocks:

1. Provide a separate #8 copper insulated ground conductor from each terminal block section ground bus to the TEGB terminal equipment ground bus.
2. Provide a separate #6 copper insulated ground conductor from the terminal room/closet to the lightning ground system.

3.11 WALL MOUNTED FIBER INTERFACE CABINET - WMIC

3.12 IDENTIFICATION (ADDITIONAL REQUIREMENTS)

A. General

1. Fiber optic and copper wire cables shall be identified in each manhole, pull box, equipment rack, patch panel and computer workstation outlets.
2. Infrastructure documentation, identification labels and color coding shall comply with ANSI/TIA/EIA- 606A Administration Standard for Telecommunications Infrastructures, Class-1 thru Class-4. Provide management software MS-Windows-based single user license, with all as-built data entry documentation information complete.

B. Identification tags shall include the following information:

1. Cable name as indicated on Drawings (i.e., HV1, F4, MSB3 etc.).
2. Installation month and date (i.e., 3/92, 4/78 etc.).
3. Conductor size conductor type (i.e., loose tube fiber; #24AWG ScTP Category 5, 200-pair, telephone/ voice etc.).
4. Feeder taps to equipment or building shall also be identified with equipment name or building (i.e. library, SW1, Rack #21, etc.)

C. Identification Tags

1. Tags shall be ⅛-inch thick 98% lead, approximately 2-inch square with chamfered corners. Two holes shall be drilled for attachment to primary cable. Lettering shall be ⅛-inch high, engraved or die stamped. Attach tags to primary cables with two #14AWG (THWN insulated) solid copper conductors "twist- tied", with insulated CAP wire-nut on the tie-wire ends, to cover sharp edges of tie-wire conductor.
2. Alternate identification tags, at the Contractor's option in lieu of lead tags. Provide polypropylene tag holders with interchangeable, yellow polypropylene tag with black alphanumeric characters sets. Characters shall be approximately .25-inch high. As manufactured by Almetek industries "EZTAG" - Ledgewood, New Jersey.

D. Equipment and outlet naming identification and color-coding shall comply with ANSI/EIA/TIA latest revision.

1. Naming method for equipment, outlets and cables; where a position in the naming string is unused, provide multiple "****" symbols.

Typical naming string "ADM-02-1141-PP17-1271"

a. "ADM" - Abbreviated Building Name or Number (i.e., Administration, B127, etc.)
b. "02" - Floor Level #2 or as applicable.
c. "1141" - Outlet, Equipment or Terminal Room/Closet name or room number as applicable.
d. "PP17" - Terminal Rack Patch Panel Identification.
e. "1271" - Individual Outlet or Port Identification.

2. Connecting hardware color coding shall be as follows: "Green" - Main central terminal location for entire site.

"White" - Distributed terminal locations other than the main terminal.

"Blue" - Horizontal wiring hardware systems for workstations.

E. Provide warning nameplates on fiber optic patch panels, fiber optic outlets, and any location where fiber optic cables are terminated. Minimum ⅛-inch high engraved/etched letters.

"WARNING - LASER LIGHT SOURCE. DO NOT LOOK DIRECTLY AT OUTLET OR FIBER CABLE ENDS. RISK OF SEVERE EYE DAMAGE OR BLINDNESS".

END OF SECTION

SECTION 27 30 00 – AREA OF REFUGE - TWO-WAY COMMUNICATION SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. IP Command Center (Base Station and Distribution Module), Call Boxes and Signage. The IP Command Center is to be located at a central control point on the first floor or as determined by local Authority Having Jurisdiction. RATH® Command Center IP Call Boxes are to be located on all floors above and below the first floor, ideally next to a stairwell emergency exit or elevator landing on each floor.

B. The IP Command Center must be capable of connecting to an existing Network and providing inputs for the IP Call Boxes. Visual indicators on the IP Command Center allow rescue personnel to know which IP Call Box needs assistance. The IP Command Center must allow rescue Personnel to speak to each IP Call Box individually. The IP Command Center must include both a handset and speakerphone to communicate back to the IP Call Boxes.

C. The emergency communication hardware shall comply with the Americans with Disabilities Act (ADA). The IP Call Box shall have the ability to be programmed with up to two emergency phone numbers (either both off- site or Base Station and off-site). Upon activation of the emergency push button, a call will be automatically placed to the IP Command Center. If no one answers at the IP Command Center, the IP Call Box must dial a secondary location outside the building to activate two way off-site person to person voice communications.

1.2 SUBMITTALS

A. Submit product data sheets. Include operation manuals.

B. Wiring or shop diagrams detailing wiring schematics, cabling.

1.3 CONSTRUCTION

A. The IP Command Center (2500 Series) shall include both the Base Station and Distribution Module. The Base Station must have a powder coated steel housing (surface or flush mount) or be desk mounted, include a black handset with coil cord and be powered from the Distribution Module.

B. Distribution Module must be a surface mount enclosure, include connections for the IP Call Boxes and power the Base Station. The Distribution Module shall be powered from 120vac power with a battery backup that provides power for a minimum of 4 hours (RATH® part # RP7700104).

C. The IP Call Boxes (2100 Series) must be in full compliance with the ADA. IP Call Boxes require a hands-free speakerphone with an LED to indicate status of call.

D. The IP Call Boxes must allow the programming in of a specific location message of the unit. This allows rescue personnel to know the location of the activated IP Call Box.

E. The IP Call Boxes are to be located no higher than 48-inches reach to the center of the push button above ground level to ensure conformance with the ADA Requirements.

F. The IP Call Boxes must have a Braille face plate to ensure conformance with the ADA Requirements.

G. The IP Command Center must provide an audible and visual indicator that an IP Call Box has been activated.

H. The 120vac Power Supply RATH® part # RP7700104 must be capable of supplying power to a minimum of one Base Station and one Distribution Module.

1.4 MOUNTING

A. The IP Command Center is to be mounted on a flat wall surface or a desk top.

B. The IP Call Boxes are to be wall surface or flush mounted.

1.5 ELECTRICAL

A. The IP Command Center is to be powered by the Distribution Module. The IP Call Boxes are to be powered by PoE at 802.3af or a separate battery backed up 12v source.

B. Distribution Module shall be powered by the RATH® part # RP7700104 Power Supply. It shall require 120vac power and provide battery backup capable of providing a minimum of 4 hours of electrical backup in case of building power failure.

C. The Base Station shall connect to the Distribution Module with a single wire pair (10 zone) 2-wire pairs (16-64 zone) or 3-wire pairs (80-up).

D. Each IP Call Box shall connect to a local Network Switch directed to the Command Center Distribution Module. Wiring from the IP Call Box to the Network Switch shall be a minimum of Cat 5e or 6. If CI cable is required, utilize RATH® cable part # RP6600300M4.

E. System shall be in compliance with all state and local Electrical Codes.

F. If protective covers are required on the Call Boxes per local municipal codes, use RATH® part # 2100- XXXIPC2.

G. If the monitoring of system integrity is required per NFPA 72, use RATH® Supervisor part # 2500-VOIPM.

1.6 COMMUNICATIONS

A. The IP Call Boxes shall be an ADA compliant and vandal resistant speakerphone.

B. The IP Call Boxes shall be hands-free and be a push-button-once to talk system. Once the button has been pushed, the IP Call Box will call the Base Station. If no answer at the Base Station, it will automatically call a preprogrammed emergency number. The IP Call Box must be capable of being programmed with up to 2 emergency phone numbers (either both off-site or Base Station and off-site).

C. The IP Call Box shall have location message capability. The IP Call Box must have a minimum 18-second recordable message capability, programmable to play 1 or 2 times. IP Call Box shall notify called party of the location of the call upon being received at the emergency dispatch center.

D. The IP Call Box shall be capable of allowing the called party to replay the location message if necessary to ensure an understanding of the caller location.

E. If system is not attended to 24 hours a day, the IP Call Box must dial a secondary location outside the building to activate two way off-site person to person voice communications.

F. Once call has been made (button pushed), the call can only be terminated by the called party.

G. The IP Call Box must have a red LED that will light up upon push of the button. The light shall be a solid color when the IP Call Box is activated, and will flash when call has been answered.

H. The IP Call Box must be capable of being programmed and reprogrammed on-site.

I. Standard IP Call Box features:

1. Two number programming (either both off-site or Base Station and off-site)
2. Operating temperature of between -40˚F to +150˚F (-40˚ to + 65˚ C)
3. On-site programmable.
4. Powered from PoE at 802.3af or separate battery backed up 12v source
5. EEPROM memory to protect programming.

PART 2 - PRODUCTS

2.1 SIGNAGE

System shall consist of a minimum of one 120/277vac edge light sign (part # 7050 or 7050E), and a “location” and “instruction” sign (part # 7049) to clearly indicate location of designated area. A tactile sign (part # 7043/7044 or 7087) with raised letter and Braille shall be located at entrance to area.

2.2 GRAPHICS

A. IP Command Center must include wording identifying the location of each IP Call Box and light an LED when a particular IP Call Box has been activated.

B. The IP Call Box wording must include “Emergency Phone”, International Phone symbol and raised Braille lettering.

C. Cabling

1. Cabling for two-way communication system shall meet the applicable Requirements for pathway survivability. Cabling installation shall consist of the following:

   a. 2 hour fire-rated circuit integrity (CI) cable – RATH® part # RP6600300M4
   b. 2 hour fire-rated cable system
   c. 2 hour fire-rated enclosure or protected area

2.3 WARRANTY

The IP Command Center and IP Call Boxes shall be warranted for a period of 3-years.

2.4 MANUFACTURER

SThe Manufacturer shall be: RATH® Area of Refuge

N56 W24720 North Corporate

Circle Sussex, WI 53089 800-451-1460

Website: www.Area-of-Refuge.com

END OF SECTION

27 51 17- CONVERGED IP PUBLIC ADDRESS AND INTERCOMMUNICATION

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Installation of all components, and configuration necessary for the complete installation and functionality of a fully tested and operational IP Converged public address and intercommunication system.

B. The system shall include all call paging access from the VoIP Telephone system, access to individual speaker, zone paging, all calls, other rooms, etc. System shall also provide for interfacing with the clock system for a class change signaling system and Fire Alarm system with override of PA tone signaling capability. The clock system shall include IP based NTP or master clock.

1.02 RELATED SECTIONS

A. Applicable Division 1 sections

B. Section 00 70 00: General Conditions

C. Section 01 77 00: Contract Closeout

D. Section 21 23 23: Excavating, Backfilling and Compacting for Utilities

E. Section 06 10 00: Rough Carpentry

F. Section 26 05 00: Common Works Results for Electrical

G. Section 26 05 13: Basic Electrical Materials and Methods.

H. Section 26 05 26: Grounding and Bonding

I. Section 26 05 33: Raceways and Boxes Fittings and Supports.

J. Section 26 24 16: Panelboards and Signal Terminal Cabinets

K. Section 27 01 26: Test and Acceptance Requirements for Structured Cabling

L. Section 27 05 36: Cable Trays for Communications

M. Section 27 10 14: Structured Cabling - new construction

N. Section 27 10 15: Premises Wiring for Convergence of Communication Systems

O. Section 27 51 29: Autonomous PA Sound System

P. Section 28 31 00: Fire Detection Alarm

1.03 REFERENCES

A. Electronics Industries Alliance (EIA):

1. EIA 160 Sound Systems
2. EIA-101 Amplifiers for Sound Equipment
3. EIA/TIA-568: Commercial building telecommunications wiring standard.
4. EIA/TIA-569: Commercial building standard for telecommunications pathways and spaces.
5. EIA/TIA-606: Administration standard for telecommunications infrastructure of commercial buildings.
6. EIA/TIA-607: Commercial building grounding and bonding requirements for telecommunications.
7. IEEE 802.3af or 802.3at: Standard for Internet

B. California Electrical and Fire Codes.

C. Building Industry Consultant Service International (BICSI):

1. Telecommunications Distribution Methods Manual

D. Federal Trade Commission (FTC):

1. Green Guides, 16 CFR Part 260, Guides for the Use of Environmental Marketing Claims.

E. Underwriters Laboratory listings and other labels

1. ANSI, ASTM, UL, NEMA, IEEE and FCC standards as applicable.
2. ANSI/UL 2900-2-1, Standard for Software Cybersecurity for Network-Connectable Products.

1.04 SUBMITTALS

A. Provide the following submittals in accordance with Division 01:

1. Materials list: Submit a complete material list for the materials and products of this section.
2. Product Data: Include Product Data sheets and/or catalog cut sheets for all items to be installed. Data shall be clearly marked and noted to identify specific ranges, model numbers, sizes, and other pertinent data. Items shall be arranged in the same order as the index and if more than one item is indicated, the submitted items shall be highlighted or marked with an arrow. Product Data shall be sufficiently detailed to allow the ARCHITECT to review the product and to allow other trades to provide necessary coordination.
3. CONTRACTOR shall include in the Product Data list submission, copies of manufacturer certificates that the CONTRACTOR is an authorized distributor of the submitted manufacturer’s products; and each member of the installation crew has been trained and certified in the installation of those products. CONTRACTOR shall submit proof that his/her company has a service organization capable of responding within 24 hours of receipt of written notification and resolution within 1 day.

B. Shop Drawings: CONTRACTOR provided Shop Drawings shall indicate the following:

1. Provide detailed and dimensioned Shop Drawings indicating kind, weight and thickness of materials, method of fitting and fastening parts together, location and number of devices and components, and complete details of method of fitting suspension and fastening devices in place. Provide wiring diagrams. Drawings shall contain enough information to assemble and install equipment at the Project site without further instructions.

2. Provide, drawn to scale, details of racks, consoles and cabinets with designations, elevations, dimensions, doors, barriers, mounting details, catalog number of locks, finishes and color.

3. Provide a dimensioned detail of console nameplate including school name, address, and power load. Indicate manufacturer's part numbers for all controls, switches, connectors and indicators.

4. Provide a complete sets of drawings of wiring diagram for each rack, instrument wiring and schematic diagrams of circuits of all equipment.

5. Provide detailed drawings as to interfaces with equipment furnished by others including number of wires, termination requirements, input/output voltages, input/output signals and other required coordination items, items including point to point connection details for all devices and equipment,

6. Shop drawings shall indicate equipment locations, wiring and schematics, details, configurations, sizes and a point-to-point wiring diagram of all components. Shop drawings shall indicate interfaces to equipment furnished by others, identifying termination interface requirements, and other specific details.

7. Provide one set of full-size shop drawings, in the same size as the Record Drawings, and 3 USB flash drive electronic copies.

8. Shop Drawings shall be prepared in the latest version of Windows compatible AutoCAD.

9. Installation and coordination drawings for items in other sections shall be included with submittal of Shop Drawings. Submit blue line copies and one reproducible copy of installation and coordination drawings.

C. Sample Materials: CONTRACTOR shall provide samples of material and equipment as required by the ARCHITECT. If samples are requested, they shall be submitted within 10 days from the date of request.

D. Sound calculations: Submit calculations of sound distribution and dB levels.

E. Certified Statements: CONTRACTOR shall provide the following certification statements:

1. CONTRACTOR shall provide a letter from the Manufacturer assuring the availability of spare parts common to proposed system for a period no less than 5 years on all components.

2. Certification of compliance with the California Health and Safety Code requirements for products containing substances identified in the California Lighting Efficiency and Toxics Reduction Act. These materials shall not exceed the following allowed content in parts per million (ppm):

   a. Lead content > 0.1% or 1000 ppm.

   b. Mercury Content > 0.1% or 1000 ppm.

c. Cadmium Content > 0.01% or 100 ppm.

d. Hexavalent Chromium > 0.1% or 1000 ppm.

e. Polybrominated Biphenyls > 0.1% or 1000 ppm.

f. Polybrominated Biphenyls Ether > 0.1% or 1000 ppm.

1.05 SUBSTITUTIONS

A. Equipment and materials that deviate from these requirements shall not be accepted without written approval from OWNER'S project manager. When deviating or substituting equipment, the following information shall be submitted:

1. Substitution request form substantiating reasons and benefits to OWNER.

2. OWNER'S approval shall be obtained for any equipment or materials substitutions. Proposed substitutions requests shall provide proof of compliance with OWNER'S criteria described in this specification.

3. Submittals must comply with contract general provisions.

1.06 QUALITY ASSURANCE

A. Work shall conform to CCR, Title 24 Part 3, Basic Electrical Regulation and National Electrical Code, latest edition.

B. Only a qualified CONTRACTOR holding licenses required by legally constituted authorities having jurisdiction over the work, shall do the work.

C. Persons skilled in trade represented by work, and in accordance with all applicable building codes, shall install system in accordance with best trade practice.

D. Work shall be performed by CONTRACTOR that has completed at least 5 college level systems of equal scope to system described herein and shall have been engaged in business of supplying and installing specified type of systems for at least 5 years. CONTRACTOR shall maintain a fully equipped service organization capable of furnishing repair service to equipment.

E. The CONTRACTOR shall use adequate numbers of skilled workmen who are currently manufacturer certified, thoroughly trained and experienced on the necessary crafts and completely familiar with the specified requirements and methods needed for the proper performance of the work.

F. The CONTRACTOR shall coordinate cable runs, and rack equipment locations with the OWNER's Authorized Representative during the initial design of the cable installation. CONTRACTOR and OAR must agree as to the final location of all devices and the cable plant design.

G. The CONTRACTOR shall provide technicians and tools required to participate in OWNER's Quality Assurance Testing as detailed in Attachment "A" of this specification.

1. Items on check list of Attachment "A" will be examined as a minimum at the Public Address Head End, terminal cabinets, ground vaults and classrooms. Should the examination show deficiencies related to items in the checklist, OWNER's acceptance testing will be discontinued until corrections have been made. When the CONTRACTOR has completed the corrections, a subsequent Quality Assurance test shall be initiated. This procedure is in addition to the system functionality testing required in section 3.03 below.

1.07 WARRANTY

A. CONTRACTOR shall warranty that all work executed and materials furnished shall be free from defects in materials and workmanship for a minimum period of five (5) years from date of installation acceptance, date of Contract Completion, excluding specific items of work that require a warranty of a greater period as set forth in this Specification. In the event a manufacturer's warranty is longer than five (5) years, the manufacturer's warranty shall be the warranty period. Immediately upon receipt of written notice from the OWNER, the CONTRACTOR shall repair or replace at no expense to the OWNER, any defective material or work that may be discovered before final acceptance of work or within warranty period; any material or work damaged thereby; and adjacent material or work that may be displaced in repair or replacement. Examination of or failure to examine work by the OWNER shall not relieve CONTRACTOR from these obligations.

B. All warranty shall provide the District direct access to manufacturer Technical Assistance Center (TAC), software updates, and defect support.

C. Equipment or materials failure rates of 10% or more during the warranty period:

1. The District shall monitor the performance and reliability of the installed base of Equipment and Materials installed in this Contract. Any deficiencies or malfunctions will be referred to the CONTRACTOR for repairs or equipment replacement.

D. If the District detects a defect within a warranty period as defined here in, it shall notify the CONTRACTOR Representative in writing ("Notice of Defect"). The CONTRACTOR shall make available and provide the District with the telephone number of a fax machine to receive Notices of Defect. This fax machine shall be available to receive faxes 24 hours per day 7 days per week, including all weekends and holidays

E. Upon receipt of written notice from the District of any failure or defect ("Defect") in any such Equipment or Work, the CONTRACTOR shall diligently perform all work necessary to determine the cause thereof, and the time necessary to remedy the Defect, and shall propose in writing to the District how and in what manner it will remedy the Defect. If the District determines that the proposal complies with the terms of the Contract, it shall authorize CONTRACTOR to proceed to redesign, repair, or replace the defective or failed Equipment or Work within the agreed time period.

F. In determining the cause of the Defect, the CONTRACTOR shall perform such investigations and tests as may be required to determine the cause, and to verify that such redesign, repairs, and replacements comply with the requirements of the Contract Document. All cost associated with such investigation, redesign, repair, replacement, and testing, including, but not limited to, the removal, replacement, and reinstallation of equipment and materials necessary to gain access to defective Equipment, shall be borne by the CONTRACTOR. Should the CONTRACTOR fail to promptly make the necessary investigations, redesign, repair, replacement, and test, the District may perform or cause to be performed the same at the CONTRACTOR's expense.

G. The CONTRACTOR will warrant the redesigned, repaired, or replaced Equipment against defective design, materials, and workmanship for the remainder of the warranty period or a period of to five (5) years from and after the date of acceptance of the redesigned, repaired or replaced Equipment thereof, whichever occurs later.

H. The CONTRACTOR shall be liable for the satisfaction and full performance of the warranties as set forth herein.

I. All warranties hereunder are deemed and acknowledged to explicitly extend to the future performance of the Equipment warranted.

J. The rights and remedies provided for herein are cumulative and shall not be exclusive and are in addition to any other rights and remedies provided by law, whether in contract or tort, or under this Contract.

K. CONTRACTOR is deemed and acknowledged to be a merchant with respect to all components and replacement parts furnished pursuant hereto, and the District is acknowledged not to be a merchant with respect thereto.

L. In the event any Supplier or manufacturer offers any extended warranty not specified herein, CONTRACTOR shall state the terms of such warranty or warranties in writing and shall extend the same to the District without additional cost to the District.

M. All warranties and guarantees of Suppliers of any tier and Manufacturers, whether expressed or implied, are deemed to be made for the benefit of the District regardless of whether stated as such, and CONTRACTOR shall enforce such warranties and guarantees for the benefit of the District.

N. CONTRACTOR shall include a letter signed by a corporate officer, partner, or OWNER of the contracting company describing their service organization, its capabilities and commitment to servicing the warranty on all work executed and materials furnished.

1.08 SYSTEM REQUIREMENTS

A. The system shall be a combined public address and intercommunication system. Furnish, install, configure and connect all necessary sub-components to provide for functions and requirements specified, including interfaces and cabling to VoIP Telephone system, autonomous systems' overrides, the Master Clock system and the Fire Alarm system.

1. Provide all labor, engineering, testing, materials, supervision, tools, mounting hardware, cable management, software and components necessary or required to provide a complete operable installation. The system shall be installed in compliance with project documents, applicable codes, and industry standards to deliver a system that meets standards of quality functionality.

2. Provide services on Project site including specified connectivity for all administration areas, classrooms, computer and science laboratories, libraries, auditoriums, multipurpose rooms, P.E. areas, quad area other instructional areas, and work areas as indicated in Project Drawings.

3. The CONTRACTOR shall provide full configuration services for all CONTRACTOR provided equipment.

B. Basic Requirements:

1. System shall be packet audio technology IP network based.

2. System shall leverage existing structured cable plant, which is typically consisting of multi/single mode fiber optic backbone and horizontal Cat6.

3. System shall have sufficient capacity for expansion without the need of adding equipment to the head end equipment.

4. System endpoint devices shall be in compliant to applicable standard TCP/IP e.g. IP Multicast, DHCP, DNS, NTP.

5. System endpoint devices shall support IEEE 802.3af or 802.3at.

6. System shall support IETF SIP.

7. System shall be capable of connecting exchanges, IP network audio adapters, IP amplifiers, IP speakers, IP paging stations and various gateway types interfacing to the IP networking infrastructure e.g. LAN, WAN.

8. System shall provide interfaces for full integration with VoIP Telephone systems for emergency 911. The classroom phones shall be provisioned for direct dialing to a 911 operator.

9. System shall be provisioned for direct outbound dialing.

10. System shall be provisioned for inward dialing using the main school number and an extension number.

11. System shall provide local and/or remote authentication e.g. 802.1X, LDAP for system central management, administration, performance tuning, maintenance, and troubleshooting over the IP network.

12. System shall be capable of providing as a minimum three levels of accessibility rights. The levels correspond to multiple user access rights and individuals or group roles and responsibilities as follows:

    a. Level 1: System Engineer – A person at the enterprise level who possesses an in-depth system knowledge and is responsible for the overall system installation, configuration, performance tuning, and modification.

    b. Level 2: System Technician – A person who possesses relevant skillset, techniques, with a relative practical understanding the system to provide field troubleshooting/resolution in order to support end users.

    c. Level 3: End User – A person who uses the system on the regular basis.

13. System shall provide set up tool that will view all IP endpoints inventory and provide complete individual, group, or all device programming of those endpoints.

14. System shall provide secured access interface for daily functions such as audio files, events, bell schedules, emergency broadcast, emergency bell schedules, graphical interface, and text to speech.

15. System shall provide the ability to replace an IP device without the system having to be disabled during set up of new device.

16. Service shall not be interrupted while replacing an IP endpoint device and setting up the new device.

17. System control shall allow:

    a. Minimum of 100 independent operating groups/zones.

    b. Speaker volume shall be software adjustable to individual zones, multiple zones, individual or group of speakers.

    c. Configuration of individual device or group(s) of devices e.g. zone-specific requirements, endpoint device firmware upgrade.

    d. Alarm notification to administrators/support staff via SMS text or email of non-functioning components that need to be serviced.

18. System shall allow duplex conversation between stations, selective or master call to page all stations, background music or audio playback for common audio digital formats e.g. MP3, WAV, and WMA.

19. System shall provide capability and option to integrate with mass notification systems. System IP endpoints shall be Mass Notification ready and be accessed via the District Office in an emergency.

20. System shall employ echo cancellation that prevents acoustic feedback and echo for duplex hand-free conversations between stations.

21. All call paging access to individual speaker, zone paging, all calls, other rooms, etc. System also provides master clock or interface with the existing master clock system for a class change signaling system, and Fire Alarm system override of PA tone signaling capability and inhibition of all audio outputs including speakers and gateways during a fire alarm event.

    a. The system shall be equipped with a separate circuit to inhibit all loudspeakers audio outputs when a separate relay contact closure occurs from the Fire Alarm system. The closure shall also require activation of the muting relay circuits to all autonomous PA systems.

22. System shall provide the following Functions and Features:

    a. Scheduling – class change, bus loading, calendar based, standard or non-standard year-round.

    b. Emergency and overhead paging – send messages to any endpoint e.g. speakers, overrides all communication systems in event of sending/receiving critical messages.

    c. The system shall automatically reset all clocks at the pre-programmed times and dates of the start and end of daylight-saving time.

    d. The system shall be capable of interfacing with access control systems to initiate immediate lockdown control of all doors.

C. Intercommunication System:

1. Communication hardware shall be furnished with the capacity for internal communication between operator and selected classrooms. Calls from classroom telephones shall be enunciated by an alerting tone and shall appear on liquid crystal display (LCD) on an administrative telephone in Main Office.

2. The main operator shall be able to answer calls in sequence by depressing one button on administrative phone, or out of sequence by dialing the number of the desired classroom.

3. Calls to classrooms shall be announced by either a tone signal over the classroom speaker or by ringing the staff telephone.

4. Predetermination as to whether to ring the telephone or to permit talking over the speaker shall be user selectable when dialing.

5. Direct Dial Telephones: A direct-dial telephone system with electronic switching shall be furnished to accomplish the above description. The central switching private exchange or VoIP communication manager shall utilize standard touch tone signaling in compliance with standard telephone practices and operation.

6. Administrative Telephones: Administrative telephone communication system shall provide the following minimum requirements:

    a. Shall be a standard touch tone dialing telephone equivalent to those employed by public telephone carrier companies.
    b. Capability as provided for direct dialing, private, two-way telephone communication between all locations furnished with administrative telephone and staff telephone shall be provided.
    c. Capability as provided for any administrative telephone to transfer a call from another administrative telephone or any staff or classroom telephones to any other telephone.

d. Capabilities, as provided for the instantaneous distribution of emergency announcements simultaneously to all locations furnished with loudspeakers.
e. Provisions for restricting access to the emergency announcements to certain administrative telephone. This shall be accomplished by the use of an authorized administrative system programming or secured access interface.
f. Capabilities as provided for the origination of normal and priority emergency calls from any staff station. Priority emergency calls shall take precedence over normal calls.
g. Capabilities as provided for directory lookup and dial by name.
h. Provisions for instantaneous distribution of announcements to prescheduled groups of speakers from an administrative telephone.
i. Local diagnostic functions shall be provided to simplify maintenance.
j. Programming: Authorized administrative system interface or telephone shall be able to distribute announcements to each individual speaker, intercom, zone page a group of speakers, or distribute all-call.
k. Volume level shall be software adjustable to individual zone, multiple zones, individual speaker or group of speakers.
l. Audio level of the telephone intercommunication system shall be adjustable at sound levels sufficient to override typical ambient school noise.
m. Upon notification from the CONTRACTOR, the OAR shall contact the Network Operations and Telecommunications Branches of OWNER to arrange for ordering of necessary additions to the voice system to complete the installation of the PA-Intercom system. Any work to the VoIP system will be provided by the OWNER to encompass both hardware/software additions and any necessary programming and is outside of the scope of this specification. The Network Operations Branch or Telecommunications Branch will manage all connections to the VoIP Telephone system. Any vendor working on the telecommunications system must be pre-approved by the Network Operations Branch or Telecommunications Branch prior to any work commencing.

D. Public Address: The system shall provide the following:

1. Reproduction of speech shall be clear, high fidelity and with all frequencies within range of system faithfully reproduced with no detectable noise, humming or distortion.

2. Reproduction of speech shall be attained at sound levels sufficient to override noise levels typical for schools.

E. Mass Notification Capabilities for Integration to:

1. Conduct Wide Area Mass Emergency Notification from a central control station to all schools, group of schools, a single school, multiple campus zones, in-building, group of classrooms, or individual classroom.

   a. Situation may include emergency, non-emergency, other events.

   b. Message types may include pre-written, Text-to-Speech, pre-recorded, and dynamic.

   c. Notification may be triggered from system authorized administrative application interface, manual desk phones, web access, cell phone, or email.

   d. Recipients may include students, school and central administrative staff, first responders, and parents.

2. Notification receiving devices may include but not limited to TV broadcast via District owned and operated KLCS Television station, landline/cellular phones, overhead

speakers, SMS/Text messages, automated voice calls, email alerts, social media networking, or desktop.

3. Any reproduction of speech shall be attained at sound levels enough to override noise levels typical for schools.

1.09 SYSTEM DESCRIPTION

The Public Address/Intercommunications system shall be comprised of 2 integrated systems which shall provide means of performing public address functions and telephone.

A. Public Address and Intercom System.

1. Shall provide standard RCA jack for audio messages or music-on-hold (MoH) source input e.g. MP3, CD/DVD players.

2. Any handset on the PA-Intercom shall be able to initiate paging/intercom functions with a pre-program key or dialing a 5-digit key sequence.

3. The all page output with contact closure shall be connected to the telephone signal and telephone page control inputs on the intercom/program distribution control panel.

4. Automatic class change signaling system shall include manual controls to select program and to do all call. The number of class change signaling systems shall be determined by the number of learning communities or other academic entities at the site. The Public Address and Intercommunication system shall be able to support multiple class change signaling needs, by providing additional zones and tones. The class change tones shall be independently programmed to target each learning community on the campus. The selected tone shall be distributed over the loud speaking intercom and P.A. system. In Middle and High schools, the class change signaling system shall be programmed to include dressing and cleanup tones for gymnasiums and shop zones.

B. The intercommunication system shall provide communication between classroom telephones, speakers, administrative phones and VoIP Telephone system and shall operate in conjunction with Public Address equipment. The system shall provide the following features and capabilities:

1. VoIP Telephone system shall be the main backend for all call processing.

2. Integration between the VoIP and PA shall allow paging to the overhead speakers from the VoIP phones.

3. Integration may include but not limited to:

   a. FXO, FXS, T-1 interfaces

   b. SIP over IP infrastructure

4. System shall be ADA compliant, the equivalent functionality of 2554 type wall mounted or 2500 type desk phones.

5. System shall provide intercom system dial tone for loop start trunk ports from the VoIP Telephone or IP Router.

6. System shall allow calls from the VoIP Telephone to individual intercom stations or to access page functions.

7. System shall be provisioned to allow minimum of eight simultaneous calls from the intercom system to outside lines. Intercoms: System shall provide VoIP phones with equivalent functionality of the 2554 or 2500 series in all rooms.

PART 2 - PRODUCTS

2.01 SYSTEM EQUIPMENT

The Public Address/Intercommunications Systems shall include the following equipment and components as identified on the project contract documents.

A. System Equipment Rack:

1. The PA-Intercom Head End Equipment shall be installed inside the Main server room MDF cabinet.

B. Uninterruptable Power Supply (UPS)

1. All PA-Intercom Head End Equipment and Head End network switches that support PA-Intercom connections shall be energized via a 90 minutes runtime battery backed UPS system.

2. All ESM network switches that support PA-Intercom field devices shall be energized via a 90 minutes runtime battery backed UPS system.

3. UPS systems shall support a native SNMP network management interface.

C. PA-Intercom Head End Processor

1. The PA-Intercom Head End Processor shall support the following services:

a. Contain the system software that controls system features, functions, scheduling of calendar-based events, daily announcements, tones, connections, zones, audio, data and

b. Provide all controls necessary for multi-participants conference calls, where applicable, and two-way intercom communication between any stations.

c. Shall provide automatic controls to adjust the emergency page volume, supervisory tone volume, time tone and to enable or disable the supervisory tone phantom power to microphone inputs.

d. Provisions shall include permitting emergency 911 dialing from classrooms and instructional support/administrative areas.

e. Provisions shall include service availability when WAN/MAN circuits are out of service via direct connection to PSTN e.g. local SIP trunk, PRI or POTS lines.

f. Provisions shall be included to permit emergency paging from a remote telephone, or microphone, which shall capture system priority and override all functions except for the emergency page feature.

g. Provisions shall provide all controls necessary for distribution of general announcements or program material to any or all classrooms, and transmission of emergency announcement to all classrooms.

h. Shall support secured web based configuration support for all PA-Intercom.

i. Shall support secured administrative login access.

j. Shall support Common Alerting Protocol (CAP) allowing interoperability with public alerting systems.

2. PA-Intercom Head End Processor hardware shall be provided with the following specification requirements:

a. Equipped with SSD

b. Minimum of one 10/100/1000 Mbps Ethernet interface; must be capable of supporting a second 10/100/1000 Mbps Ethernet interface.

c. Shall be capable of supporting FXO/FXS interfaces and SIP allowing integration with PBX or VoIP systems.

3. Shall provide server disk image which include Operating System (OS), all applications and final site configuration for quick service restoration.

4. Shall provide management capabilities:

a. Access locally or via programming software or secured web (SSL) interface

b. Support local and centralized management for PA/IC system administration, regular maintenance, configuration, and system performance tuning and troubleshooting.

c. Support 802.1X, Active Directory, and LDAP for secured access from anywhere on the District IP network.

d. Support multiple user/group access privilege levels for their corresponding roles and responsibilities.

e. Support SNMP for server status monitoring.

D. PA-Intercom VOIP Telephone Handsets:

1. VOIP telephone handsets shall be OWNER Furnished CONTRACTOR Installed.

2. The District shall provide The CONTRACTOR a Bill of Materials listing all proposed VOIP telephone handsets to be installed by the CONTRACTOR.

2.02 GROUNDING

Wiring enclosures, terminal cabinets, outlets, frames of cabinet racks and other enclosures shall be grounded in accordance with requirements of California Electrical Code and as specified, and as indicated in the ANSI/EIA/TIA applicable standard.

2.03 SPEAKERS AND ACCESSORIES

A. Loudspeakers shall meet or exceed the following performance specification:

1. At the minimum, equipped with one 10/100 auto negotiate Ethernet interface

2. Support 802.3af or 802.3at

3. Support DHCP and static IP addressing

4. Each loudspeaker mechanism shall be mounted in flush back-box or surface baffle as indicated on Drawings and as specified.

5. Adjust power delivered to each speaker, as necessary, to insure a satisfactory sound level, with reproduction of good quality, in each of locations where speakers are installed.

6. Loudspeaker Volume Controls: Loudspeaker volume controls shall be adjustable from the server via administrative programming or secured web interface (SSL).

7. Loudspeaker audio performance shall meet or exceed the following:

   a. Average Sensitivity: 95 dB SPL, 1W/1M

   b. Loudspeaker Power Rating: 12W RMS EIA 426A Standard

   c. Maximum Power Rating: 15W @ 8 Ohms

   d. Calculated Output: 102 dB SPL 5W/1M

   e. Frequency Response: 65 Hz - 17 kHz EIA 426A Standard

   f. Nominal Coverage Angle: 100° Included Angle -6 dB / 2 kHz, Half space

B. Horn Loudspeakers shall meet or exceed the following criteria:

1. Horn loudspeakers shall be provided in 15-Watt and 30-Watt options.

2. 15-Watt Horn Loudspeakers shall be furnished for outdoor areas such as lunch shelters, arcades, and walkways.

3. 30-Watt Horn Loudspeakers shall be furnished for large outdoor areas such as playgrounds, physical education fields, and athletic fields.

4. Horn Loudspeakers shall meet the following performance specifications:

   a. Network interface shall support at the minimum one 10/100 auto negotiate Ethernet interface

   b. Network interface shall support 802.3af or 802.3at

   c. Network interface shall support DHCP and static IP addressing

   d. Horn Loudspeakers shall be weatherproof vandal-resistant type.

   e. Horn Loudspeakers shall be installed with weatherproof cover plates with plastic bushed holes in plates to admit waterproof cable to speaker in drip loops.

   f. Each horn speaker assembly shall be mounted in a vandal-resistant steel enclosure.

5. Horn Loudspeaker audio performance shall meet or exceed the following:

   a. Average Sensitivity: 120dB at 15 Watts (peak) 114dB at 15 Watts / 1 Meter (avg) 700-5,500Hz

   b. Minimum Loudspeaker Power Rating: 12W RMS EIA 426A Standard

c. Maximum Power Rating: 15W/30W @ 8 Ohms

d. Calculated Output: 102 dB SPL 5W/1M

e. Frequency Response: 600-14,000Hz (nominal) 700-5,500Hz (± 5dB)

f. Nominal Coverage Angle: 95° (-6dB, 2000Hz octave band)

2.04 NETWORK SWITCHING EQUIPMENT

A. Networking switching equipment shall be OWNER Furnished CONTRACTOR Installed.

B. The District shall provide The CONTRACTOR a Bill of Materials listing all proposed Network Switching Equipment to be installed by the CONTRACTOR.

2.05 IP TALKBACK AND ONE-WAY SPEAKER

A. At the minimum, talkback speaker shall support:

1. At the minimum, one 10/100 auto negotiate Ethernet interface
2. IEEE 802.3af or 802.3at
3. Network Time Protocol (NTP)
4. DHCP or statically IP addressable
5. Software volume control capability per speaker
6. Frequency response 80Hz to 15kHz
7. Input: 45Ω / 12Watts

B. One-way speakers

1. At the minimum, one 10/100 auto negotiate Ethernet interface
2. IEEE 802.3af or 802.3at
3. Network Time Protocol (NTP)
4. DHCP or statically IP addressable
5. Software volume control capability per speaker
6. Frequency response: 80Hz to 15kHz

2.06 NON-IP TALKBACK AND ONE-WAY SPEAKER

A. At the minimum, talkback speaker shall support:

1. Software volume control capability per speaker
2. Frequency response 80Hz to 15kHz
3. Input: 45Ω / 12Watts

B. One-way speakers

1. Software volume control capability per speaker
2. Frequency response: 80Hz to 15kHz

2.07 INTEGRATED IP CLOCK/SPEAKER

A. As provided, integrated clock/speaker shall support:

1. At the minimum, one 10/100 auto negotiate Ethernet interface
2. IEEE 802.3af or 802.3at
3. Network Time Protocol (NTP)
4. DHCP or statically IP addressable
5. Does not require a master clock
6. Time zones and automatic update system clock for annual Daylight Savings Time and Standard Time changes
7. Automatic time correction after complete power outage.

B. Power options

1. Primary source is PoE

2.08 CALL BUTTON

A. A call button unit shall be installed in each classroom at the location as indicated on the contract drawings or at a location as directed by the project ARCHITECT of Record.

B. The “Acknowledge Lockdown” action to be activated by engaging this call button to a registrar headend reporting location (e.g. classroom, confined office, etc.) is in the lockdown status.

C. The registrar lockdown status console must be accessible at any District designated location(s).

D. The “Call Office” button shall establish 2-way hand-free communication between classrooms over the talkback speaker and the main office designated device(s).

E. The call button shall meet the following requirements:

1. A single unit Two (2) button assembly (Red for “Acknowledge Lockdown” status report and Black or Navy Blue for classroom to “Call Office” the main office) capable of generating discrete critical and/or non-critical alerting to the Head End Processor.
2. Both “Acknowledge Lockdown” and “Office Call” buttons share the same wire pair.

2.09 GATEWAY/CONTACT CLOSURE

A. IP/Analog gateways

1. Interfacing field analog devices (e.g. speakers, handsets) to IP network.

B. Contact Closures

1. Interfacing the PA-Intercom with other systems (e.g. fire alarm, autonomous PA) for signal overriding.

2.010 CABLING SYSTEM

A. All system and sub-components shall be interconnected using the existing standard installed per EIA/TIA-568, 569, 606, 607 specifications data network cabling plant with no further modification. Solutions require non-standard custom cabling terminations are not acceptable.

B. Addition to the existing cabling plant shall be compliant with 27 0536 Cable Tray and 27 1014 Structured Cabling.

2.011 LABELING

A. Cable labeling shall be consistent with labeling requirements as defined in specification 27 1014 Part 3-Execution and Installation Subsection 3.04C.

2.012 KEYS AND LOCKS

A. Provide keys and locks for all cabinets and equipment; locks shall be keyed to a Corbin #90 key, for access to operate equipment and to service equipment.

2.013 PORTABLE EQUIPMENT

A. Furnish and deliver to the OAR, one auxiliary console microphone with coiled cord and press-to-talk switch.

B. Portable equipment shall remain in individual boxes and be delivered to the OAR.

PART 3 - EXECUTION AND INSTALLATION

3.01 INSTALLATION

A. Install equipment as specified, as indicated on Shop Drawings, and as required. Installation shall be in accordance with manufacturers' instructions and applicable codes. Installation shall be in accordance with manufacturers' instructions and applicable codes.

B. Systems that are re-designed with the intention to increase station or port capacity of systems shall not be accepted.

C. Systems not installed as manufacturer instructions shall not be accepted.

3.02 RELATED SYSTEM OR SUB-COMPONENT INSTALLATION

A. Public Address system installation

1. Rack Equipment Installation: All equipment within each rack shall be logically arranged for accessibility of convenient maintenance. Cables to shall be dressed only from the right side of the rack, as viewed from the rear. Cable bundle must be dressed neatly to allow room for system service.

B. Administrative display telephones

1. Unless otherwise shown on Contract Drawings, provide, program, install and connect a minimum of one administrative telephone in the Main Office, in each Academic Entity on the campus SLC and in each Academy.

C. Intercom instruments

1. Wall-mounted: Install where indicated modular wall plate.

2. Desk mounted: Install and connect where indicated and specified.

D. Special programming requirement

1. Privacy

a. The system shall be configured to prohibit the initiation of a two way conversation from any telephone or speaker to any speaker connected to the system without the presence of a supervisory or permitted privacy. This requirement extends to calls from the office to any classroom, from a classroom to any other classroom and from any classroom to any office.

b. The tone shall have sufficient volume to alert the occupant of a classroom with typical ambient sound that a two-way communications path has been initiated.

3.03 CERTIFICATIONS AND TESTING

A. Provide all instruments for testing and demonstrate, in presence of the OWNER, that all circuits and wiring test free of shorts and grounds.

B. Provide test and reception gear to test for specified performance of active equipment.

C. Furnish all labor, instruments, appliances, equipment, and materials necessary to demonstrate to the OWNER the installation performs as required and specified.

D. Before Substantial Completion, submit test results and related documents to the IOR.

E. The OWNER reserves the right to perform independent tests of equipment furnished, to determine whether or not equipment complies with requirements specified, and to proceed in accordance with the Contract Documents.

3.04 PROJECT RECORD DOCUMENTS

A. As-Built Documentation

1. Provide 3 Blue line copies size E (30” X 42”) of Project site and building plans, indicating location of equipment, conduit, cable routing, ground vaults terminal cabinets, pull boxes and other installation information.

2. Provide 3 copies on USB flash drive of the system CPU programming and configuration.

3. Provide two copies of the record Drawings in AutoCAD or Microsoft Visio format prepared using the most recent version of Windows compatible AutoCAD on a USB flash drive for use on a Windows platform.

a. OWNER utilizes layers as a key tool in controlling visibility of drawing elements and to provide consistent information between drawings yet provide control over what is seen on each sheet. Public Address wiring shall be shown on a separate layer, labeled as “Public Address” that uses both building floor plans and conduit supporting structure layers below. The use of any version control that blocks or company logo(s) shall be on a layer separate from the premise wiring as-built drawings.

b. All software copies supplied shall be multi-layer drawings, consistent with District AutoCAD standards. The following separate layers are expected in all drawings:

(1) Title blocks.

(2) Buildings

(3) Site plan.

(4) Separate layers for equipment, devices, cabling and other system components.

4. Floor plans indicating all devices, terminal cabinets and cross connect locations, conduit runs, ground vaults, wire types, cable routing of all cables, both underground and in each building with conduit fill and count, and as-built coding used on each cable.

a. Drawings shall include block diagrams indicating all items and their point-to-point connections in a manner following floor and site plan layout. Drawings shall also include as-built single line diagram, cable site plot plan and floor plans indicating all cables, both underground and in each building with conduit, and as-built coding used on each cable.

b. Floor plans shall indicate all devices, terminal cabinets and cross connect locations, conduit runs, ground vaults, wire types, cable routing of all cables, both underground and in each building with conduit fill and count, and as-built coding used on each cable

B. Operating and Servicing Manuals, Record Drawings:

1. Deliver three copies of operating and servicing manual. Each complete manual shall be bound in three ring binders and all data shall be typewritten or drafted.

a. Each manual shall include a page with Project site and Project name, date of Substantial Completion, CONTRACTOR name, address, telephone, and fax numbers.

b. Each manual shall contain a letter, signed by an officer of the company indicating the beginning and ending date of any warranties described in subsection 1.07 of this specification and shall describe the companies' commitment to service the warranty during the terms specified.

c. Each manual shall include all instructions necessary for proper operation and servicing of system and shall include:

(1) A single line diagram of the system indicating all items and their point-to-point connections in a manner following floor and site plan layout.

(2) A complete 2 wire diagram of all connections made between components inside the system console.

(3) A wiring destination schedule for each circuit leaving console and each rack.

(4) All custom fabricated circuits, components and connections not detailed in the manufacturer's manuals shall have wiring diagrams detailing to component level, and the way circuits are connected. Provide details of input/output voltages and input/output signal levels.

(5) A schematic diagram of each amplifier and other components, transistor complements and replacement part numbers.

d. Each manual shall also include as-built single line diagram, cable site plot plan and floor plans indicating all cables, both underground and in each building with conduit, and as-built coding used on each cable. Drawings Size A (8-1/2 inches x 11 inches) and size B (11 inches x 17 inches) shall be bound into the manual. Larger drawings shall be folded and inserted into transparent envelopes bound into the manual. Programming forms of each system shall be submitted with complete information.

3.05 CLEANUP

A. Remove rubbish, debris and waste materials and legally dispose of off the Project site.

3.06 TRAINING

A. Before Substantial Completion, provide an eight-hour training instruction period to designated OWNER personnel. Contact OAR first, if assistance is needed in scheduling an appropriate time, location, or list of attendees for this training.

B. Instruction shall be based on manufacturers written operating instructions covering those features of interest to the OWNER and applicable to the Work. Instruction shall include the following:

1. Making normal calls from intercom telephone to other intercom telephones or to the intercom administrative station. Revisit office staff preferred method for clarity and understanding of function and methodology.

2. Answering normal calls from intercom telephones.

3. Transferring loudspeaker intercom calls from the speaker to the intercom phone.

4. Answering normal or emergency calls from the intercom administrative station.

5. Returning calls shown in the administrative station display queue.

6. Answering calls shown on the wall display from VoIP Telephone phones (remote answer feature).

7. Answering calls ringing at a secondary station from admin phone or assigned intercom phone.

8. Placing calls from VoIP Telephone to other phones.

9. Placing calls from intercom stations to VoIP Telephone phones.

10. Placing calls from intercom telephone to the public switched telephone network (PSTN).

11. Making an emergency all call from the rack, program all call, zone all call and individual announcement from the admin telephone and VoIP Telephone, and all-call from the hand held microphone located in the main office. Explain that emergency all-call from rack activates the hearing assistance system. Also explain where these hear assistance systems and the autonomous systems are located.

12. Show distribution of radio and media player programs.

13. Provide copies of manufacturer user's manual to training staff and explain all users' manual functions described. Provide 3 quick user's functions reference guides in a plastic laminated form. The training shall include hands on equipment.

C. After Substantial Completion and before contract completion, provide two additional one hour "refresher" instruction sessions at times agreed upon by the OWNER.

END OF SECTION

SECTION 27 51 26 - ASSISTIVE LISTENING SYSTEM

PART 1 - GENERAL

1.1 SCOPE

A. Assistive listening system shall comply with CBC 11B-219 and CBC 11B-706. The minimum number of receivers provided for each area shall equal to 4% of the total number of seats, but no less than two. Identify assembly areas and indicate the number of headsets provided for each room or area.

B. Work Included: All labor, materials, appliances tools, equipment, facilities transportation and services necessary for and incidental to performing all operations in connection with furnishing, delivery and installation of the work of this Section, complete as shown on the Drawings and/or specified herein. Work includes, but is not necessarily limited to the following:

1. Examine all other Sections for work related to those other Sections and required to be included as work under this Section.
2. General Provisions and Requirements for electrical work.

1.2 SUBMITTALS (ADDITIONAL REQUIREMENTS)

Submit block wiring diagrams and catalog data showing component interconnection and descriptive literature for all component parts and cabinets.

1.3 EQUIPMENT QUALIFICATION

A. All Equipment shall conform to Federal, State and Local applicable Codes, Ordinances and AHJ, and shall be listed and labeled by Underwriters Laboratories.

B. Assistive-Listening Systems

1. Assistive-listening systems shall be provided in accordance with CBC Section 11B-219 and shall comply with CBC Section 11B-706.
2. The minimum number of receivers to be provided shall be equal to 4% of the total number of seats, but in no case less than two. 25% minimum of the receivers provided, but no less than two shall be hearing- aid compatible in accordance with CBC Section 11B-706.3.
3. If the system provided is limited to specific areas or seats, then such areas or seats shall be within a 50- foot viewing distance of, and have a complete view of, the stage or playing area. CBC Section 11B- 219.4.

PART 2 - PRODUCTS

2.1 GENERAL

A. The Assistive Listening System shall include the following items

1. Instructor (program source) wireless transmitter units.
2. Student (audience) portable wireless receiver units.
3. Plug-in microphones and earphones, for each unit.
4. Multiple program source inputs for, Instructor’s microphone, respective room audio/video A/V system input/output and Instructor’s computer audio input/ output.
5. System accessories.
6. Provide each assembly area with a Sign which includes the symbol for Hearing Loss in compliance with CBC 11B-216.10 and CBC 11B-703.7.2.4,

B. Function

1. The Assistive Listening System shall provide amplified available audio programs for hearing impaired students/audience, originating from classroom/stage/room instructors and audio/video instructional program source materials, and equipment in respective building spaces, rooms, classrooms and outdoor areas.
2. The audible program shall be transmitted wireless from the program source to the student/audience, with reception coverage throughout not less than approximately 80% of the respective floor space/area space.
3. Shall provide automatic stereo or mono audio full system operation, depending on program source input.
4. The system in each space shall comply with Federal ADA, State and Local AHJ Requirements for the hearing impaired.

2.2 MATERIALS (RF WIRELESS)

A. General

1. Provide system equipment, devices and accessories per plans and specifications. Where discrepancies may occur, contractor shall be responsible to provide the most stringent per manufacturer and project as required per code.
2. Power for each portable unit operation shall be supplied by internal, changeable rechargeable lithium batteries and alternately by alkaline disposable batteries. Rechargeable batteries shall be recharged without removal from the unit. Each unit shall have a charging indicator light. The batteries shall be recharged from either a portable charger/organizer and with wall transformer/two unit chargers. The units shall operate for up to 40-hours with alkaline batteries, and up to 10-hours with Lithium or NiCad (NiMH) batteries. The batteries shall be rechargeable without removal from unit.
3. Provide power on-off control on each unit, to extend Cad duration.
4. A protection circuit shall prevent battery “back-drain” if the power to the charger is turned off while the unit is being recharged.
5. The receivers and transmitters shall be US Government FCC and Industry Canada-approved, for FM- RF (radio frequency) wireless operation.
6. All components shall be the product of the same Manufacturer.
7. As manufactured by Williams Sound; or PhonicEar; or Listen Technologies; or Centrum Sound.

B. Instructors Portable (Program Source) RF Transmitter Units

1. The transmitter, shall be compact, easily portable units, self-contained ABS, plastic housing/enclosure shall clip to a pocket or belt.
2. Each portable transmitter shall provide RF transmitting on one of the US Government 40 different FCC
3. – and Industry Canada-approved narrow-band channels in the 72-86MHz RF band.
4. Line-of-sight transmit-distance range of not less than 100-feet up to 150-feet from transmitter to receiver.
5. Easy-to-read channel label and volume adjustment on the front unit face. Stereo and mono audio processing.
6. 3.5mm auxiliary input jack that allows transmission of audio from an auxiliary source such as a cassette recorder, computer, CD/DVD player or television audio source. The transmitter shall also provide a second 3.5mm microphone input source jack. The two input sources shall be simultaneously operational to provide a mixed signal output RF transmission of the two sources.
7. Select the separate independent RF transmission frequency for each transmitter to prevent transmission interference between units and to provide for at least two student receiver units to selectively overlap reception of the transmitter.

8. Quantity of Instructor's portable RF transmitters

    a. Provide quantity of nine instructor portable transmitters, 3-on low band; 3-on mid band and 3-on high band RF frequencies.
    b. Provide a quantity of one portable transmitter at the respective room audio/video (A/V) equipment, program output source. Provide 120 volt AC-to-DC power-supply for portable transmitter at the A/V equipment location.

9. Extended range fixed base non-portable RF transmitter.

    a. Provide fixed location non-portable base unit RF transmitter for spaces larger than 9,000 square foot indoor or outdoor spaces.
    b. Shall have the same RF characteristics and performance as the portable transmitter except as follows:

        1) Line-of-sight transmit-distance range of not less than 800-feet from transmitter to receiver.
        2) Fixed install location non-portable, with NEMA-1 metal housing.
        3) Radiated RF energy intensity shall provide manual attenuation adjustments to prevent multiple adjacency RF interferences.

    c. Provide a student/audience portable RF receiver unit at the RF base unit to receive RF signals from an instructors RF transmitter. Connect to the base unit to rebroadcast. Provide a self- contained 120-volt AC-to-DC power-supply for the portable receiver at the base unit transmitter.
    d. Shall operate on 120 volt 60Hz AC branch circuit. Provide remote system master on-off control.
    e. Provide remote RF antenna (outdoor/indoor) rated, for fixed base RF transmitter. Antenna shall extend the transmitter range for large spaces. Provide two RG-6 coaxial cable connects from antenna to base transmitter.

C. Student/Audience Receiver Units

1. The multi-channel narrow-band FM receivers shall be compact easily portable units, self-contained ABS/plastic housing/enclosure and shall clip to a pocket or belt.
2. The receiver shall provide an on/off switch and volume control which adjusts the output level as required by the listener.
3. The receiver shall have a 3.5mm output jack which accepts one of any of the plug-in listening accessories. Headsets shall provide magnetic induction pick-up for hearing impaired, hearing aid interface operation.
4. The receiver shall have an easy-to-read channel label on the front face. The receiver shall incorporate an automatic squelch circuit which eliminates white noise when the receiver is out of transmission range. Stereo and mono audio reception and processing.
5. The multi-channel receiver shall receive any six of the US Government forty different FCC- approved narrow-band FM frequencies within the 72-76MHz band from the respective transmitter units. The user shall be able to change to any one of these six frequencies by using a slide or rotary switch on the receiver. Label on the front face shall indicate the receiver is a multi-channel unit. A label inside the battery compartment shall indicate the six channels that are available to the user.
6. Quantity of portable RF receivers

    a. Provide a quantity of two receivers with matching frequencies for each transmitter, not less than eighteen total quantities of receivers.
    b. Provide a quantity of one receiver with matching RF frequency of the transmitter at the respective room audio/video (A/V) equipment, program input source. Provide 120 volt AC-to-DC power- supply for portable receiver at the A/V equipment location.

c. Provide hearing aid compatible units at a ratio of one per four receivers in accordance with ADA 219.3.

D. RF System Accessories

1. Battery recharger portable charger/organizer pack.

   Locking, portable case with cover, shall accept a group of not less than twelve plug-in portable transmitter and receiver units in each pack for simultaneous multi-unit battery recharging. Provide a quantity of one organizer for each quantity group of twelve (or fraction thereof) transmitters receivers provided as part of the Contract.

2. Stereo audio headset style automatic noise canceling microphone, integral on-off-volume control and with behind the neck support style each with cable and outlet plug-jacks to match transmitter jacks. Provide two cables for each transmitter.
3. Equipment wall mount support brackets.
4. Auxiliary audio program source 15-feet long cables with plug-in at both ends to match transmitter jacks. Provide two for each transmitter.
5. Stereo audio headset style earphones with cable and plug to match receiver jacks. Headsets shall provide magnetic induction pick-up for hearing impaired, hearing aid interface operation. Provide one headset for each receiver.
6. Rechargeable Lithium or Ni-Cad (NiMH) batteries, one complete set for each transmitter and receiver unit, based on unit requirements.
7. Locking auxiliary equipment storage cases for cables, microphones and headsets, with quantity and capacity for all auxiliary accessories furnished as part of the Contract.

2.3 MATERIAL (INFRARED WIRELESS)

A. General

1. All equipment shall be the product of the same Manufacturer.
2. The receivers and transmitters shall be US Government FCC and Industry Canada-approved.
3. Provide power on-off control on each unit, to extend battery duration.
4. As manufactured by Williams Sound; or PhonicEar; or Listen Technologies; or Centrum Sound.

B. Master (Program Source) Transmitter (Infrared Emitter) Units

1. The infrared emitter/transmitter shall be compact, portable units, self-contained ABS/plastic housing/ enclosure. The emitter panel shall be a dual-channel system operating on both 2.3 and 2.8MHz invisible infrared light waves' frequencies. The channels shall be designated "CHANNEL A" for the left and "CHANNEL B" for the right.
2. Each area supplies with Assistive Listening shall be provided with Min. (1) Transmitter as required per system.
3. The emitter shall provide left and right AUDIO IN jacks to accept an input signal from a sound system, left and right "SYNC IN/SYNC OUT" jacks for master/slave daisy-chaining with other emitters if desired, and left and right "MIC-IN" jacks to accept an audio signal from a microphone or Audio/ Video preamplifier.
4. The emitter shall provide separate LED input level detectors for each channel which illuminate when the audio signal peaks. Stereo and mono audio processing.
5. The emitter shall be mounted by the following methods:

   a. Fixed to a wall with an adjustable, wall-mounting support bracket accessory.
   b. Portable mounted to a table-top-or floor-stand, using accessory support-stand adapter.

6. Each emitter shall provide an array of not less than 130-infrared LEDs covered by an infrared transparent acrylic lens. The infrared signal from each emitter shall cover not less than 3,000 square feet (32,000 cubic feet) enclosed space. Note: For room sizes smaller than 3000 square feet, the infrared transmitter/emitter infrared output shall be reduced to accommodate the actual smaller room square feet size and height.
7. 120 volt 60Hz AC input to nominal 24-volt DC output (plug-in “power-brick”) power supply external transformer shall be UL approved, with cable “plug-in” connection to emitter/transmitter. Provide remote system master on-off control.
8. Slave emitter/transmitter for rooms exceeding 30,000 cubic feet. Provide one additional infrared emitter/transmitter repeater slave unit, for each additional 30,000 cubic feet room volume, or fraction thereof. The slave repeater shall receive and retransmit the program signals from the master unit. Provide one 100-foot long “master-to-slave” auxiliary portable extension wire cable for each slave unit.
9. Provide wall mount plug-in outlets for instructors’ microphone outlet connect ports to emitter/ transmitter.
    a. Provide 1.0-inch conduit and wire, homerun connect from microphone outlet to each room respective emitter/transmitter and slaves. Provide conductors as recommended by Manufacturer.
    b. Provide 1.0-inch conduit and wire homerun connect from microphone outlet to respective room Audio/Video (A/V) equipment, microphone program source input. Provide conductors as recommended by Manufacturer.
10. Provide a quantity of nine emitter/transmitter “master” units, plus additional “slave” units for adjusted room sizes or as required per code.

C. Student/Audience Receiver Units

1. Battery Power
    a. Power for each unit operation shall be supplied by internal, changeable rechargeable Lithium, or NiCad batteries and alternately by alkaline disposable batteries. Rechargeable batteries shall be recharged without removal from the unit. Each unit shall have a charging indicator light. The batteries shall be recharged from either a portable charger/organizer and with wall transformer / two unit chargers. The units shall operate for up to 40-hours with alkaline batteries, and up to 15-hours with Lithium or NiCad (NiMH) batteries.
    b. Provide power on-off control on each unit, to extend battery duration.
    c. A protection circuit shall prevent battery “back-drain” if the power to the charger is turned off while the unit is being recharged.
2. The receiver shall be a dual-channel unit for wearing around the neck with an adjustable strap. Stereo and mono audio reception and processing.
3. Compatible with the transmitter (emitter) and operate on 2.3MHz and 2.8MHz frequencies invisible infrared light waves. Self-contained and switchable from “CHANNEL A” to “CHANNEL B” through a switch located on the back of the unit.
4. The receiver shall provide an infrared light-gathering lens on the front of the unit to focus the light signal from the emitter onto the infrared detector element. The receiver shall detect and decode the infrared emitter/transmitter light source within a 160□ acceptance angle.
5. Audio squelch circuit which turns the output circuit off when the infrared signal is reduced or not received, with on/off and volume control.
6. Output jack, which accepts any of the listening accessories. Headsets shall provide magnetic induction pick-up for hearing impaired, hearing aid interface operation.
7. Shall be compact easily portable units, self-contained ABS/plastic housing/ enclosure with red infrared receiver lens. Shall clip to pocket or belt.

8. Provide quantity of two infrared receivers for each master transmitter, not less than eighteen total quantities of receivers.

D. Infrared System Accessories

1. Battery recharger portable charger/organizer pack.

   Locking, portable case with cover, shall accept a group of not less than twelve plug-in portable transmitters and receiver units in each pack for simultaneous multi-unit battery recharging. Provide a quantity of one organizer for each quantity group of twelve (or fraction thereof) receivers provided as part of the Contract.

2. Stereo audio headset style automatic noise canceling microphones, integral on-off-volume control and with behind the neck support style. Each with 25-feet long extension cables and outlet plug-jacks to match transmitter outlet jacks. Provide two cables for each emitter/transmitter.
3. Equipment wall mount support brackets.
4. Auxiliary audio program source 15-feet long cables with plug-in at both ends to match transmitter jacks. Provide two for each transmitter.
5. Headset style earphones with cable and plug to match receiver jacks. Headsets shall provide magnetic induction pick-up for hearing impaired, hearing aid interface operation. Provide one headset for each receiver.
6. Rechargeable Lithium or Ni-Cad (NiMH) batteries, one complete set for each unit based on unit requirements.
7. Locking auxiliary equipment storage cases for cables, microphones and headsets. Quantity and capacity as required to store all accessories.
8. Portable floor stand, for infrared emitter/transmitter units mounting and support, with variable height adjustment and tip-resistant weighted base. Provide one floor stand for each infrared emitter/ transmitter.
9. Locking, portable case for infrared emitter/transmitter. One for each emitter/ transmitter unit.
10. Provide microphone extension cable with plug to match microphone and infrared emitter/transmitter microphone input jack, 25-feet length. One for each microphone.

PART 3 - EXECUTION

3.01 GENERAL

A. Each System General

1. Assemble, set up, and test each transmitter, receiver, and accessories units.
2. Install and fully charge all batteries prior to and after testing/set up is complete.

B. Wireless RF Units

1. Perform an onsite RF frequency survey to determine available unused RF channels, prior to selecting unit operating channels and prior to ordering the equipment.
2. Select operational RF frequency to prevent system RF interference’s with other equipment.
3. Provide - one 0.75-inch conduit with two Category–6, ANSI/EIA/TIA-568C 4-pair, UTP cables connecting from each emitter/transmitter master outlet box location to respective room instructors microphone outlet box location. Provide matching RJ-45 Category-6 female jacks at each outlet box for each cable. Provide an audio circuit matching Balun at each outlet RJ-45 jack location, for RJ-45-to- portable cable plug-in transition and circuit impedance matching audio/transformer, into respective equipment. Additionally provide four Portable Category-6 patch cables with RJ-45 jacks on each end of 7-foot long patch cable. Typical for each outlet location.

C. Wireless Infrared Units

1. Provide aiming and intensity adjustments of emitter/transmitter units to insure complete room coverage.
2. Provide - one 0.75-inch conduit with two Category–6, ANSI/EIA/TIA-568C 4-pair, UTP cables connecting from each emitter/transmitter master outlet box location to respective room instructors microphone outlet box location. Provide matching RJ-45 Category-6 female jacks at each outlet box for each cable. Provide an audio circuit matching Balun at each outlet RJ-45 jack location, for RJ-45-to- portable cable plug-in transition and circuit impedance matching audio/transformer, into respective equipment. Additionally provide four portable Category-6 patch cables with RJ-45 jacks on each end of 7-foot long patch cable. Typical for each outlet location.
3. Provide - one 0.75-inch conduit with two Category–6, ANSI/EIA/TIA – 568C, 4-pair UTP cables connecting from each emitter/transmitter master outlet box location to respective room audio amplifier
4. / preamplifier location. Provide matching RJ-45 Category-6 female jacks at each outlet box location for each UTP cable. Provide an audio circuit matching Balun at each outlet RJ-45 jack location, for RJ-45- to-portable cable plug-in transition and circuit impedance matching audio/transformer, into respective equipment. Additionally provide four portable Category-6 patch cables with RJ-45 jacks on each end of 7-foot long patch cable. Typical for each outlet location.

END OF SECTION

SECTIION 27 51 29 - AUTONOMOUS PUBLIC ADDRESS SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

A. Principal items of Work in this Section include but are not limited to:

1. Autonomous public address (PA) system for middle and high schools.
2. Conductors and terminal strips to provide for functions.
3. Labor, engineering, design, testing, materials, components, and supervision necessary to provide a complete operable installation.

B. Related Requirements:

1. Division 01 – General Requirements.
2. Section 26 05 00: Common Work Results for Electrical.
3. Section 26 05 13: Basic Electrical Materials and Methods.
4. Section 26 05 19: Low Voltage Wires (600 Volt AC).
5. Section 26 05 26: Grounding and Bonding.
6. Section 26 05 33: Raceways and Boxes Fitting and Supports.
7. Section 26 24 16: Panelboards and Signal Terminal Cabinets.
8. Section 26 52 00: Emergency Power Systems.
9. Section 27 51 16: Public Address and Intercommunication Systems.
10. Section 27 53 13: Clock and Program System.

C. Acronyms:

DTMF	Dual Tone Multiple Frequency
IC	Intercom
LCD	Liquid Crystal Display
OAR	Owner Authorized Representative
PA	Public Address
PABX	Private Auxiliary Branch Exchange

1.02 SYSTEM REQUIREMENTS

A. Reproduction of speech shall be clear, high fidelity, and with all frequencies within range of system faithfully reproduced with no detectable echo, noise, hum, or distortion. This shall additionally apply to the audio from the main PA heard in the gymnasium.

B. Audio level of system shall be attained at sound levels sufficient to override noise levels typical for schools' gymnasium, to provide a satisfactory and serviceable system.

C. Entire system shall be supported by engineering documentation including:

1. Floor plans indicating devices, conduit runs, wire types, and terminal cabinets.

2. Block diagrams indicating items and their point-to-point connections in a manner following floor plan layout.

1.03 SUBMITTALS

A. Submit the following:

1. Catalog cuts, technical data, and descriptive literature on components. Data shall be clearly marked and noted to identify specific ranges, model numbers, sizes, and other pertinent data.

2. Submittals shall be bound and shall contain an index organized vertically by assembly and item number and horizontally by columns.

a. The first assembly shall be the major head end equipment.

b. The leftmost column shall be the item number; next shall be the description, followed by the applicable specification section number, and followed by the specified item, which is followed by the submitted item.

c. The rightmost column shall be for notes, which shall be used to reference the reason for submitting items other than as specified.

3. Submittals shall contain product data sheets or catalog cut sheets for each item listed in the Index. These shall be arranged in the same order as the index and if more than one item is shown, the submitted items shall be highlighted or marked with an arrow.

a. The product data shall be sufficiently detailed to allow the Architect to evaluate the suitability of the product and to allow other trades to provide necessary coordination.

4. Provide Shop Drawings, in the same size as the Record Drawings. Shop Drawings shall be prepared in latest version of AutoCAD with three CD-ROM electronic copies submitted along with full sized Shop Drawings.

a. Provide a complete set of scaled drawings of racks, consoles, and cabinets with designations, dimensions, color, operating controls, instrument wiring, and schematic diagrams of circuits, following Drawings as baseline.

b. Shop Drawings shall provide details as to interfaces of equipment of other Work, identifying numbers of wires, termination requirements, voltages, and other pertinent details. Include front elevations, cabinet dimensions, types of mounting, doors, barriers, catalog number of locks, and finishes for terminal cabinets.

c. Include a dimensional Shop Drawing of console nameplate. Nameplate shall contain school name, firm, address, telephone number for warrantee and maintenance, and power load.

d. For Signal Terminal Cabinets: (Refer to Structured Cabling (New Sites) Specification, Section 27 1014) Include a front elevation indicating cabinet dimensions, make, location and capacity of equipment, size of gutters, type of mounting, finish, and catalog number of locks. General layout of internal devices, wiring drawings with wire numbers and device connections, cut sheets of devices in enclosure and bill of materials listing description, manufacturer, part number, and quantity of items shall be included.

e. Shop drawings shall indicate equipment locations, wiring and schematics, details, panel configurations, sizes and a point-to-point wiring diagram of circuits. Shop drawings shall indicate interfaces to equipment furnished by others, identifying numbers of wires, termination requirements, and other pertinent details. Responsibility for each end of interfaces shall be noted on shop drawings.

f. Submit Drawings prepared, signed, and sealed by structural engineer licensed in the State of California. Details shall be provided indicating the proposed means of support and attachment of speakers and wall and floor mounted racks. Calculations shall be based on the maximum seismic loads as determined by the CBC based on specifications provided by the cabinet manufacturer.

5. Contractor shall have completed at least five projects of equal scope to systems described herein and shall have been in the business of supplying and installing specified type of systems for at least five years. Include the telephone number of the customer's client contact for each project.

6. Include in the Material List Submission copies of the manufacturers' certifications that the Contractor is an authorized distributor and service provider of the submitted manufacturers' products and Contractor's staff has been adequately trained and certified in the installation of those products.

7. Provide a letter from the Manufacturer warranting the availability of spare parts common to proposed system for a period no less than five years on components

8. Calculations: Power load of PA system shall be calculated on a separate sheet and shall be included in submittal.

9. Design Analysis: Submit an electro-acoustical design analysis for review. Provide scale drawings indicating plans and sections of the gymnasium along with an elevation of the cluster. One drawing shall indicate contours with the maximum predicted sound pressure level for the 1KHz octave with a band limited pink noise test signal. Another drawing shall indicate the calculated area within which the specified electro-acoustic frequency response may be maintained for the first arrival sound from the cluster. Submit the name and the organizational affiliation of the individuals responsible for performing the electro-acoustical design analysis. Submit evidence, including appropriate certificates, that these individuals are trained in the specified modeling application. The design shall be generated by or based upon the output of a Computer Aided Electro-Acoustical Design Program such as Ease, Acousta CADD, Bose Modeler, EAW SMAART or equal.

1.04 CODES AND STANDARDS

A. Complete installation shall meet or exceed the latest edition of following standards.

1. EIA/TIA-568: Commercial building telecommunications wiring standard.

2. EIA/TIA-569: Commercial building standard for telecommunications pathways and spaces.

3. EIA/TIA-606: Administration standard for telecommunications infrastructure of commercial buildings.

4. EIA/TIA-607: Commercial building grounding and bonding requirements for telecommunications.

5. CCR Part 2 - California Building Code (CBC).

6. CCR Part 3 - California Electrical Code (CEC).

7. ANSI, ASTM, UL, NEMA, IEEE and FCC standards as applicable.

8. BICSI Telecommunications Distribution Methods Manual, current edition.

1.05 QUALITY ASSURANCE

A. Work shall conform to CCR, Title 24 Part 3, Basic Electrical Regulation and National Electrical Code, latest edition.

B. Only a qualified Contractor holding licenses required by legally constituted authorities having jurisdiction over the work, shall do the work.

C. Persons skilled in trade represented by work, and in accordance with applicable building codes, shall install system in accordance with best trade practice.

D. Work shall be performed by a Contractor that has completed at least five school systems of equal scope to system described herein and shall have been engaged in business of supplying and installing specified type of systems for at least five years. Contractor shall maintain a fully equipped service organization capable of furnishing repair service to equipment

E. Use adequate numbers of skilled technicians who are manufacturer certified, thoroughly trained and experienced on the necessary crafts and completely familiar with the specified requirements and methods needed for the proper performance of the work.

F. Coordinate cable runs, loudspeakers, speaker horns and rack equipment locations with the OAR prior to start of any work. Contractor and OAR must agree as to the final location of devices and the cable plant design.

G. Provide sufficient personnel and tools required to participate in Owners Quality Assurance Testing as detailed in Appendix “A” of this specification.

1. Items on check list of Appendix “A” will be examined as a minimum at the Public Address Head End, terminal cabinets, microphone pockets and speaker locations. Should the examination show deficiencies related to items in the checklist, Owners

acceptance testing will be discontinued until corrections have been made. When the Contractor has completed the corrections, a subsequent Quality Assurance test shall be initiated. This procedure is in addition to the system functionality testing required in section 3.02 below.

H. Design analysis shall be performed by certified individuals under the direct observation of the sound engineer responsible for preparation of the Shop Drawings.

I. System startup and electro-acoustical testing with TDS Techron TEF25, or equivalent instrumentation shall be performed under the direct observation of the sound engineer responsible for preparation of the Shop Drawings.

1.06 WARRANTY

A. Warranty that work executed and materials furnished shall be free from defects in materials and workmanship for a minimum period of three years from date of installation acceptance, date of Contract Completion, excluding specific items of work that require a warranty of a greater period as set forth in this Specification. In the event a manufacturer's warranty is longer than three years, the manufacturer's warranty shall be the warranty period. Immediately upon receipt of written notice from the Owner, the Contractor shall repair or replace at no expense to the Owner, any defective material or work that may be discovered before final acceptance of work or within warranty period; any material or work damaged thereby; and adjacent material or work that may be displaced in repair or replacement. Examination of or failure to examine work by the Owner shall not relieve Contractor from these obligations.

PART 2 - PRODUCTS

2.01 GROUNDING

A. Grounding:

1. Wiring enclosures, terminal cabinets, outlets, frames of cabinet racks, and other enclosures shall be grounded in accordance with the requirements of the California Electrical Code, as specified, or required.

2. Chassis of amplifiers, power supplies, and accessories shall be grounded by being bonded to the control cabinet.

3. Housing, grips of microphones, conductive housings, and other equipment shall be grounded by means of grounding wire or shield in cord or cable furnished for equipment connections.

4. Circuits shall be grounded as recommended by manufacturer of equipment to which they are connected unless otherwise specified or required.

2.02 GYMNASIUM AUTONOMOUS PA SYSTEM

A. Gymnasium autonomous PA system: Provide the following features and accessories:

1. Equipment shall be contained in a freestanding rack, providing at least 77 inches of total mounting space. Rack shall be not more than 81 3/8-inch high, 22 3/8-inch wide and 18 ½-inch deep. The rack shall be constructed of at least 15 gage steel, heavily

reinforced for maximum strength and durability. Cabinet shall be constructed with mounting rails tapped for No. 10-32 screws on EIA spacing front and rear, and shall be provided with CBC compliant earthquake bracing kits. Calculations for seismic bracing shall be based on the maximum seismic loads as determined by the CBC based on specifications provided by the cabinet manufacturer. It shall be furnished with a hinged and key-locking rear door and shall be finished in black enamel. Rack shall be listed by UL re-examination service.

2. "Program All" and "Emergency All" audio from the main school PA system shall be reproduced in the gymnasium over loudspeaker(s) through a parallel speaker system. An automatic method of muting gymnasium PA system during Emergency All call shall be implemented. The voice audio from the main PA system shall be intelligible in this noisy and highly reflective environment.

3. Mixer/Preamplifier: TOA M-900MK2, or equal. It shall be modular in design for maximum flexibility and shall be furnished with high performance circuitry. Conventional mixer/preamplifiers without modular input and high-performance circuitry are not permitted. Unit shall be furnished with the following features and accessories:

   a. Provide eight input modules furnished with variable mute, with any combination of TOA input modules. The variable mute circuit shall be screwdriver adjustable over a range of at least 60 dB and capable of being activated by either an external contact closure or the mixture internal priority circuits. Module ports shall be accessible only from the rear and shall be of the plug in type, utilizing ribbon type connectors with gold plated contact.

   b. Each input shall be furnished with two controls to set the level of each mix. Bass and treble controls shall be furnished and shall provide plus or minus 10 dB cut or boost at 100Hz and 10 KHz, respectively. Tone control defeat switches shall be provided and shall be located in the module port cage to prevent accidentals adjustments.

   c. Provide output channel, with direct 600 ohm unbalanced, and transformer-coupled 600 ohm balanced taps. Each output channel shall provide an independent mix of the program input and up to six module input. A separate master volume control shall set the overall output level of each mix. Front panel LED output level indicators shall be furnished.

   d. Frequency response shall be 20Hz to 20 KHz, plus 0, -1dB. Distortion levels shall be less than 0.2 percent at the maximum output and shall be typically less than 0.015 percent. The signal-to-noise ratio shall be 72dB with master control set at maximum. Sensitivity shall be 100mV per 10,000 ohms for the program and module inputs.

   e. Bridging in or out jacks shall be furnished for each channel, for recording or for connecting either mixing bus to other D-series equipment. Sensitivity for the bridging I/O shall be 100mV/3,000 ohms.

   f. Mixer/preamplifier shall be designed for continuous-duty service on line voltages of 120 VAC, 60Hz and shall be furnished with an AC line circuit breaker.

4. AM-FM tuner and cassette tape player shall be a Bogen CR-100A, or equal, and shall be furnished with the following features:

a. Unit shall mount in standard 19-inch rack and shall require only 3-1/2 inches of vertical space. Unit shall be finished in textured gray, resistant to fingerprints.

b. AM radio section shall be furnished with a tuning range of 530 - 1,620 KHz. FM radio section shall be furnished with a tuning range of 87.5 - 108 MHz.

c. Back-lit digital readout shall display frequency of station currently tuned, whether AM or FM, and shall indicate stereo status. It shall alternatively display time. A tone control knob, a balance control lever and fader control lever shall be provided. Other furnished front panel controls shall include band selector button, up and down scan buttons, five preset buttons also furnished to store preferred stations.

d. Cassette player shall play standard cassettes with exceptional fidelity (50Hz to 8KHz), with less than 0.35 percent WRMS WOW, and shall reverse automatically when it reaches its end. Fast forward, fast rewind and eject buttons shall be provided. There shall be separate visual indicators for cassette operation and stereo reception.

e. Unit shall be furnished with a front panel-mounted monitor speaker to permit program monitoring before it is transmitted to schoolrooms or other locations.

5. Equalizer shall be ElectroVoice EQ-231, or equal, graphic equalizer and shall be furnished with the following features:

a. Provide 31 filter sections of 1/3 octave, positioned at standard ISO frequencies from 20Hz to 20 KHz. Each filter shall be furnished with a center detent slide control, which permits up to 15 dB of boost or cut at the center frequency. "RANGE" push-button switch (with LED indicator) shall be provided to switch the boost /cut range 25 dB to 7.5 dB. "HI-PASS" filter push-button switch (with LED indicator) shall be incorporated to provide an 18 dB per octave roll off. There shall be a "BY-PASS" switch (with LED indicator) to permit the equalizer to operate either with the established filter settings or essentially flat. LED level-meter shall provide a visual indication of the level.

b. The equalizer shall accept balanced or unbalanced inputs. Input impedance shall be 600 ohms balanced and 10,000 ohms unbalanced. Outputs may be balanced or unbalanced.

c. The unit shall be capable of operation from 120 VAC power source. Power consumption shall be seven Watts. A front panel "POWER" switch with LED indicator shall be provided.

d. The equalizer shall be designed for installation in standard 19-inch equipment racks with the furnished accessory rack panel kit, Model RPK-56. It shall be provided with a front panel cover to prevent tampering with the established filter settings.

6. Dual-channel power amplifiers for loudspeakers: Amplifier shall be furnished with a minimum FTC output power rating of 500 watts per channel into eight ohms at less than 0.25 percent THD from 20Hz to 20KHz. Hum and noise shall be-100 dB or better referred to rated power output into eight ohms. Amplifier shall be furnished with thermal, short circuit and clipping protection. Provide one amplifier channel for every two horn speakers, at a minimum, and provide a controller module, if specified by the

manufacturer, appropriate to the associated loudspeakers for each amplifier to optimize array performance. Amplifier shall be Electro-Voice P2000, Apogee Sound CA8000, QSC CX902 or equal. Amplifier and array speakers shall be the products of one manufacturer.

7. Hearing Assistance System: FM hearing assistance system shall be as manufactured by Phonic Ear, Williams Sound, or equal, and shall be furnished with the following components:

   a. No. PPA 375 base station mounted in a 19-inch rack. The base station shall operate in 72 MHz - 76 MHz band and shall be furnished with remote-mounted antenna to cover a minimum of 500 feet.

   b. No. PPA-R35 single channel receiver for use by the listener with standard headset connection including headphones. Receiver shall be capable of being clipped to a pocket or belt. Unit shall be furnished with two AA rechargeable nickel Metal Hydride batteries with receivers furnished at 100:4 ratio of seats in the auditorium to receivers provided, but never less that two receivers. Deliver receivers to the OAR before Substantial Completion.

   c. No. CHG-3512 battery charger organizer. Unit shall be capable of storing or recharging up to 12 receivers at one time. The charger shall be capable of recharging the nickel Metal Hydride batteries without removing the batteries from the receiver. Battery chargers shall be furnished in sufficient quantity to charge provided receivers simultaneously, and transmitted to the OAR before Substantial Completion.

8. Relays furnished to switch PA audio circuits shall be a standard sensitivity, plug-in type, Potter Brumfield KP Series, or equal. Coils shall be 24 volts DC. Contacts shall be provided for functions specified herein. Plug-in relays shall be enclosed in dust-tight cases.

9. Provide necessary power supplies, relays, networks, and other components for an operational system as required.

10. Gymnasium loudspeakers: Quantity, selection of coverage patterns and locations shall be as required to provide specified levels and uniformity of coverage for first arrival sound over the required coverage area. Loudspeaker shall be available with a minimum coverage pattern of 60 by 40 degrees and shall provide a frequency range of 50Hz to 15 KHz. Speaker shall have sensitivity of at least 95 dB, 1w, 1m at 1KHz. Provide a custom protective metal enclosure. Speakers shall be Electro-Voice Fri+152 series, Apogee AFI-3, or equal.

11. Floor Microphone Outlets and Power Outlets: Provide floor microphone and power outlets at locations indicated on Drawings. Floor microphone and power outlets shall comply with requirements in other sections of this Specification.

12. Central system override speakers shall be reentrant horns with wide dispersion, Atlas Sound APC-30T, or equal. They shall be mounted with the gym cluster and shall be connected directly to the central system. During emergency all calls, the feed to the local system shall be muted by an override relay controlled from the central system.

2.03 PORTABLE EQUIPMENT

A. Provide four low-impedance, dynamic cardioid microphones with floor stands. Microphone shall be a Shure Type SM-58, or equal with on or off switch and microphone holders. Microphones will be furnished with 15-foot Shure microphone cables. Floor stands shall be Atlas MS-20, or equal.

B. Provide one, 100-foot, one-piece microphone extension cable. Provide two cables, 20 gage, shielded, Belden No. 8412, or equal, terminated with Cannon No. XLR-3-11C and No. XLR-3-12C plugs.

C. Portable equipment shall remain in the manufacturer boxes and shall be transmitted to the OAR before Substantial Completion.

2.04 LOADS ON EQUIPMENT AND COMPONENTS

A. Equipment and component parts shall carry continuously, without undue heating or change in rated value; loads connected thereto and rated output loads where such are specified. Equipment shall be properly fused and rated for continuous operation.

B. Operating voltages on capacitors shall not exceed 60 percent of their rated working voltages.

C. Operating wattages to be dissipated by resistors shall not exceed 25 percent of their ratings.

PART 3 - EXECUTION

3.01 AUTONOMOUS PUBLIC ADDRESS SYSTEM (GYMNASIUMS) INSTALLATION

A. Console and Cabinet Rack Equipment Installation: Equipment within consoles and cabinet racks shall be logically arranged for convenient accessibility and maintenance. Equipment shall be mounted on shelves or panels and shall be securely attached.

B. Amplifiers, power supplies, and other heavy devices shall be mounted in the lowest available rack spaces on steel shelves fabricated by manufacturer of console and cabinet racks. Cabinets, consoles, and panel faces including drawers shall be the same color.

C. Wiring within console and cabinets shall be installed to conform to standard engineering practice and shall be terminated on terminal strips having a terminal for required external connections. Wiring shall be cabled, laced, and securely fastened in place so no weight is imposed on any equipment, control switches, or terminals. Wires carrying audio power shall be shielded. Input and output circuits and terminal strips shall be installed to provide separation necessary for proper operation. Wires shall be identified by number and chart.

D. Conductor shields for each system shall be grounded at one location only. Grounding shall be provided within console and cabinet racks. There shall be no metallic connection between systems. Conduits for system and 120 volt AC system shall be bonded together at console and cabinet racks.

E. Examination and Inspection: Project Inspector shall observe and inspect installation of underground cable runs and main aboveground cable runs. Notify the Project Inspector not less than two working days before commencement of installation.

3.02 OWNERS QUALITY ASSURANCE CERTIFICATION AND TESTING

A. Provide instruments for testing, and demonstrate in the presence of the Owner that the circuits and wiring test free of shorts and grounds.

B. Furnish labor, instruments, appliances, equipment, and materials necessary to demonstrate to the Owner the installation performs as required.

C. Owner has the right to perform independent tests of equipment furnished, to determine whether or not equipment complies with requirements specified, and to proceed based on results obtained.

D. The system shall be fully tested and operational before final inspection. Test results shall be provided to the Owner before final inspection.

E. System startup and electro-acoustical testing with the Techron TEF25 instrumentation or equal shall be performed under the direct observation of the engineer responsible for preparation of the Shop Drawings.

F. Reproduction of speech shall be clear, high fidelity, and with frequencies within range of system faithfully reproduced without detectable noise, hum and distortion.

G. With a 0 dB sine wave test signal applied at a line input of the, and with the gain adjusted so that the output has a 0 dB output, and with the 1/3 octave equalizer bypassed, demonstrate that each channel of the Renkus-Heinz P2800 amps can deliver 250 watts RMS or greater into an eight ohm resistive load from 250 to 12.55Hz. Record measurements at 250Hz, 630Hz, 2.5 KHz and 12.5 KHz for each amplifier.

H. With setup and gain adjusted, as described above, short the balanced line input with a 620 ohm resistor. 20KHz band limited noise at any cluster amp channel output shall be 70 dB below the level required to reproduce 250 watts RMS. Record the measured noise level for each line input to a given amplifier output.

I. With setup and gain adjusted as described above and with 500Hz test signal, measure the total harmonic generation and noise (THG&N) through the audio chain. THG&N shall be 0.25 percent or less. Record the THG&N for each line input to a given amplifier channel. Record the THG&N from a given line input to each amplifier channel.

J. With a 1 KHz, 1mV sine wave signal applied to a microphone input, with the gain adjusted so that the sum of stereo electronically balanced output has a 0 dB output, with the 1/3 octave equalizer bypassed, adjust the level of a given amplifier to deliver 250 watts RMS into an eight ohm resistive load. Record the THG&N for each microphone input to a given amplifier channel output. THG&N shall be 0.25 percent or less.

K. With setup as described above, short the input with a 120 ohm resistor and measure the 20 KHz band limited noise at the output; 20 KHz band limited noise shall be 70 dB below the level required to deliver 250 watts RMS into an eight ohm resistive load. Record the noise level for each microphone input to the given high-frequency cluster amplifier channel output.

L. Perform measurement of first arrival sound pressure levels to verify compliance with the reviewed design analysis. System shall be capable of producing first arrival levels of 90 dB SPL Cwt. with band limited pink noise from the 400Hz 1/3 octave band to the 12.5 KHz 1/3 octave band in the center of the last row of fixed seating and in more than 80 percent of the gymnasium when measured with the Techron TEF25, or equal, electro-acoustical testing equipment. One third octave smoothed first arrival levels as measured with the TEF25, or equal, shall demonstrate that the system frequency response is plus and minus four dB over the 400Hz to 12.5 KHz spectrum and in more than 80 percent of the gymnasium. First arrival

requirements do not apply to areas in the acoustical shadow of columns, etcetera. Provide full TEF contours at six locations to provide the Architect with information on which to base recommendations for acoustical treatment.

3.03 PROJECT RECORD DOCUMENTS

A. As-Built Documentation

1. Provide three copies Size E (30-inch by 42-inch) of Project site and building plans, indicating location of equipment, conduit, cable routing, ground vaults terminal cabinets, pull boxes and other installation information.

2. Provide two copies of the record Drawings in .DWG format prepared using the most recent version of AutoCAD on a labeled CD-ROM for use on a Windows platform.

   a. LAUSD utilizes layers as a key tool in controlling visibility of drawing elements and to provide consistent information between drawings, yet provide control over what is seen on each sheet. Public Address wiring shall be shown on a separate layer, labeled as “Public Address” that uses both building floor plans and conduit supporting structure layers below. The use of any version control blocks or company logos shall be on a layer separate from the premise wiring as-built drawings.

3. Floor plans indicating devices, terminal cabinets and cross connect locations, conduit runs, ground vaults, wire types, cable routing of cables, both underground and in each building with conduit fill and count, and as-built coding used on each cable.

   a. Drawings shall include block diagrams indicating items and their point-to-point connections in a manner following floor and site plan layout. Drawings shall also include as-built single line diagram, cable site plot plan and floor plans indicating cables, both underground and in each building with conduit, and as-built coding used on each cable

   b. Floor plans shall indicate devices, terminal cabinets and cross connect locations, conduit runs, ground vaults, wire types, cable routing of cables, both underground and in each building with conduit fill and count, and as-built coding used on each cable

B. Operating and Servicing Manuals, Record Drawings:

1. Deliver three copies of operating and servicing manual. Each complete manual shall be bound in three ring binders and data shall be typewritten or drafted.

2. Manuals shall include a page with Project site and Project name, date of Substantial Completion, Contractor name, address, telephone, and fax numbers.

3. Manuals shall contain a letter, signed by an officer of the company indicating the beginning and ending date of any warranties described in subsection 1.07 of this specification and shall describe the companies’ commitment to service the warranty during the terms specified.

4. Manuals shall include instructions necessary for proper operation and servicing of system and shall include:

a. A single line diagram of the system indicating items and their point-to-point connections in a manner following floor and site plan layout.

b. A complete two wire diagram of connections made between components inside the system console.

c. A wiring destination schedule for each circuit leaving console and each rack.

d. Custom fabricated circuits, components and connections not detailed in the manufacturer's manuals shall have wiring diagrams detailing to component level, the manner in which the circuits are connected.

e. A schematic diagram of each amplifier and other components, transistor complements and replacement part numbers.

5. Each manual shall include as-built single line diagram, cable site plot plan and floor plans indicating cables, both underground and in each building with conduit, and as-built coding used on each cable. Drawings Size A (8 ½ by 11) and size B (11 by 17) shall be bound into the manual. Larger drawings shall be folded and inserted into transparent envelopes bound into the manual. Programming forms of each system shall be submitted with complete information.

3.04 PROTECTION

A. Protect the Work of this section until Substantial Completion.

3.05 CLEANUP

A. Remove rubbish, debris and waste materials and legally dispose of off the Project site.

3.06 OWNER ORIENTATION (IF REQUIRED)

A. Before Substantial Completion, provide a four hour Owner instruction period to designated Owner personnel. Coordinate time and location with OAR. This training may be combined with instruction provided for the public address system.

B. Instruction shall be based on manufacturers written operating instructions covering those features of interest to the Owner and applicable to the Work.

C. After Substantial Completion, and before contract completion, provide two additional one hour "refresher" instruction sessions at times agreed upon by the Owner.

END OF SECTION

SECTION 27 53 13 - CLOCK SYSTEM

PART 1 - GENERAL

1.01 SCOPE

A. Work Included: All labor, materials, appliances tools, equipment, facilities transportation and services necessary for and incidental to performing all operations in connection with furnishing, delivery and installation of the work of this Section, complete as shown on the Drawings and/or specified herein. Work includes, but is not necessarily limited to the following:

1. Examine all other Sections for work related to those other Sections and required to be included as work under this Section.
2. General Provisions and Requirements for electrical work.

1.02 SUBMITTALS (ADDITIONAL REQUIREMENTS)

A. Submit product data sheets and descriptive literature for all component parts.

B. Submit block wiring diagram of the clock and paging systems, showing headend equipment, terminal cabinets, remote power supplies, and typical clock for each zone.

1.03 EQUIPMENT QUALIFICATION

A. The Specification is based on the equipment of Manufacturers who have been approved by the District and the Manufacturers herein named shall be considered as meeting the Requirements of this Specification. For all items which are identified by part number and Manufacturer the Performance Specifications which are published in the most recent Manufacturer's data sheets available at the time of bidding this Project shall be applicable to the present work as though fully written out herein.

B. All equipment shall conform to all local applicable Codes and Ordinances, and shall be listed by Underwriters Laboratories.

1.04 QUALIFICATIONS

To qualify as an acceptable Bidder, whether the bid is submitted to the District, his Agent, a General Contractor or a Sub-Contractor, the System Bidder or Contractor shall be qualified Sound Contractor and shall hold a valid C61 License issued by the Contractors State License Board of California. The System Bidder or Contractor shall hereinafter be referred to as the Contractor.
The Contractor shall hold all other licenses required by the legally constituted Authorities Having Jurisdiction (AHJ) over the work. The Contractor shall be the Factory Authorized Distributor for the brand of equipment offered and shall have been engaged in the business of supplying and installing the specified type of system for at least 5-years. The Contractor shall maintain a fully equipped service organization capable of furnishing adequate repair service to the equipment.

1.05 GENERAL REQUIREMENTS AND SCOPE

A. Furnish and Install a complete new GPS wireless clock system using Primex Wireless Inc. GPS wireless system or equal by American Time and Signal, Sapling. All bids shall be based on the equipment as specified herein.

B. Section includes Transmission Systems GPS Receiver, Primary Transmitter, and Satellite Transmitter.

1. Clocks:
   a. Analog

b. Digital

1.06 RELATED SECTIONS

Division 26 – Electrical (120 volt grounded outlet required for transmitter).

1.07 REFERENCES

This Technical Specification and Associated Drawings, Primex Wireless GPS Satellite Time System User Manual.

1.08 DEFINITIONS

GPS: Global Positioning System, a worldwide system that employs 24-satellites in an integrated network to determine geographic location anywhere in the world, and which employs and transmits Universal Coordinated Time, the world's most accurate and reliable time.

1.09 SYSTEM DESCRIPTION

A. GPS wireless clock system shall continually synchronize clocks throughout the facility, and shall be capable of clock readouts in multiple time zones where desired.

B. The system shall provide wireless time using GPS and be synchronized to UTC. The system shall not require hard wiring. Clocks shall automatically adjust for Daylight Saving Time

C. Analog Clocks shall be synchronized to within 10-milliseconds 6-times per day, and the system shall have an internal oscillator that maintains plus or minus 1-second per day between synchronizations, so that clock accuracy shall not exceed plus or minus 0.2 seconds.

D. The system shall include an internal clock reference so that failure of the GPS signal shall not cause the clocks to fail in indicating time.

E. The system shall incorporate a "fail-safe" design so that failure of any component shall not cause failure of the system. Upon restoration of power or repair of failed component, the system shall resume normal operation without the need to reset the system or any component thereof.

F. Clock locations shall be as indicated, and clocks shall be fully portable, capable of being relocated at any time.

G. The system must operate in accordance with a "Radio Station Authorization", Form FCC 601 – LM, granted by the Federal Communications Commission (FCC). This license will be issued to and held by the end user.

1.10 REGULATORY REQUIREMENTS

A. Equipment and components furnished shall be of Manufacturer's latest model.

B. The end user will hold a License, known as a "Radio Station Authorization" granted by the FCC.

1. This License grants the end user protected use for wireless transmission at the designated frequency.

2. This License will designate a unique "call sign" for each end user.

C. Transmitter and Receiver shall comply with Part 90 of FCC rules as follows:

1. This device may not cause harmful interference, and

2. This device must accept interference received, including interference that may cause undesired operation.

3. Transmitter frequency shall be Governed by FCC Part 90.35.

4. Transmitter output power shall be Governed by FCC Part 90 257 (b)

D. System shall be installed in compliance with Local and State Authorities Having Jurisdiction.

E. Operating License: Submit evidence of application for FCC Radio Station Authorization prior to installing equipment. Furnish the license or a copy of the application for the license, to the District/End User prior to operating the equipment. The original license must be delivered to the District/End User.

F. Samples: Submit one clock for approval. Approved sample shall be tagged and shall be installed in the work at location directed.

G. Manufacturer's Instructions: Submit complete installation, set-up and maintenance instructions.

H. Floor Plans indicating the location of system transmitter(s), approved by Manufacturer, will be submitted to District prior to installation.

1.11 QUALITY ASSURANCE

A. Permits: Obtain Operating License for the transmitter from the FCC.

1. Qualifications:

a. Manufacturer: Company specializing in manufacturing commercial time system products with a minimum of 30 continuous years of documented experience including 4 years' experience producing GPS wireless time systems.

b. Installer: Company with documented experience in the installation of commercial time systems.

2. Prior to installation, a site survey must be performed to determine proper transmitter placement.

1.12 DELIVERY STORAGE AND HANDLING

A. Deliver all components to the site in the Manufacturer's original packaging. Packaging shall contain Manufacturer's name and address, product identification number, and other related information.

B. Store equipment in finished building, unopened containers until ready for installation.

1.13 PROJECT SITE CONDITIONS

A. Clocks shall not be installed until painting and other finish work in each room is complete.

B. Coordinate installation of GPS receiver for access to the roof or exterior side wall so that the bracket and related fasteners are watertight.

1.14 SYSTEM STARTUP

At completion of installation and prior to final acceptance, turn on the equipment; ensure that all equipment is operating properly, and that all clocks are functioning.

1.15 WARRANTY

Manufacturer will provide a 1-year warranty on GPS receiver, transmitter, and satellite transmitter. All other components will have a 1-year warranty.

PART 2 - PRODUCTS

2.01 MANUFACTURER

GPS wireless clock system shall be manufactured by Primex Wireless, Inc., N3211 County Road H, Lake Geneva WI 53147, telephone (800) 537-0464, Fax (262) 248-0061, www.primexwireless.com or equal by American Time and Signal, Sapling.

2.02 SEQUENCE OF OPERATION

A. Transmitter Operation: When power is first applied to the transmitter, it checks for and displays the software version. It then checks the position of the switches and stores their position in memory. The transmitter looks for the GPS time signal. Once the transmitter has received the GPS time, it sets its internal clock to that time. The transmitter then starts to transmit its internal time once every second. The transmitter updates its internal clock every time it receives valid time data from the GPS.

B. Analog Clock Operation:

1. Apply power or insert batteries. Follow set up procedures detailed in Manufacturer's instructions.
2. After initial setup, the clock will shut off the receiver. Six times each day, the micro-processor will activate the receiver and starting with the stored channel, it will again look for a valid time signal. If necessary, the clocks will resynchronize to the correct time.
3. If the clock has not decoded a valid time signal for a pre-determined number of days, it will go to a step mode. Non signal reception can be caused by low battery voltage. If this occurs, replace the batteries.

2.03 EQUIPMENT

A. General: The clock system shall include a transmitter, a roof or window mounted GPS receiver, indicating clocks, and all accessories for complete operation.

B. The GPS Receiver shall be a complete GPS receiver including antenna in a waterproof case, designed for roof or outdoor mounting. Provide mounting bracket for attachment to roof structure.

C. The GPS Receiver cable must be plenum rated where required by local Code.

D. Transmitter: Primex Wireless Model 14400, consisting of wireless transmitter with GPS receiver, a surge suppressor/battery backup, and a mounting shelf. Unit shall obtain current atomic time from satellite. The clock system shall transmit time continuously to all clocks in the system.

1. Transmission:
   a. Frequency Range: 72.100 to 72.400 MHz.
   b. Transmission Power: 1 watt (30dBm) maximum
   c. Radio technology: narrow band FM
   d. Number of channels: 16
   e. Channel bandwidth: 20kHz maximum
   f. Transition mode: one-way communication
   g. Data rate: 2 KBps
   h. Operating range: 32 degree F to 158 degrees F (0 degrees C. to 70 degrees C).
2. Transmitter:
   a. Transmitter output power: +26 to +30 dBm
   b. Frequency deviation: +/- 4 kHz
   c. Transmitter Power Requirements: 120 VAC 60 Hz
   d. Internal Power Requirements: 5 VDC
   e. Carrier frequency stability: +/- 20 ppm
3. Transmitter shall have 16 selectable channels to assure interference-free reception.

4. Transmitter shall have the following switches:
   a. Time zone adjustment switches for all time zones in the World. Includes Eastern, Central, Mountain, Pacific, Alaska, and Hawaii.
   b. Daylight Saving Time bypass switch.
   c. 12-hours or 24-hours display.
5. Transmitter housing shall be black metal case, 16¾-inches (424.4mm) by 12 inches (304.8mm) by 1-7/8 inches (46.4mm) in size.
6. Antenna shall be 46-inches (1168mm) high, commercial type, mounted on top center of transmitter housing. Antenna gain shall be < 2.2 dB. Antenna polarization shall be vertical.
7. Transmitter housing shall incorporate a display which shall include the following:
   a. Time readout
   b. AM and PM indicator if 12-hour time display is set
   c. Day and date readout
   d. Indicator for daylight savings or standard time
   e. LED which shall flash red in event of reception problem
   f. GPS reception indicator
8. Transmitter shall contain an internal clock such that failure of reception from the GPS will not disable the operation of the clocks.
9. Power supply (included):
   a. Input: 120 volt AC 50/60 Hz, 0.4 amps.
   b. Output: 9 volt DC, 1.5 amps.

E. Surge Protector/Battery Backup (included).
   1. Input: 120 volt AC 60 Hz +/- 1 Hz.
   2. Output: 120 volt AC, 500VA, 300 watts
   3. Surge Energy Rating: 365 joules

F. Additional Equipment
   1. Wireless Receiver Switches: Switches shall receive time packets from the Primary Transmitter and relay the synchronized time to the Satellite Transmitter connected to it. The unit shall include the following:
      a. Antenna mounted on top of the switch housing, 11½-inches (292mm) long. Power Supply:
         1) Input 120 VAC 50/60Hz, 0.4 amps
         2) Output: 9 volt DC, 1.5 amps RS 232 data cable, 5 feet (1.5mm) long
      b. Daylight Savings Time bypass switch
      c. Dimensions: 4¼-inches (108mm) long, 5¾-inches (146mm) wide, 1¼-inches (31.75mm) deep.
      d. Weight: 12 ounces (.34kg)
      e. Operating Range: 32 degrees F to 158 degrees F (0 to 70 degrees C)
   2. Satellite Transmitters Primex Wireless Model 14401: Satellite Transmitters shall receive the signal from the Wireless Receiver Switches and transmit the signal to the devices in its vicinity, which are out of the range from the Master Transmitter. The unit shall include the following:
      a. Antenna mounted on top of the housing, 46 inches (1168mm) long.
      b. Wireless Receiver Switch.
      c. Power Supply Input: 120
      d. VAC, 50/60Hz, 0.4-amps

e. Output: 9 volt DC, 1.5-amps.
f. 6 foot (1.83m) cord
g. Surge Suppressor/Battery Backup
h. Mounting Shelf.
i. Transmission Power: 1 watt maximum
j. 72 MHz frequency.

3. Traditional analog clocks (battery): Analog clocks shall be wall mounted. Clocks shall have polycarbonate frame and polycarbonate lens. Face shall be white. Hour and minute hands shall be black.
   a. 9 inches (228.6mm) diameter analog clock: Primex Wireless Model 14280
   b. 12½-inch (317.5mm) diameter analog clock: Primex Wireless Model 14155
   c. 16 inches (406.4mm) diameter analog clock: Primex Wireless Model 14163
   d. 24 inches (610mm) diameter analog clock: Primex Wireless Model 14346
4. Additional colors, finishes, and dial faces are available from Manufacturer.
   a. Analog clocks shall be battery-operated,
   b. Analog clocks shall be capable of automatically adjusting for Daylight Saving Time. An on-off switch located on the transmitter shall disable this function if desired.
   c. Time shall be automatically updated from the transmitter 6 times per day.
   d. Analog clocks shall remember the time during changing of batteries.
   e. 9 inches (228.6mm) and 12.5 inches (317.5mm) analog clocks shall have a tamper proof/ theft resistant clock lock mounting slots.
5. Analog clock receivers shall be as follows:
   a. Receiver sensitivity: >-110 dBm
   b. Receiver power: 24 VAC or 120 VAC (see model #)
   c. Antenna type: internal
   d. Antenna gain: -7 dBd

   If transmitter stops transmitting valid time signals due to power failure, the clocks will continue to function as accurate quartz clocks until a valid time signal is decoded. If signal transmission is not restored after 96 hours, the second-hand will “five-step” as a visual indicator that the signal has been lost. Should the clocks lose power and signal, the clocks will not function.
6. Wire guards: Provide one for each analog clock as follows:
   a. Analog clock wire guard Primex Wireless Model 14131, 14-inches by 14-inches (355.6 by 355.6 mm) size, for nominal 12½-inch (317.5 mm) diameter analog clocks.
   b. Analog clock wire guard Primex Wireless Model 14123, 18-inches by 18-inches (457.2 by 457.2mm) size, for 16 inches (406.4mm) diameter analog clocks.
7. Cable Connection Sealant: Radio Shack Coaxial Cable Connector Sealant 278-1645, or approved electrical grade silicone sealant.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that construction is complete in spaces to receive equipment and that rooms are clean and dry.

B. Verify that 120-volt electrical outlet is located within 6 feet (1.83m) of location of transmitter

and the outlet is operational and properly grounded.

3.02 INSTALLATION

A. Provide all equipment necessary for a complete and operable system.

B. Transmitter: Locate transmitter where indicated, a minimum of 2 to 3 feet (.6 to 1 meter) above the floor, away from large metal objects such as filing cabinets, lockers or metal framed walls. Transmitter(s) will be placed at locations indicated below:

1. Attach receiver to transmitter using cable.
2. Connect antenna to transmitter, using care not to strip threads.
3. Connect power supply to the transmitter. Set the channel number on the display to correspond to the FCC license.
4. Plug power supply into electrical outlet.

C. Analog clocks shall perform the following operations with each clock:

1. Set clock to correct time in accordance with Manufacturer's instructions.
2. Observe analog clock until valid signals are received and analog clock adjusts itself to correct time.
3. Install the analog clock on the wall in the indicated location, plumb, level and tight against the wall. If using 12½-inch (317.5mm) clock, attach using clock-lock hanging method and suitable fasteners as approved by Clock Manufacturer.
4. Wire guards: Secure to wall, using approved theft-resistant fasteners.

3.03 ADJUSTING

Prior to final acceptance, inspect each clock, adjust as required, and replace parts which are found defective.

3.04 CLEANING

Prior to final acceptance, clean exposed surfaces of clocks, using cleaning methods recommended by Clock Manufacturer. Remove temporary labels from clock faces. Do not remove labels from backs of clocks.

3.05 DEMONSTRATION

Provide training to District's Representative on setting and adjusting clocks, replacing batteries and routine maintenance.

3.06 PROTECTION

Protect finished installation until final acceptance of the Project.

3.07 TESTING

All devices must be tested at their operational location under normal operational conditions to assure reception of signal.

END OF SECTION

DIVISION 28

ELECTRONIC SAFETY & SECURITY

SECTION 28 13 00 - ACCESS CONTROL

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes access control door hardware for the following:

1. Swinging doors.
2. Sliding doors.
3. Other doors to the extent indicated.

B. Section includes, but is not necessarily limited to, the following for the integrated access control security and site management system:

1. IP-enabled integrated access control door hardware.
2. Monitoring and signaling equipment.
3. System network control processors.
4. Reader controller interfaces and modules.
5. Input monitor and output control interfaces and modules.
6. Remote card readers and display terminals.
7. Power sourcing equipment, network switches and wireless access points.
8. Access control cards and credentials.
9. Access control system application software.
10. Access control system power supplies, back-ups and surge protection.

C. Related Sections:

1. Section 017900 - Demonstration and Training: Operations and Maintenance.
2. Section 080671 - Door Hardware Schedule.
3. Section 081113 - Hollow Metal Doors and Frames.
4. Section 087100 - Door Hardware.
5. Division 26 - Electrical: Connections to electrical power system and for low-voltage wiring work.
6. Division 27 - Communications: Connections to the LAN.
7. Section 284620 - Fire Alarm System: Connections to building fire alarm system.

1.2 REFERENCE STANDARDS

A. BHMA A156.13 - American National Standard for Mortise Locks and Latches Series 1000; 2012.

B. BHMA A156.18 - American National Standard for Materials and Finishes; 2012.

C. DHI (LOCS) - Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames; 2004.

D. DHI WDHS.3 - Recommended Locations for Architectural Hardware for Flush Wood Doors; 1993; also in WDHS-1/WDHS-5 Series, 1996.

E. IEEE 802.3 - IEEE Standard for Ethernet; 2015, with Amendments, 2016.

F. NFPA 101 - Life Safety Code; 2015.

G. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2016.

H. TIA/EIA-568 - Commercial Building Telecommunications Cabling Standard; Rev C, 2012 and latest addenda.

I. Codes and References: Comply with the current version adopted by the Authority Having Jurisdiction.

1. See Section 014100 - Regulatory Requirements.

1.3 SUBMITTALS

A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.

B. System Operational Descriptions: Complete system operational narratives for the integrated access controlled openings defining the Owner's Prescribed Requirements for the opening functionality. Narratives include, but are not limited to, the following situations: normal secured/unsecured state of door; authorized access; authorized egress; unauthorized access; unauthorized egress; fire alarm and loss of power conditions, and interfaces with other building control systems.

C. Shop Drawings: Details of electrified integrated locking hardware and access control firmware, indicating the following:

1. Wiring Diagrams: Upon receipt of approved schedules, submit detailed system wiring diagrams for power, signaling, monitoring, communication and control of the access control system electrified hard- ware and firmware. Differentiate between Manufacturer-installed and field-installed wiring. Include the following:
   a. Elevation diagram of each unique access controlled opening showing location and inter- connection of major system components with respect to their placement in the respective door openings.
   b. Complete (risers, point-to-point) access control system block wiring diagrams.
2. Electrical Coordination: Coordinate with related Division 26 Electrical Sections the voltages and wiring details required at electrically controlled and operated hardware openings.

D. Proof of Certification: Provide copy of Manufacturer(s) official certification or accreditation document indicating proof of status as a qualified and authorized Provider of the primary access control components.

E. Keying Schedule: Reference Division 08 Section "Door Hardware".

F. Product Test Reports: Indicating compliance with Cycle Testing Requirements, based on evaluation of comprehensive tests performed by Manufacturer and witnessed by a qualified Independent Testing Agency.

G. Operating and Maintenance Manuals: Provide Manufacturers operating and maintenance manuals for each item comprising the complete access control and site management installation in quantity as required in Division 01, Closeout Submittals. The manual to include the name, address, and telephone number of the Supplier/Integrator providing the installation and the nearest Service Representatives for each item of equipment included in the system. The final copies delivered after completion of the installation test to include "As Built" modifications made during installation, checkout, and acceptance.

1. Record Drawings: During system installation, the Contractor to maintain a separate hard copy set of Drawings, Elevation Diagrams and Wiring Diagrams of the access control system to be used for Record Drawings. This set to be kept up to date by the Contractor with all changes and additions to the access control system accurately recorded.

H. Warranties and Maintenance: Special Warranties and Maintenance Agreements specified in this Section.

1.4 QUALITY ASSURANCE

A. Manufacturers Qualifications: Engage Qualified Manufacturers with a minimum of 5-years of documented experience in providing access control and security systems equipment and software similar to that indicated for this Project and that have a proven record of successful in-service performance.

1. Software and access control systems components to have been previously and thoroughly tested together with proven installations similar in size and functionality to the Design Requirements indicated for this Project.

B. Integrator Qualifications: Systems Integrators, verifiably factory trained and certified by the Primary Product Manufacturers, with a minimum 3 years documented experience installing complete integrated access control systems similar in material, design, and scope to that indicated for this Project and whose work has resulted in construction with a proven record of successful in-service performance. Qualifications include, but are not necessarily limited, to the following:

1. References: Provide a list of references for similar projects including contact name, phone number, name and type of Project.
2. Professional Staffing: Firms to have a dedicated access control systems integration department with full time, experienced professionals on staff experienced in providing on site consulting services for both electrified door hardware and integrated access control systems installations.
3. Factory Training: Installation and service technicians are to be competent factory trained and certified Personnel capable of maintaining the system.
4. Service Center: Firms to have a service center capable of providing training, in-stock parts, and emergency maintenance and repairs at the Project site with 24-hour/7-days a week maximum response time.

C. Supplier/Dealer Qualifications: Supplier/Dealers verifiably authorized and in good standing with the Primary Product Manufacturers, with a minimum 3 years' experience supplying integrated access control systems similar in material, design, and scope to that indicated for this Project and whose work has resulted in construction with a proven record of successful in-service performance.

D. Integrated Wiegand Output, Wireless, and IP-Enabled access control products are required to be supplied and installed only through designated ASSA ABLOY "Authorized Channel Partner" (ACP) and “Certified Integrator” (CI) accounts.

E. Source Limitations: Obtain the access control door hardware, system firmware and application software specified in this Section from a single source, qualified Supplier/Integrator unless otherwise indicated.

1. Electrified modifications or enhancements made to a Source Manufacturer's product line by a secondary or third party source will not be accepted.
2. Provide integrated access control door hardware from the same Manufacturer as mechanical door hard- ware, unless otherwise indicated.

F. Regulatory Requirements: Comply with Section 014100 - Regulatory Requirements and Guidelines as directed in the Building Code including, but not limited to, the following:

1. Comply with California Electrical Code, including electrical components, devices and accessories listed and labeled as defined in Article 100 by a Testing Agency acceptable to authorities having jurisdiction, and marked for intended use.
2. Where indicated to comply with Accessibility Requirements, comply with Americans with Disabilities Act (ADA), "Accessibility Guidelines for Buildings and Facilities (ADAAG)," CBC Chapter 11B as follows:

a. Handles, Pulls, Latches, Locks, and other Operating Devices: Shape that is easy to grasp with one hand and does not require tight grasping, tight pinching, or twisting of the wrist.
b. Door Closers: Comply with the following maximum Opening-Force Requirements indicated:

1) Interior Hinged Doors: 5 lbf applied perpendicular to door.
2) Fire Doors: Minimum opening force allowable by authorities having jurisdiction.

3. Comply with NFPA 101 for doors in a means of egress.
4. Comply with NFPA 80 for fire labeled opening assemblies.
5. The installed access control system shall conform to all Local Jurisdiction Requirements.

G. Keying Conference: Reference Section 087100 - Door Hardware.

H. Pre-Submittal Conference: Conduct coordination conference in compliance with Requirements in Section 013000 - Administrative Requirements with attendance by Representatives of Supplier(s), Installer(s), Systems Integrator(s), and Contractor(s) to review proper methods and procedures for receiving, handling, and installing door and access control hardware to Manufacturer's recommendations and according to Specifications.

1. Prior to installation of door hardware, arrange for Manufacturers' Representatives to hold a Project specific training meeting on the proper installation and adjustment of their respective products. Product training to be attended by the Installers of access control hardware for the aluminum, hollow metal and wood door sections. Training will include the use of installation manuals, hardware schedules, templates and physical product samples as required.
2. Inspect and discuss electrical roughing-in, power supply connections, and other preparatory work performed by other trades.
3. Review sequence of operation narratives for each unique access controlled opening.
4. Review and finalize construction schedule and verify availability of materials.
5. Review the required Inspecting, Testing, Commissioning, and Demonstration Procedures.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.

1. Access control firmware and software: Where approved and directed, inventory upon receipt and store electronic access control equipment in a secure, temperature and humidity controlled environment in original Manufacturer's sealed containers.

B. Tag each item or package separately with identification related to the final Access Control Door Schedule, and include basic installation instructions with each item or package.

C. Deliver permanent keys, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner established at the “Pre- Submittal Conference".

1.6 COORDINATION

A. Coordinate quantity and arrangement of assemblies with ceiling space configuration and with components occupying ceiling space, including structural members, pipes, air-distribution components, raceways, cable trays, recessed lighting fixtures, and other items.

B. Integrated Access Control Door Hardware and Electrical Coordination: Coordinate the layout and installation of scheduled integrated access control door hardware, and related access control equipment, with required connections to source power junction boxes, power supplies, detection and monitoring hardware and fire alarm system.

1. Door Hardware Interface: The access control system to interface and be connected to electrified and integrated access control door hardware as described under Division 08 Sections "Door Hardware" or "Access Control Door Hardware". Coordinate the installation and configuration of electrified door hardware being monitored or controlled with the controls, software and access control hardware specified in this Section.

C. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing electrified door hardware and access control system components. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing access control system hardware to comply with Indicated Requirements.

D. Door and Frame Preparation: Related Division 08 Sections (Steel, Aluminum and Wood) doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

1.7 WARRANTY

A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article will not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and are in addition to, and run concurrent with, other warranties made by Contractor under Requirements of the Contract Documents.

B. Warranty Period: Written warranty, executed by Manufacturer(s), agreeing to repair or replace components of the installed access control system hardware and software that fails in materials or workmanship, including all related parts and labor, within specified warranty period after final testing and acceptance by the Owner. Failures include, but are not limited to, the following:

1. Structural failures including excessive deflection, cracking, or breakage.
2. Faulty operation of the hardware.
3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
4. Electrical component defects and failures within the systems operation.

C. Standard Warranty Period: One year from date of Substantial Completion, unless otherwise indicated.

D. Special Warranty Periods:

Two years for Integrated Access Control Door Hardware.

1.8 MAINTENANCE SERVICE

A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of standard and access control door hardware.

B. Maintenance Service: Beginning at Substantial Completion, and running concurrent with the specified warranty period, provides continuous 6-months full maintenance including repair and replacement of worn or defective components, lubrication, cleaning, and adjusting as required

for proper door opening operation. Provide parts and supplies as used in the manufacture and installation of original products.

C. Maintenance Support and Extended Service Agreement: Submit for Owner’s consideration an optional extended Service Agreement for the installed access control system, including support for software related issues. The extended Service Agreement is considered elective and is without Manufacturer's Requirement stipulating mandatory coverage for owner and/or vendor system support.

1. A published copy of this Agreement to be included with the submittal package
2. Support for the installed access control system components is provided through the Vendor under a 24 hour Technical Assistance Program.
3. Access control and management system components are to be available on a 1-day turn-around time frame from the Manufacturer.
4. Primary Systems Manufacturer to offer and provide remote modem or internet access for direct factory support to the Vendor. The factory level support to include diagnostics and troubleshooting support on systems related issues at no additional cost to the Owner.

D. Access Control Software Upgrades: Version upgrades and "fix" releases to the access control system software are available at no extra charge as long as the version of software provided in this Specification remains the current Manufacturer’s version or for up to 2-years after a new version release.

1. Major access control software revisions that provide new functionality to the product provided free of charge for up to 1-year from the date of substantial completion.
2. Access control system software is to be upgradeable as may be required or as necessary, to expand and manage the Owner’s site or sites. Upgrades are to be offered at a published flat fee for the primary system software, with single license modules included in the primary fee structure. System upgrades offered at a costing structure based upon the original number of licensed modules issued, or on those to be purchased at a future date, are not allowed.
3. As part of the submittal package, provide a list of available software upgrades and/or expansions modules. List to identify related costs for upgrades, or expansions to the original system, up to the next qualifying operational level.

1.9 SCOPE OF WORK

A. Access Control Site Management System: Furnish and install at the indicated locations the specified integrated access control door hardware and access control system firmware and software for a completely operational access control and security site management system. System includes, but is not necessarily limited, to the following:

1. Electrified integrated access control locks and exit hardware, network control processors, reader controller panels, I/O monitor/control interfaces, door position switches, remote card readers, keypads, and display terminals, access cards and credentials, system application software, special tools, operating manuals, and required cabling and accessories as detailed below and listed in the Access Control Hardware Sets at the end of Part 3.

a. Provide the appropriate number of reader controller panels and I/O monitoring / control expansion interfaces as needed to handle the number of card readers, locking devices, door status devices, and identified alarm inputs specified in this section, and as shown on the Security Drawings.

b. Provide Manufacturer approved integrated access control locks, exit hardware, and remote mounted card readers, keypads, and display terminals that are functionally compatible with the specified access control equipment interfaces.

2. Access control system equipment to be installed in an enclosure box compatible with the specified components. This enclosure to include, but is not necessarily limited to, the network control processor, I/O monitor/control interface panels, power supplies, terminal strips, wire ducts, keyed lock cylinder, integrated outlet for A/C power, and standoffs.

   a. Enclosure box to be located in the designated IT/Telecom room(s) with connection to the owner designated local area network for communication back to the central server host.

3. Owner to provide the following:

   a. Computer hardware and peripherals to be from an approved, Major Line Computer Manufacturer. The following Manufacturers will be considered “pre-approved”, however, specific information detailing compliance with the Manufacturer’s Requirements must be included within the Project submittal package as specified.

      1) Compaq
      2) Dell
      3) Hewlett-Packard
      4) IBM

   b. Central Server Host Computer:

      1) System Server to include the following Minimal Requirements: Windows Server 2003 (Service Pack 1 or higher) or later Operating System, Intel Pentium IV 1 GHz (equivalent or greater), SQL Server 2005 Express Edition or SQL 2005, 1GB Ram or larger, 120GB hard disk space available or more as needed, CRT or LCD minimum 15-inch display Monitor, CD/RW Drive. Single serial port, or multiple USB ports, and one parallel port, keyboard and mouse.

   c. Client Workstations:

      1) Client Workstation to include the following minimal Requirements: Windows XP Professional (Service Pack 2 or higher) or Windows Vista Business, Intel Pentium III 500 MHz (equivalent or greater), SQL Server 2000 Client Access License, 1GB Ram or larger, 30GB hard disk space available or more as needed, CRT or LCD minimum 15-inch display Monitor, CD/RW Drive. Single serial port, or multiple USB ports, and one parallel port, keyboard and mouse.

   d. Owner will be responsible for ensuring that each computer hardware component includes the required interfaces, expansion boards, and peripherals that will be necessary to allow the system to operate as described within this Specification and as indicated on the Drawings.

   e. Power Sourcing, Network Switches and Wireless Access Points: Quantity as required to accommodate installed access control (and video surveillance) devices.

   f. Network Control Processor Connections:

      1) LAN/Ethernet communication ports (jacks) and network interface cards as needed, CAT5e (CAT6) cabling from network router/switch to network control processor, outlet and cover plates and/or patch cables required for network connection within each designated IT/Telecom room.

2) Required static IP addresses.

4. Power Supplies, including battery or uninterrupted backup powers supply (UPS) and separately fused surge protection, required for the electrified door hardware, access control equipment, and PoE switches or wireless routers driving the integrated card reader locking devices.
5. Installation, final configuration and commissioning of electrified door and access control system hard- ware, communication firmware, power supplies and related accessories.
6. System application software including installation, programming, and end user training of the access control system demonstrating operating, repair, and maintenance procedures. Include on-site central server training for designated Personnel (facilities maintenance, security, IT, administration) by a Factory Certified Representative.

    a. Include Client Software Application (client workstation) training at each of the remote installed facilities for local Administrative Staff.

7. Provide Manufacturer required power controllers, interface boards, and programming that may be required for approved electric latch retraction exit devices supplied under Division 08 Section "Door Hardware."
8. Electrical Contractor, Division 26, to provide the following:

    a. Source power wiring (120VAC) as required for the integrated locking and access control hard- ware, equipment, accessories and power supplies. This includes quad outlets as required on a dedicated circuit in the designated IT/Telecom room(s) and the related conduit, stub-in, junction boxes and connectors required for the source power delivery and connections.
    b. Provide required conduit, stub-in, junction and back boxes for both the electrified locking hardware and access control equipment at each of the access controlled or monitored openings per Plan Drawings and Specifications. Supply and install conduit between each of the aforementioned devices and between the electrical junction boxes, power supplies and access control equipment located on or above the door opening.

        1) At wall mounted remote readers, provide conduit on the secured side of the door, 36- inches from the finish floor and 6-inches from the edge of the frame, to the related power supplies and access control equipment.
        2) At electrical hardware power transfers provide conduit on the secured side of the opening from the power transfer, thru-wire hinge, or serviceable panel location on the frame jamb to the related power supplies and access control equipment.

    c. Electrical Contractor to provide all 120VAC cabling connections and terminations from the electrical junction boxes to these electrical devices.

9. Access Control System Integrator to provide the following:

    a. Low voltage wiring (12/24VDC) and communication cabling (RS-232/RS-485) from network control processors to reader controllers, I/O monitor/control interface panels, electrified and integrated locking hardware, remote card readers, keypads, or display terminals, monitoring and signaling switches, and power supplies. Work includes related connectors, final terminations, and hook-ups required for a complete and functional access controlled opening in accordance with applicable Codes and specified system operational narratives.

10. Elevator Contractor to provide the following:

    a. Interface or landing of interface cable onto the elevator call button will be performed by a Certified Elevator Contractor.

b. Coordinate with access control systems integrator provisions for a card reader with output allowing the elevator call button to be activated. A validated card read will be required for activation.

11. Full and seamless integration of the analog, digital or IP-enabled CCTV video surveillance system (Division 28) if applicable, with the installed site access control system software.
12. Full and seamless integration of the site intrusion alarm service and motion detector systems, (Division
13. 28) if applicable, with the installed site access control system software.
14. Final connections to fire alarm system, if required, by electrical and fire alarm system contractors.
15. Provide permits, submittals and approvals required by the authority having jurisdiction, prior to commencing with work.

PART 2 – PRODUCTS

2.1 SYSTEM ARCHITECTURE - ACCESS CONTROL SITE MANAGEMENT SYSTEM (ACSMS)

A. General: The ACSMS is a modular and networked based system providing physical access control security to a Wide Area District, campus or educational enterprise. The system to be capable of controlling and integrating multiple security functions including the configuration, management and monitoring of cardholder access, locking hardware units, events, alarms, visitors, and real-time tracking and reporting. The ACSMS is to be alterable at any time depending on the Facility Requirements and will allow for easy upgradeability or modification of network processors, controller, interface modules, card data, inputs, outputs, and remote work stations. The ACSMS to include, but is not be limited to, the following features and functions:

1. An "Enterprise" class access control software application.
2. Client/Server model operating central server host software modules and client workstation software applications in a multi-user and a multi-tasking environment.

   a. The ACSMS to permit multiple instances of client software applications to run simultaneously on the network. The base system to include software application licenses with an unlimited number of licenses available subject to connection fees.

3. Partitioning: The system to support security partitioning enabling system administrator to segment the configuration database and group multiple entities within the security partition.

Security partitions limit what users can view in the configuration database. Administrators, who have all rights and privileges, can segment a database into multiple security partitions. A user who is given access to a specific partition will only be able to view entities (components) within the partition they have been assigned.

4. Encryption: The system to support encrypted communication between the central server software and client software applications (sever-to-server and client-to-server) using a 128-bit AES encryption algorithm (at a minimum).

   a. Communication between the central server host software module and system controllers to be encrypted if supported by the controllers.
   b. The ACSMS client software applications to be password protected with passwords stored in the central server database in an encrypted manner.

5. Distributed Processing: The system is a fully distributed processing application allowing information, including time, date, zones, valid Codes, tasks, access levels, and similar data, to be downloaded from the central host station to controller interface devices allowing access-control decisions with or without central host station communication. If

communications to a central host station are lost, the controllers will automatically buffer event transactions until communications are restored and events are automatically uploaded to the central host station.

a. Provide for a higher level of distributed database management at defined perimeter access points such that no single point of failure will allow more than two access points to fail, or affect more than two access points at perimeter points system wide.

6. Single Data Base: The system to support a single database for access control site setup, credential and identity file creation, alarm and control setup, and system user operation and commandfunctions.
7. System Access Management: The system to allow operators through password authentication the ability to make access granted or denied decisions, define access levels, time zones, holidays, assign cardholders, access groups, develop tasks, and generally manage access control, alarm monitoring and response activities system wide from a single login. Operator and user privileges are managed by a system administrator allowing for different levels of system access and system control. Authorization management is fully Owner definable.
8. Cardholder Management: The system to include a cardholder management system integrated within the access control system. This cardholder management functionality allows the enrollment of card-holders into the database, and import/export of employee data.
9. Access Groups and Access Levels: The system to provide adequate access groups and access level assignment capability to meet Owner Requirements for the specified project. If required, software application can be expandable to support unlimited access groups and access levels.
10. Alarm Monitoring: The system is able to monitor, report, and provide information about the time and location of alarms, along with their priority.
11. Event Monitoring: The system is able to monitor, report, and archive network access control activity.
12. Transaction Logs: The system to support an unlimited number of logs and historical transactions (events and alarms) with the maximum allowed being limited by the amount of hard disk space available.
13. System Monitoring: The system to have ability to report on the integrity of all network assigned devices, circuits and communications and provide a diagnostics screen showing field level communications system wide
14. Lock/Unlock Commands: The system to allow an operator to manually lock and unlock doors over- riding scheduled access control restrictions and configurations if necessary.
15. Hardware Interface: The system to integrate with and control specified electrified hardware, signaling and monitoring devices.
16. Report Generator: The system to have the ability to generate and output reports with any and all combinations of system fields and data including, but not limited to: by cardholder, by door, by site, by time, by groups of doors and by cardholder field. Any and all combinations of fields must be available for reporting. The report feature to allow exporting of generated reports over a network connection or by remote printing.
17. Multi-User/Web Based Network Capabilities: The system to support multiple operator workstations via local area network/wide area network (LAN/WAN), the Internet, or VPN. The system to be capable of supporting minimum number concurrent Users/Clients with software expansions to an unlimited number of workstations based on the Owners Network Requirements.
18. Systems Integration: The system to have the ability to be fully and seamlessly integrated with existing or specified intrusion detection alarm and video surveillance (CCTV) systems.

B. Open Architecture: The access control system infrastructure will be based on an open Architecture Design capable of supporting multiple Access Control Hardware Manufacturers and integrate with multiple non- proprietary network processors, controllers, interface modules, integrated locking hardware, remote card readers, keypads and display terminals, and other third party applications.

C. Network Support: Communication network connecting the central server host software modules, Client work- station software applications, and hardware controllers to be designed to support all of the following:

1. LAN/Ethernet enterprise ring topology and localized star topology based on TCP/IP.

2. Direct-connected RS-232 and RS-485 communication cabling.

3. Dial-up modem connection using a standard dial-up telephone line.

2.2 MANUFACTURERS

A. Approved Access Control and Site Management System Manufacturers:

1. Corbin Russwin (Integrated Access Control Locking Devices and Accessories).

2. HID Global (Access Cards and Credentials, Remote Readers).

3. Sargent Manufacturing (Integrated Access Control Locking Devices and Accessories).

4. Securitron Corporation (Power Supplies).

5. Substitutions: See Section 01 60 00 - Product Requirements.

B. General: Provide integrated access control door hardware and access control system equipment and accessories for each designated opening to comply with Requirements in this Section and with the Access Control Hardware Sets listed at the end of Part 3.

1. Access Control Hardware Sets: Requirements for quantity, item, model, design, grade, finish, size, and other distinctive qualities of each type of integrated door and access control hardware are indicated in the Access Control Hardware Sets at the end of Part 3.

2. Named Manufacturer's Products: Product designation and Manufacturer are listed for each door hard- ware type required for the purpose of establishing Minimum Requirements. Manufacturers' names are abbreviated in the Door Hardware Schedule.

C. System Design: The equipment and materials supplied are to be standardized components regularly manufactured and utilized within the Source Manufacturer’s access control systems.

1. System components to be non-proprietary in design and implementations, providing for an open protocol platform with multiple Manufacturers having functional software capable of integrating with the hardware specified. The installed integrated product is to be part of a single, cohesive management and access control system.

D. Substitutions: Requests for substitution and product approval for inclusive integrated access control door and access control systems hardware in compliance with the specifications must be submitted in writing and in accordance with the procedures and time frames outlined in Section 012500 - Substitution Procedures. Approval of requests is at the discretion of the Architect, Owner, and their Designated Consultants.

1. The access control system described in this specification represents a complete engineered system. If alternate products are submitted, it is the responsibility of the Supplier/Dealer/Integrator to provide an acceptable complete and working system layout, including re-engineering of elevation and wiring diagrams, as applicable. Complete systems to include at a minimum required power supplies, power transfers, and integrated access control locking hardware and accessories.

2.3 ACCESS CONTROL AND SITE MANAGEMENT SYSTEM HARDWARE

A. General: Provide all necessary access control field hardware devices required to receive alarms and administer all access granted/denied decisions. Field hardware devices must be designed and installed in accordance with applicable Electrical Codes.

B. Central Computer Host Server (Owner Provided): The central host server is interconnected to all system components, including client workstations and field installed controllers, providing operator interface, inter- action, display, control, and real-time monitoring.

2.4 INTEGRATED IP-ENABLED ACCESS CONTROL DEVICES

A. IP Enabled Power-over-Ethernet (PoE) Integrated Card Reader Mortise Lock: IP enabled ANSI/BHMA A156.13 Grade 1 mortise lockset with integrated credential reader, request-to-exit, and door position signaling in one complete unit. Motor driven locking/unlocking control of the lever handle trim, ¾-inch projection latch bolt, and optional 1 inch steel deadbolt. Lock is UL listed and labeled for use on up to 3 hour fire rated openings. Available with or without keyed high security cylinder override.

1. Acceptable Manufacturers:

a. Corbin Russwin Hardware (RU) - IN220 Series.
b. Mortise locks - IN220-ML20234 B OA BIP PSA M17 CT6R 626
c. Exit Devices - ED5200N IN220 PR9134 B OA BIP 5CH M110 CT6R 630 - Special App request for 5CH
d.
e. Fire-Rated Exit Devices - ED5200AN IN220 PR9134 B OA BIP 5CH M110 CT6R 630 - Special App request for 5CH
f. Substitutions: See Section 016000 - Product Requirements.

2. Operational Narratives required at ALL Card Access openings.

3. Completely intelligent and integrated locking unit with Ethernet power and communication connection capability directly from the locking unit back to the central system host server without additional access control interfaces or components (excluding PoE Endspan and Midspan devices) via an existing or newly installed IEEE 802.3af PoE enabled network.
4. Open architecture design supports wired integration with third party access control systems applications via software development kit (SDK). Real-time software accessible alarms for forced door, unknown card and door held open, with inside lever handle (request-to-exit), battery status, tampering, and door position (open/closed status) monitoring.
5. 2,400 users and 10,000 event transaction history (audit trail). Distributed intelligence allows stand-alone operation in absence of network communication allowing for system operational redundancy.
6. Provide a network and lock configuration CD tool kit for initial lock setup and programming via a USB connection.
7. Energy Efficient Design: Provide lock bodies which have a holding current draw of 15mA maximum, and can operate on either 12 or 24 volts. Locks are to be field configurable for fail safe or fail secure operation.
8. Integrated reader supports the following credentials:

    a. 125kHz proximity credentials: HID, AWID, Indala, and EM4102.
    b. 13.56 MHz contactless credentials: HID iClass, HID iClass SE, HID iClass Seos, SIO on MIFARE Classic, SIO on MIFARE DESFire EV1, MIFARE Classic, DESfire EV1, NFC- enabled mobile phones, Bluetooth Smart-enabled mobile phones.

9. Communication between access control system and device is protected by AES 128 bit encryption via the SDK. Programmable for time zones, holidays, and automatic unlocking.
10. Power and communication from one Ethernet (CAT5e or higher) cable. Compliant with IEEE 802.3af Class 1 device specifications requiring 3.84 watts for Power over Ethernet.
11. Supports real-time system lockdown capabilities. Inside lever retracts latch bolt and deadbolt simultaneously.
12. High security mechanical key provides emergency override retraction of latch-bolt without need for electronic activation.
13. Ethernet system framework, network cabling, mounting boxes, PoE end-span/mid-span, electrical hard wiring, grounding, and connections are required for complete system functionality. All system components are by others and are specified elsewhere.
14.

    Power Requirement: PoE Class 2, maximum 7 watts.
    Network Cabling Requirements: Cat5e or higher meeting or exceeding ANSI/TIA/EIA-568-C. 24 AWG Plenum rated.
    Bonding and Grounding: Meet or exceed TIA-607-B Requirements. Connect device ground cable to building electrical earth ground.
    Network Surface Mount Box: Meet or exceed ANSI/TIA/EIA-568-C Requirements. CAT5e or higher (RJ45).

2.5 CABLES AND WIRING

A. Comply with Division 26 and 27

B. Data Line Supervision: System to include alarm initiation capability in response to opening, closing, shorting, or grounding of data transmission lines.

C. Install appropriate number of conductor pairs, in the wire gage (AWG) recommended by Manufacturer, corresponding to the electronic locking functions specified, amperage drawn and

distances covered between the power supplies, power transfer devices, electrified hardware and access control equipment.

2.6 FABRICATION

Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to Manufacturers recognized installation standards for application intended.

2.7 ACCESS CONTROL HARDWARE FINISHES

A. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain Manufacturers for their products.

B. Protect mechanical finishes on exposed surfaces from damage by applying temporary protective coverings before shipping.

C. Where specified, finishes on integrated card key locksets or exit hardware to incorporate an FDA recognized antimicrobial coating (i.e., MicroShield™) listed for use on equipment as a suppressant to the growth and spread of a broad range of bacteria, algae, fungus, mold and mildew.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine scheduled openings, with Installer present, for compliance with Requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance of the installed access control system.

B. Examine roughing-in for electrical source power to verify actual locations of wiring connections before electrified and integrated access control door hardware installation.

C. Examine roughing-in for LAN and control cable conduit systems to PCs, controllers, card readers, and other cable-connected devices to verify actual locations of conduit and back boxes before device installation.

D. Notify architect of any discrepancies or conflicts between the Specifications, Drawings and Scheduled access controlled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

3.2 PREPARATION

Doors and frames at scheduled access controlled openings to be properly prepared to receive specified electrified and access control hardware and connections without additional in-field modifications.

3.3 INSTALLATION

A. Install each item of integrated access control door hardware and access control equipment to comply with Manufacturer's written instructions and according to Specifications.

B. Mounting Heights: Mount integrated access control door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with Governing Regulations:

1. Standard Steel Doors and Frames: DHI (LOCS).
2. Wood Doors: DHI WDHS.3.
3. Where indicated to comply with Accessibility Requirements, comply with CBC Chapter 11B.

C. Boxed Power Supplies: Verify locations.

1. Configuration: Provide the least number of power supplies required to adequately serve doors with access control hardware and equipment.

D. Integrated Wiegand access control products, campus locks, and IP enabled products are required to be installed through current members of the ASSA ABLOY "Certified Integrator" (CI) program.

E. Final connect the system control switches (integrated access control door hardware, remote readers, keypads, display terminals, biometrics), and monitoring, and signaling equipment to the related controller devices at each opening to properly operate the electrified door and access control hardware according to system operational narratives.

F. Retrofitting: Install each door hardware and access control item to comply with Manufacturer's published templates and written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface- mounted items until finishes have been completed on substrates involved.

G. Networked System Application Software: Install, and test application(s) software and databases for the complete and proper operation of systems involved. Assign software license(s) to Owner.

3.4 FIELD QUALITY CONTROL

A. Field Inspection: Perform a final inspection of the installed integrated access control door hardware and access control system and state in report whether installed work complies with or deviates from Requirements, including whether each component representing the opening assembly is properly installed, adjusted, operating and performing to system operational narratives.

B. Commissioning and Testing Schedule: Prior to final acceptance of the access control system installation, the following testing and documentation to be performed and provided to the Owner.

C. Inspection: Verify that units and controls are properly installed, connected, and labeled and that inter- connecting wires and terminals are identified.

D. Pre-testing: Program and adjust the system and pretest all components, wiring, and functions to verify they conform to Specified Requirements. Provide testing reports indicating devices tested, pass/fail status, and actions taken to resolve problem(s) on failed tests.

E. Acceptance Test Schedule: Correct deficiencies identified by tests and observations and retest until Specified Requirements are met.

F. Provide “As Designed” Drawings showing each device and wiring connection and electronic enclosure legends indicating cabling in and out.

G. Provide a complete set of operating instructions for access control hardware devices and a complete software user manual. The documentation includes module reference guides for each electronic enclosure.

3.5 ADJUSTING

Adjust and check each operating item of integrated access control door hardware, and each door opening to ensure proper secured operation and function of every unit. Replace units that cannot be adjusted to operate as intended.

A. CLEANING AND PROTECTION

B. Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all integrated access control door hardware at the latest possible time frame.

C. Clean adjacent surfaces soiled by access control system installation.

D. Clean operating items as necessary to restore proper finish and provide final protection and maintain conditions that ensure access control door hardware is without damage or deterioration at time of Owner occupancy.

3.6 DEMONSTRATION

Instruct Owner's Maintenance Personnel to adjust, operate, and maintain electronic integrated door hardware and the access control system.

3.7 ACCESS CONTROL HARDWARE SETSS

A. The hardware sets listed represent the design intent and direction of the Owner and Architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hard- ware and missing items should be brought to the attention of the Architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.

B. Refer to Door Hardware Schedule for hardware sets.

END OF SECTION

SECTION 28 16 00 – INTRUSION DETECTION SYSTEM

PART 1 - GENERAL

1.1 SCOPE

A. Work Included: All labor, materials, appliances, tools, equipment necessary for and incidental to performing all operations in connection with furnishing, delivery and installation of the work of this Section, complete, as shown on the Drawings and/or specified herein. Work includes, but is not necessarily limited to the following:

1. Examine all other Specifications Sections and Drawings for related work required to be included as work under Division 26 0000, 27 0000, and 28 0000.
2. General Provisions and Requirements for electrical work.

1.2 PERFORMANCE REQUIREMENTS AND SCOPE

All intrusion detection equipment as specified herein is future and is indicated for reference only. Provide all conduit outlet boxes and power connections only for all devices as indicated on the Drawings.

PART 2 - PRODUCTS

2.1 SYSTEM FUNCTIONS

A. Provide provisions only for a complete supervised Intrusion Detection System as shown on the Plans including but not limited to master control panel, key pad stations, motion detectors, connections to door switches, a State Fire Marshal listed digital communicator and an automatic dialer.

B. Upon detection of an intruder by initiation of any device in the system, the system shall cause the annunciator LED to light and sound an alarm signal on the School's telecommunication system. Alarm information shall be sent by digital dialer to Central Station Alarm Monitoring Agency.

C. Systems shall detect the motion of a body taking not more than four steps in an area secured with motion detection equipment where entry doors or windows are possible access.

D. Each building area shall be on a separate zone with each zone controlled separately so that any building area may be secured while others remain unsecured.

E. The System shall be capable of off-site computerized access for remote access, programming and control.

2.2 CONTROL PANEL

A. Control/Communicator Panel shall be a DMP #XR-500N control panel with an integral digital communicator and shall be Underwriters Laboratories listed. All external circuit connections shall be UL listed as power limited in accordance with the provisions of Article 760 of the California Electrical Code (CEC).

1. Provide Point of Protection (POPEX) modules at the control panel for Popit module supervision.
2. Provide Point of Protection Identification Transponders (Popit) modules at building terminal cabinets to individually identify each detector in the system.

B. The Control/Communicator shall be IP based.

C. System shall include the following features:

1. Real time clock and test timer.
2. Battery charging circuit.
3. Battery voltage supervision.
4. Supervised automatic reset circuit breakers.
5. Onboard warning buzzer and diagnostic LEDs.
6. Automatic answer modem.
7. Lightning and RFI protection.
8. Central Station reporting format.
9. Printer/CRT interface module for on-site serial data printer recording or CRT display of events.
10. Quad serial output module for enhanced serial data interface capability for specific accessory modules and devices.
11. Individual zone responses.
12. Custom annunciator text.
13. Audible alarm output, steady or pulsed.
14. Automatic silencing.
15. Attack-Resistant enclosure and lock meeting Underwriters Laboratory Local Burglary requirements.
16. A minimum of eight auxiliary form "C" dry contacts for a variety of programmable responses to alarm and trouble conditions.
17. Transformer enclosure for internal mounting of Class 2 transformer.
18. Two telephone numbers with selective signaling options.
19. Individual zone responses.
20. Automatic test reports.

2.3 BAR-CODE

Bar-code programmer for diagnostics and programming capability.

2.4 RECEIVER

A. Receiver shall be Bosch Security System #D6600 Series, UL listed for fire and intrusion detection.

B. Provide a 50VA Class 2 plug in transformer for power input.

C. System shall contain 48 hours of standby power utilizing rechargeable sealed lead acid batteries and a battery charger.

D. System shall be FCC approved for telephone connections.

E. An alphanumeric LCD Display shall indicate account number, area number, time, date, event, zone or point number, line or group number, status and external devices.

F. Twenty-four hour Clock and 128 year calendar.

G. Forty Character Line internal printer and interface capability with an external serial printer.

H. Transmission Verification appropriate with the format utilized.

I. Storage of 249 separate events.

J. Transmission Format shall support the control panel.

K. Turn the Receiver over to the District for Central Station or Campus Monitoring.

2.5 REMOTE ACCOUNT MANAGER

A. System shall be Bosch Security Systems #D5300 Series or equal with all equipment necessary for computerized access, programming, diagnostics, and remote control of the system. It shall

be possible to remotely change passcodes, locate faults, shunt problem zones, arm and disarm the system, silence alarms, and control the auxiliary output contacts in the control panel.

B. System shall permit remote diagnostics including utility and battery power conditions, phone line condition, event memory by zone, and current clock and calendar settings.

C. System shall be 100% IBM compatible for use with personal computers.

D. System shall include a plug-in modem and software necessary for a complete and operable installation. Furnish the District with a Software License Agreement for updated software enhancements as they develop.

2.6 KEYPADS

A. Master Keypad shall be DMP or equal capable of displaying system status and controlling the alarm system. Unit shall receive its operating power from the main control panel. Keypad shall be flush-mounted on a wall near the entry doors of each building. Faceplate shall be brass or stainless steel as selected by the Architect.

B. Sub-Zone Keypads shall be DMP or equal to allow individual zones to be bypassed. Keypad shall be flush wall where shown on Plans Faceplate shall be brass or stainless steel as selected by the Architect.

2.7 MOTION SENSORS

Motion sensors shall be Honeywell DT-7450 with Bosch B328 mounting bracket. Sensors shall be dual performance, dual event devices to minimize false alarms or equal passive infrared devices detecting thermal motion signals. Sensor coverage patterns shall be as required for optimum coverage at each individual location. Sensor shall be adjustable Gimbal mounted with plate and outlet box. Provide an attack resistant enclosure DS AE774 at Multipurpose and Gymnasium areas.

2.8 MAGNETIC SWITCH

Magnetic switch shall be fully concealed in the door frame, Admeco, Sentrol or equal.

2.9 INTRUSION DETECTION SYSTEM

Each Intrusion Detection System terminal cabinet shall contain a power supply for motion sensors and/or POPIT/POPEX (Zonex) modules.

2.10 CABLING

Cabling shall be as required for system operation. All cabling shall be shielded.

2.11 SIREN

Siren shall be ATW (Mascon) PR-D550PW or equal.

PART 3 - EXECUTION

3.1 MOTION SENSORS

Locate motion sensors to provide optimum coverage of the space and to avoid conflicts with the architectural aesthetics of the building. Submittal Drawings shall show the exact locations of all system sensors and keypads for approval by District’s Maintenance Managers.

3.2 CONCEALED DOOR SWITCH

Coordinate concealed door switch installations with Finish Hardware Manufacturer.

END OF SECTION

SECTION 28 23 00 - VIDEO MONITORING AND SURVEILLANCE SYSTEM (CCTV)

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes: Digital Video Monitoring and surveillance system, including card access control systems. System components include cameras, terminal cabinets, conduits, cables, monitors, switchers, digital video recorders, connectors, speaker/microphones, combiners, sound activated monitor base station with listen/talkback amplifier companion, call stations, alarming base station, and other materials and equipment.

B. Video surveillance system shall be integrated with existing Integrated Security Management and Monitoring System (ISMS).

1.02 RELATED SECTIONS

A. Applicable Division 1 sections

B. Section 26 0500: Common Works Results for Electrical

C. Section 26 0513: Basic Electrical Materials and Methods.

D. Section 26 0526: Grounding and Bonding

E. Section 26 0533: Raceways and Boxes Fittings and Supports.

F. Section 26 2416: Panelboards and Signal Terminal Cabinets

G. Section 265200: Emergency Power Systems.

H. Section 27 0536: Cable Trays for Communications.

I. Section 27 1015 Pemises Wiring New Installation

J. Section 28 1000 Access Control System (ACS)

1.03 REFERENCES

A. IEC/EN/UL 60950-1: – Information Technology Equipment - Safety - Part 1: General Requirements

B. IEC/EN/UL 60950-22: Technology Equipment Safety – Part 22: Equipment to be Installed Outdoors

C. SMPTE 296M (HDTV 720p) - 1280 x 720 Progressive Image Sample Structure – Analogue and Digital Representation and Analogue Interface.

D. SMPTE 274M (HDTV 1080p) - 1920 x 1080 Image Sample Structure, Digital Representation and Digital Timing Reference Sequences for Multiple Picture Rates.

E. SMPTE ST 2036-1 (UHDTV): Ultra High Definition Television (UHDTV)

F. ISO/IEC 14496-10 Advanced Video Coding (H.264) – Advanced Video Coding (H.264)

G. IEEE 802.3at (Power over Ethernet Plus) – Power over Ethernet Plus

H. IEEE 802.1X (Authentication) – Standard for Local and metropolitan area networks-Port-Based Network Access Control (Authentication)

I. IPv4 (RFC 791) – Internet Protocol Version 4

J. IPv6 (RFC 2460) – Internet Protocol Version 6

K. QoS – DiffServ (RFC 2475) – Scalable End-to-End Quality of Service Model

L. Relevant ONVIF “S”profile as defined by the ONVIF Organization.

M. IEC/EN 60529 IP66 (Ingress protection) – Degrees of Protection Provided by Enclosures (IP Code)

N. NEMA 250 Type 4X – Enclosures for Electrical Equipment

O. IEC/EN 62262 IK10 – Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code)

1.04 SUBMITTALS

A. List of Materials: Submit a complete list of proposed materials.

B. Shop Drawings: Provide detailed and dimensioned Shop Drawings indicating kind, weight and thickness of materials, method of fitting and fastening parts together, location and number of parts or modules, sizes, and complete details of method of fitting suspension and fastening luminaires in place. Provide wiring and cabling diagrams. Drawings shall contain sufficient information to assemble and install equipment at the Project site without further instructions.

C. Installation Instructions: Submit manufacturer's written installation instructions for luminaires and accessories.

1.05 SUBSTITUTIONS

A. Equipment and materials that deviate from these requirements shall not be accepted without written approval from OWNER’S Information Technology project manager. When deviating or proposing material substitutions the following information shall be submitted:

1. Substitution request form substantiating reasons and benefits to OWNER, and all necessary documents to validate the claims made in the substitution form.

2. Submittals must comply with contract general provisions.

B. The CONTRACTOR assumes all responsibility for additional costs, directly or indirectly, associated with proposing and installing an approved substitution products. All substituted products must meet the intent of form and function identified in the specification.

1.06 QUALITY ASSURANCE

A. The CONTRACTOR or security sub-CONTRACTOR shall be a licensed security CONTRACTOR with a minimum of five (5) years’ experience installing and servicing systems of similar scope and complexity, and evidence that CONTRACTOR has completed at least three (3) projects of similar scope, and is currently engaged in the installation and maintenance of systems herein described.

B. All installation, configuration, setup, program and related work shall be performed by electronic technicians thoroughly trained by the manufacturer in the installation and service of the equipment provided.

C. The CONTRACTOR or designated sub-CONTRACTOR shall submit installer’s third party verified credentials of completion of manufacturer certification. The CONTRACTOR system programmer shall have attended manufacturer training and obtained the highest level certifications for the ISMS, ACS and VMS.

D. The CONTRACTOR shall provide four (4) current references from clients with systems of similar scope and complexity that became operational in the past three (3) years. At least three (3) of the references shall be utilizing the same system components, in a similar configuration as the proposed system.

E. The video surveillance system shall be in compliance with applicable industry standards listed under article 1.03-References.

1.07 WARRANTY

A. CONTRACTOR shall warranty that all work executed and materials furnished shall be free from defects in materials and workmanship for a minimum period of five (5) years from date of installation acceptance, excluding specific items of work that require a warranty of a greater period that may be set forth in this Specification. In the event a manufacturer's warranty is longer than five (5) years, the manufacturer's warranty shall be the warranty period. Immediately upon receipt of written notice from the OWNER, the CONTRACTOR shall repair or replace at no expense to the OWNER, any defective material or work that may be discovered before final acceptance of work or within the warranty period; any material or work damaged thereby; and adjacent material or work that may be displaced in repair or replacement. Examination of, or failure to, examine work by the OWNER shall not relieve CONTRACTOR from these obligations.

B. Warranty shall provide the OWNER direct access to manufacturer Technical Assistance Center (TAC), software updates, and defect support.

C. Manufacturer of provided equipment shall guarantee availability of parts common to provided system and/or full replacement units, for a period not less than 5 years. Parts for the supplied systems shall be available within 30 calendar days during the 5 year period.

D. Installation CONTRACTOR shall install all equipment in accordance with manufacturer's specifications and recommendations necessary to ensure continuation of the manufacturer's warranty. If the installation CONTRACTOR cannot install manufacturer's equipment in such a manner, it is the responsibility of the installation CONTRACTOR to provide written, timely notification to OWNER ITD Project Management.

E. OWNER monitors equipment service records and failure rates. In the event that the OWNER determines that a LAN system component, or model part, provided through this specification exceeds acceptable failure rate, or repeated failure rate, the CONTRACTOR shall replace all systems of the same model purchased through this procurement with a new model that meets or exceeds the same functional requirements. Units or components exceeding either the acceptable or repeated failure rates shall be known as a "mass failure." The CONTRACTOR shall provide qualified technicians to install the replacement systems and a project manager to coordinate replacement schedule with ITD. Replacement of mass failing systems, labor, and project management shall be provided and completed in accordance with this specification and related OWNER installation guidelines at no additional cost to the OWNER.

F. The acceptable failure rate/repeat failure rate for a single system model or individual modular model part, at a single site, or OWNER-wide, shall be:

G. Equal to or less than 10% in any 12 month period during the original warranty term.

H. Equal to or less than 15% cumulative failures during the entire term of the original warranty.

I. If, at any time during of the warranty term, the failure rate of the LAN systems or components exceeds 10%, the CONTRACTOR shall extend the original warranty term by one year, at no additional cost to the OWNER.

J. The CONTRACTOR is responsible for replacement of any failed equipment provided by the CONTRACTOR, during the warranty period or the extended warranty period. This includes equipment that falls under the “mass failure” definition.

K. In the event of a “mass failure” the CONTRACTOR shall replace all units and/or components affected within 60 days or written notification from the OWNER.

L. Upon replacement of each unit or component, the replaced unit warranty shall continue as if the original equipment were still in service.

M. The warranty shall cover the complete system including fan assembly, power supplies, and the device itself.

N. The warranty shall include onsite 48-hour advanced part replacement.

O. The warranty shall include all labor to service and/or replace warranted system(s).

P. In the event any Supplier or manufacturer offers additional warranty, at no additional cost, beyond that specified herein, CONTRACTOR shall state the terms of such warranty or warranties in writing and shall extend the same to the OWNER without additional cost.

Q. Equipment manufacturers shall have E-mail trouble reporting and response mechanisms in place and a toll free 24-hour help center to assist with troubleshooting and operation of the equipment at no additional cost to the OWNER, or as part of the warranty.

PART 2 – PRODUCTS

2.01 CAMERAS AND CAPABILITIES

A. General Requirements:

1. System overall shall be capable of intelligent video analytic and triggers actions based on programming requirements.
2. Cameras shall be IP-based and comply with established network and video standards.
3. Cameras shall support true day/night vision modes using IR cut filters.
4. Camera enclosure shall be rated as follow;
   a. Vandal resistance – IK10
   b. Ingress protection – IP67, NEMA 4X, or higher
5. The primary power source of cameras shall be powered by data nework switches equipped with PoE/PoE+/UPoE capabilities as specified by Section 27 1018 10G Local Area Network (LAN) Systems. The secondary power sources (e.g. injectors, midspans, local power) shall be reviewed and approved by OWNER on a case by case basis.
6. Cameras shall be fully supported by an open and published API (Application Programmers Interface), which shall provide necessary information for integration of functionality into third party applications. Manufacturers SDK (software development kit) must be available to the general public.
7. Cameras shall be in conformance with profile S as currently defined by the ONVIF Organization (www.onvif.org/conformant-products) including firmware upgrade to meet future revisions.

8. Camera types listed below describing various resolutions, form-factor and features shall be supplied by a single manufacturer per site, and meet or exceed the following requirements:
    a. The camera shall be equipped with IR progressive scan sensor.
    b. The camera shall provide true day/night functionality.
    c. The camera shall be equipped with shall provide local video storage (e.g. a microSD/microSDHC/microSDXC memory card expansion).
9. The camera shall allow for video to be transported over:
    a. HTTP (Unicast)
    b. HTTPS (Unicast)
    c. SRTP (Unicast & Multicast)
    d. RTP over RTSP (Unicast)
    e. RTP over RTSP over HTTP (Unicast)
10. The camera shall support Quality of Service (QoS) for traffic prioritization.
11. User Interface shall comply with the following:
    a. The camera shall contain a built-in web server making video and configuration available to multiple clients in a standard operating system and browser environment using HTTP, without the need for additional software or specialty plugins
    b. The camera shall be accessible via camera IP address directly using client software supported by the equipment manufacturer
12. Protocol Requirements:
    a. At the minimum, camera shall incorporate support for IPv4/v6, HTTP, HTTPS, SSL/TLS, QoS, TCP, ICMP, SNMPv1/v2c/v3 (MIB-II), RTSP, RTP, SRTP, UDP, IGMP, RTCP, SMTP, FTP, DHCP, ARP, DNS, DynDNS, SOCKS, SSH, NTP, CIFS/SMB.
13. Text overlay requirement:
    a. Provide embedded on-screen text with support for date & time, and a customer-specific text, camera name, minimum of 45 ASCII characters.
    b. Provide the ability to apply privacy masks to the image.
    c. Allow for the overlay of a graphical image, such as a logotype, into the image.
14. Security
    a. The camera shall support the use minimum of 128 bit encryption for secured authentication and communication of both administration data and video streams.
    b. The camera shall support IEEE 802.1X authentication.
    c. The camera shall provide support for restricting access to pre-defined IP addresses only.
    d. The camera shall restrict access to the built-in web server by usernames and passwords at three different levels.

e. The camera shall not allow third party firmware to be loaded onto the camera.

15. The camera shall be equipped with basic intelligent video analytic functionality that can be triggered by:
    a. Intelligent Video Detection
    b. Audio Detection (optional)
    c. Live Stream Accessed
    d. Camera tampering
    e. Auto tracking
    f. Scene alteration detection (e.g. removed object detection)
16. Response to triggers shall include capability of:
    a. Send SNMP trap or email notification
    b. Send images, using FTP, HTTP, HTTPS, network share or email
    c. Send video clip, using FTP, HTTP, HTTPS, network share or email
17. The camera shall incorporate a function for image stabilization
18. The camera shall provide remote focus, remote zoom, and alignment
19. Hardware interface requirements
    a. Network interface
        1) The camera shall be equipped with one (1) auto-negotiating10/100 Base-T Ethernet port.
20. Environmental operational requirements
    a. Operate in a temperature range of -40 °C to +60 °C (-40 °F to 140 °F).
    b. Operate in a humidity range of 10–100% RH (condensing).
21. Installation and maintenance:
    a. The camera shall be supplied with management software which allows the assignment of IP addresses, upgrade of firmware and backup of the cameras' configuration.
    b. The camera shall allow updates of the software (firmware) remotely over the IP network infrastructure.
    c. The camera shall provide Autorotation functionality.

B. Type 1 Camera Requirements
1. Illumination: The camera shall meet or exceed the following illumination specifications:
    a. Color: 0.3 with WDR image processing capability;
    b. B/W: 0.02 lux with WDR image processing capability
2. Target Resolution:
    a. Ability to distinguish an object from background within 125 feet (*)
    b. Provide 20 pixels per linear foot. Contractor shall provide a pixel count per linera foot.

3. Encoding - The camera shall support the following video encoding algorithms:
    a. Compression Format:
        1) Motion JPEG
        2) H.264 (Baseline/Main/High Profiles)
        3) The camera shall provide configurable compression levels.
    b. The camera shall in H.264 support Variable Bit Rate (VBR) for video quality adapted to scene content. To protect the network from unexpected bit rate spikes the camera shall support Constant Bit Rate (CBR) or Maximum Bit Rate (MBR).

B. Type 2 Camera Requirements
1. Illumination: The camera shall meet or exceed the following illumination specifications:
    a. Color: 0.1 lux with WDR image processing capability. Minimum WDR of 120 db.
2. Target Resolution:
    a. Ability to classify an object class within 95 feet.
    b. Provide 40 pixels per linear foot.
3. Encoding - The camera shall support the following video encoding algorithms and format:
    a. Motion JPEG
    b. H.264 (Baseline/Main/High Profiles)
    c. The camera shall provide configurable compression levels.
    d. The camera shall in H.264 support Variable Bit Rate (VBR) for video quality adapted to scene content. To protect the network from unexpected bit rate spikes the camera shall support Constant Bit Rate (CBR) or Maximum Bit Rate (MBR).

C. Type 3 Camera Requirements:
1. Illumination: The camera shall meet or exceed the following illumination specifications:
    a. Color: 0.2 with WDR image processing capability and minimum WDR of 120 db.
    b. B/W: 0.008 lux with WDR image processing capability and minimum DWR of 120 db.
2. Target Resolution:
    a. Ability to describe the object in details within 45 feet.
    b. Provide 80 pixels per linear foot.
    c. The camera shall provide both landscape format (4:3 and 16:9 aspect ratio) as well as corridor format (3:4 and 9:16 aspect ratio).
3. Encoding:
    a. The camera shall support the following video encoding algorithms and format:
        1) Motion JPEG
        2) H.264 (Baseline/Main/High Profiles)
        3) The camera shall provide configurable compression levels.

b. The camera shall in H.264 support Variable Bit Rate (VBR) for video quality adapted to scene content. To protect the network from unexpected bit rate spikes the camera shall support Constant Bit Rate (CBR) or Maximum Bit Rate (MBR).

D. Onboard Camera Minimum Requirements:

1. Electronic day/night
2. Meet EN 50115 (vibration and shock) and ISO 16750-3
3. Maximum power consumption: 4 watts
4. Illumination: The camera shall meet or exceed the following illumination specifications:
   a. Minimum sensitivity of 1.0 lux with WDR image processing capability; (with minimum WDR of 70db)
5. Target Resolution:
   a. Ability to describe an object in details within 45 feet.
   b. Provide 80 pixels per linear foot.
6. Encoding - The camera shall support the following video encoding algorithms:
   a. Compression Format:
      1) Motion JPEG
      2) H.264 (Baseline/Main/High Profiles)
      3) The camera shall provide configurable compression levels.
   b. The camera shall in H.264 support Variable Bit Rate (VBR) for video quality adapted to scene content. To protect the network from unexpected bit rate spikes the camera shall support Constant Bit Rate (CBR) or Maximum Bit Rate (MBR).

2.02 NVR AND RELATED COMPONENTS

A. NVR general requirements where required, Project cameras shall be connected to existing Security system, otherwise provide per below as required.:

1. The NRVshall be based on a true open architecture that shall allow the use of non-proprietary workstation and server hardware, non-proprietary network infrastructure and non-proprietary storage.
2. The NVR shall be a pre-assembled appliance solution, or software based supporting VM (e.g. VMWare, Microsoft hypervisor). Other solution platforms be reviewed and approved by theOWNER on the case by case basis.
3. The NVR shall be an IP enabled solution. All communication with the VSS system shall be based on standard TCP/IP protocol and have the capability to use network security.
4. The NVR shall provide minimum of two (2) 1Gbps Ethernet network ports
5. The NVR shall support user authentication with claims-based authentication using external providers.
6. The NVR shall offer a complete and scalable video surveillance solution that shall allow cameras to be added on a unit-by-unit basis.
7. The NVR shall interface with analog-to-digital video encoders and IP cameras.
8. All video streams supplied from analog cameras or IP cameras shall be digitally encoded in MPEG-4, MPEG-2, MJPEG, H.264, H265, Wavelet, or JPEG2000 compression formats and recorded simultaneously in real time.

9. All audio streams supplied from IP video servers shall be digitally encoded in G.711 (u-law), G.721, G.723, or AAC compression formats and recorded simultaneously in real time.

10. Each camera's bit rate, frame rate, and resolution shall be set independently from other cameras in the system, and altering these settings shall not affect the recording and display settings of other cameras.

11. The NVR shall to support support only secured media stream requests, unless explicitly configured otherwise. Or have the capability to laverage network security cotrols. Secured media stream requests shall be secured with strong certificate based authentication leveraging RTSPS (aka RTSP over TLS). Client authentication for media stream requests is claims-based and may use a limited lifetime security token.

12. The NVR shall have the cability to encrypt the media stream, including video, audio, and metadata with authenticated encryption for transmission. Media stream encryption shall be done at rest and in transit and be a certificate based AES 128b bits encryption. The VMS shall:

    a. Allow encryption to be set on a per camera basis for all or some of the cameras.

    b. Allow encrypted streams to be exported.

13. The NVR shall support end to end encrypted streams with cameras supporting Secure RTP (SRTP) both in unicast and multicast from the camera.

14. The NVR shall be able to use multiple VSS keyboards to operate the entire set of cameras throughout the system, including brands of cameras from various manufacturers and including their PTZ functionalities.

15. The NVR shall be able to retrieve and set the current position of PTZ cameras using XYZ coordinates.

16. The NVR shall support PTZ camera protocols from multiple manufacturers, including analog and IP protocols.

17. The NVR shall arbitrate the user conflict on PTZ usage based on user levels per camera.

18. The NVR shall support Audio and Video storage configuration for the NVR shall support:

    a. Internal or external computer data storage in RAID 0, 1, 5, 6, or 10 configuration.

    b. Within the overall storage system, the Audio and Video shall have the capability to include disks located on:

        1) Local.

        2) Network Attached Servers (NAS).

        3) Storage Area Networks (SAN).

B. NVR RECORDING FUNCTION

1. The Recorder shall use an event and timestamp database for the advanced search of audio/video archives. This database shall use a SQL database.

2. The Recorder shall protect archived audio/video files and the system database against network access and non-administrative user access.

3. The Recorder shall digitally sign recorded video using 248-bit RSA public/private key cryptography.

4. The Recorder shall have the capacity to configure the key frame interval (I-frame) in seconds or number of frames.

5. The Recorder shall provide a pre-alarm and post-alarm recording option that can be set between one second and 5 minutes on a per camera basis.

6. The Recorder shall provide the functionality of storing of video and audio streams based on triggering events, such as:

   a. Digital motion detection.

   b. Digital input activation.

   c. Macros.

   d. Through SDK application recording.

7. The Recorder shall be capable of intelligent video analytic detection on each individual camera leveraging management template or levearage external server video analytics. Detection can be set into four different modes:

   a. Full Screen: All 1320 blocks on screen are activated and a general threshold for the overall detection in the entire image can be set, and when it is reached, it can trigger recording and a motion event or a custom event.

   b. Full Screen Unit: This is the same as the Full Screen but the motion detection takes place in the DVS.

   c. Detection Zone: Six overlapping zones can be defined in the 1320 blocks on screen with each of these zones having its own threshold, and, when that threshold is reached, each one of them can trigger recording and a motion event or a custom event. Each zone triggering its own event allows for the configuration of directional motion detection events and other complex motion detection logic.

   d. Detection Zone Unit: This is the same as the Detection Zone, but the motion detection takes place in the DVS and only one zone is supported.

   e. Disabled: No motion detection is performed on this camera.

8. The Recorder shall allow for multiple recording schedules to be assigned to a single camera. Each schedule shall be created with the following parameters:

   a. Recording mode:

      1) Continuous.

      2) On Motion/Manual.

      3) Manual.

      4) Disabled.

   b. Recurrence pattern:

      1) Once on specific days.

      2) Specific days on a yearly basis.

      3) Specific days on a monthly basis.

      4) Specific days on a weekly basis.

      5) Daily.

   c. Time coverage:

      1) All day.

2) Specific time range(s).

3) Daytime or night time based on the times of sunrise and sunset that are automatically calculated from the time of year and a geographical location. Provision shall be given to offset the calculated sunrise or sunset time by plus or minus 3 hours.

9. The Recorder shall allow each camera (video source) to be encoded multiple times for each camera stream in the same or different video formats (MPEG-4, MPEG-2, MJPEG, H.264, H.265, Wavelet or JPEG2000), limited only by the capabilities of each DVS.

10. The Recorder shall have the capacity to manage up to 10,000 video endpoints from one operation manager.

11. The Recorder shall allow users to view up to 5 million camera feeds across a federation model.

12. The Recorder shall have open APIs allowing integration into 3rd party applications, internally development applications and/or data connectivity for deeper analytics.

13. Whenever multiple video streams are available from the same camera, users shall be free to use any one of them based on their assigned usage. The standard video stream usages are:

    a. Live.

    b. Recording.

    c. Remote.

    d. Low resolution.

    e. High resolution.

14. The Recorder shall allow the video quality to vary according to predefined schedules. Such schedules shall have the same configuration flexibility as the recording schedules mentioned earlier. The video quality shall be based on, but not limited to, the following parameters:

    a. Maximum bit rate.

    b. Maximum frame rate.

    c. Image quality.

    d. Key frame interval.

15. The Recorder shall have the ability to dynamically boost the quality of the "recording stream" (see previous bullet) based on specific events:

    a. When recording is started manually by a user.

    b. When recording is triggered by a macro, an alarm or detected motion.

16. The Recorder shall have the capacity to communicate using 128 bits SSL encryption and HTTPS secure protocol.

17. The Recorder shall have the capacity to redirect audio/video streams to active viewing clients on the network using unicast UDP or TCP.

18. The Recorder shall empower the administrator with a full range of disk management options:

a. The Recorder shall allow the administrator to choose which disks to use for RECORDING and to set a maximum quota for each.

b. The Recorder shall allow the administrator to spread the RECORDING of different cameras on different disk groups (groups of disks controlled by the same controller) so that RECORDING could be carried out in parallel on multiple disks.

19. The Recorder shall offer the following options to clean up old archives, on a camera by camera basis:

a. After a preset number of days.

b. Write over the oldest archives first when disks are full (FIFO – First In First Out).

c. Stop RECORDING when disks are full.

20. The Recorder shall allow important video sequences to be protected against normal disk cleanup routines.

21. Users shall have the following options when protecting a video sequence:

a. Until a specified date.

b. For a specified number of days.

c. Indefinitely (until the protection is explicitly removed).

22. The Recorder shall allow the administrator to put a cap on the percentage of storage space occupied by protected video.

23. The Recorder shall have the capacity to down-sample video streams for storage saving purposes. The down-sampling options available are the following:

a. For H.264, MPEG-4, and H.265, streams the down-sampling options are: all key frames, 1 fps, 2 sec./frame, 5 sec./frame, 10 sec./frame, 15 sec./frame, 30 sec./frame, 60 sec./frame, 120 sec./frame.

b. For MJPEG streams the down-sampling options are: 15 fps, 10 fps, 5 fps, 2 fps, 1 fps, 2 sec./frame, 5 sec./frame, 10 sec./frame, 15 sec./frame, 30 sec./frame, 60 sec./frame, 120 sec./frame.

C. VMS CLIENT USER INTERFACE (UI)

1. The Client Application shall provide the user interface for VSS configuration and monitoring over any network and be accessible locally or from a remote connection.

2. The Client Application shall provide an easy-to-use graphical user interface (UI).

3. The Client Application shall allow users to access up to 10,000 video end points.

4. The Client Application shall allow users the capability to access up to 5 million video end points when in federator type of architecture.

5. The client application for monitoring shall support running oin 64-bit mode.

6. Logging on to a Client Application shall be done either through locally stored user accounts and passwords the operator’s credentials when Active Directory integration is enabled.

7. When integrated with Microsoft’s Active Directory, the Client Application shall authenticate users using their Active Directory credentials.

8. The Client Application shall fulfill the role of a Unified Security Interface that is able to monitor intrusion detection and access control events and alarms, as well as view live and recorded video.

9. The Client Application shall provide a graphical user interface to control and monitor VSS. It shall allow administrators and operators with appropriate privileges to monitor their unified security platform, run reports, and manage alarms.

10. The Client Application shall include advanced video capabilities, including:

    a. Advanced live video viewing functionality.

    b. Advanced archive playing and video playback functionality.

    c. Monitoring and management of video system events and alarms.

    d. Intercom or duplex audio or SIP based application.

    e. Generation of video reports.

    f. Control of PTZ cameras.

    g. Creating and monitoring archive transfer requests.

    h. Display metadata overlaid on live or playback video.

11. The live video viewing capabilities of the Client Application shall include:

    a. The ability to display all cameras attached to the NVR's.

    b. Support for live video monitoring on each and every display tile within a task in the user's workspace.

    c. The ability to drag and drop a camera into a display tile for live viewing.

    d. The ability to drag and drop a camera from a map into a display tile for live viewing.

    e. Support for digital zoom on live camera video streams.

    f. The ability for audio communication with video units with audio input and output.

    g. The ability to control pan-tilt-zoom, iris, focus, and presets.

    h. The ability to bookmark important events for later retrieval on any RECORDING camera and to uniquely name each bookmark in order to facilitate future searches.

    i. The ability to start/stop recording on any camera in the system that is configured to allow manual recording by clicking on a single button.

    j. The ability to activate or de-activate viewing of all system events as they occur.

    k. The ability to switch to instant replay of the video for any RECORDING camera with the simple click of button.

    l. The ability to take snapshots of live video and be able to save or print the snapshots.

    m. The ability to view the same camera multiple times in different tiles.

12. The video playback (archive playing) capabilities of the Client Application shall include:

    a. Support for audio and video playback for any time span.

    b. Support for video playback on each and every display tile.

c. The ability to instantly replay the video for any RECORDING camera with the simple click of a button.

d. The ability to select between instant synch of all video streams in playback mode, allowing operators to view events from multiple angles or across several camera fields, or non-synchronous playback.

e. The ability to simultaneously view the same camera in multiple tiles at different time intervals.

f. The ability to control playback with:

1) Pause.

2) Lock Speed.

3) Forward and Reverse Playback at: 1x, 2x, 4x, 6x, 8x, 10x, 20x, 40x, 100x.

4) Forward and Reverse Playback frame by frame.

5) Slow Forward and Reverse Playback at: 1/8x, 1/4x, 1/3x, 1/2x.

6) Loop playback between two time markers.

13. The ability to display a single timeline or one timeline for each selected video stream, which would allow the operator to navigate through the video sequence by simply clicking on any point in the timeline.

14. The ability to display the level of motion at any point on a timeline.

15. The ability to clearly display bookmarked events on the timeline(s).

16. The ability to query archived video using various search criteria, including, but not limited to, time, date, camera, and area.

17. The tool necessary for searching video and associated audio based on user- defined events or motion parameters.

18. The ability to define an area of the video field in which to search for motion as well as define the amount of motion that will trigger search results with the client or with intelligent video analytics. The Client Application shall then retrieve all archived video streams that contain motion that meets the search parameters. There shall be a graphical timeline on which the time of each search hit shall be indicated.

19. The ability to browse through a list of all bookmarks created on the system and select any bookmarked event for viewing.

20. The ability to add bookmarks to previously archived video for easier searching and retrieval.

21. Support for digital zoom on playback video streams.

22. Still image export to PNG, JPEG, GIF, and BMP format with Date and Time stamp, and Camera Name on the image (snapshot).

23. Tools for exporting video sequences in standard video formats, such as ASF.

24. The ability to encrypt exported video files.

25. The ability for an operator to load previously exported video files from their computer or network.

26. The ability for queries to be saved upon closing the Client Application and reappear when the application is reopened.

27. The ability to dynamically block, on demand, video stream dynamically to lower level users to prevent access, for a specific time, to live and recorded video.

28. A tool building and exporting a set of videos into a single container. This tool shall allow the operator to build sequences of video to create a storyboard and allow the export of synchronous cameras.

29. The ability to store the video export and still image export at a pre-defined storage location.

30. An interface with the ability to list, search, and manipulate previously generated video exports.

31. The ability to export sequences of video in open standards including ASF and MP4

32. Visual Tracking

    a. The Client Application shall support the ability to manually track a moving target with the single click of a button.

    b. The ability to switch from one camera view to an adjacent camera shall be done within a single display tile.

    c. Switching between camera streams shall be accomplished by simply clicking on a semi-transparent shape or overlay.

    d. Visual tracking shall be available with both live and recorded video.

D. WEB CLIENT

1. The VSS shall provide a desktop application and a web client interface for configuration, management, and/or viewing.

2. The web client shall be a truly thin client with no download required other than an internet web browser or standard web browser plugins.

3. The web client shall be platform independent and run within Microsoft Internet Explorer, Firefox, Safari, and Google Chrome.

4. Video Stream shall be redirected to the Web Client with no stream transformation or re-encoding for all streams in H264, H265, and Mpeg4 ISO.

5. The CONTRACTOR shall provide up to 10 number of simultaneous Web Clients.

6. Functionalities:

    a. Login using name and password or Active Directory support shall be available.

    b. Encrypted communications for all transactions.

    c. Print reports and export to CSV file.

    d. Video

        1) Live and playback video at 320 x 240, 640 x 480 or 1280 x 1024 @ 15 fps.

        2) Video export.

        3) 1, 4, 6 or 9 tiles.

        4) Basic PTZ Controls (Pan/Tilt, Zoom, go to presets, start pattern).

        5) Start / Stop recording.

        6) Alarm report.

E. MOVILE APPLICATION GENERAL REQUIREMENTS

1. The VSS shall support mobile apps for various off-the-shelf smartphones and tablets. The mobile apps shall communicate with the Mobile Server of the VSS over any WiFi or mobile network connection.
2. Mobile apps shall communicate with the VSS via a Mobile Server. Communication between the mobile device and the Mobile Server shall support optional encryption.
3. Supported manufacturers shall include:
    a. Apple IOS devices.
    b. Android based tablets and Smartphones.
    c. Microsoft Windows based devices.
4. It shall be possible to download the mobile apps from the Central application store (Apple iTunes App Store, Google Play, Windows Store).
5. Functionalities:
    a. Live monitoring and command and control of the VSS.
    b. Receive alarm push notifications from the Apple Push Notification Server or from the Google Android push server.
    c. Alarm management (view and acknowledge alarms, video tied to alarms).
    d. View VSS hierarchy and search for entities.
    e. Stream video from the mobile device using the built-in camera.
    f. Video streams from mobile devices shall be available in the VSS to be viewed in live and recorded on the Archiver.
    g. Video system shall provide the following:
        1) View live and playback video at 320 x 240, 640 x 480 or 1280 x 1024 @ 15 fps.
        2) Monitor camera status.
        3) View up to 6 video feeds.
        4) Control PTZ functionality of a camera, including access to PTZ presets.
        5) Save snapshots locally on the device.
        6) View video tied to access control events, and alarms.

PART 3 - EXECUTION

3.01 DEPLOYMENT

A. Deployment Management Service

1. The Deployment Management service from the vendor shall include a Project Manager acting as the single point of contact for all communications between the CONTRACTOR and the vendor organization and who will be responsible for:
    a. Conducting a Risk Assessment of the impact of potential risk factors on the operation of the vendor's ISMS.

b. Providing a project plan for the deployment of the vendor's ISMS.

c. Managing the development and deployment of the custom solution components that will be integrated into the vendor's ISMS (if applicable).

d. Providing a scope of work detailing the services to be provided by the vendor to assist in the deployment of the vendor's ISMS.

e. Coordinating and scheduling the vendor field services with the CONTRACTOR to assist with the deployment of the vendor's ISMS.

f. Providing regular project status updates to the CONTRACTOR regarding the development of custom solutions (if applicable) and the deployment of the vendor's ISMS.

2. System Configuration and Commissioning Service. The System Configuration and Commissioning service from the vendor shall include a Field Engineer who will be responsible for:

a. Assisting the CONTRACTOR's or subcontractor's onsite/remote technicians with the configuration and commissioning of the vendor's ISMS at the client site.

b. Conducting a test of the ISMS following the deployment of the system using real-world operator scenarios to ensure optimal system performance.

c. Providing the CONTRACTOR with a Service Report detailing the tasks completed during the deployment of the ISMS at the client site, as well as any recommendations for improving the performance of the ISMS that must be implemented by the CONTRACTOR.

d. Providing a knowledge transfer of the vendor's ISMS to the CONTRACTOR following the deployment of the ISMS at the client site.

3.02 INSTALLATION

A. The CONTRACTOR or subcontractors main resources within the project shall carry proper professional certification issued by the manufacturer and verified by a third party organization to confirm sufficient product and technology knowledge.

B. The CONTRACTOR shall carefully follow instructions in documentation provided by the manufacturer to ensure all steps have been taken to provide a reliable, easy-to-operate system.

C. All equipment shall be tested and configured in accordance with instructions provided by the manufacturer prior to installation.

D. All firmware found in products shall be the latest and most up-to-date provided by the manufacturer, or of a version as specified by the integrator of the VSS system.

E. All equipment requiring users to log on using a password shall be configured with user/site-specific password/passwords. No system/product default passwords shall be allowed.

F. A proper installation shall meet NEC (National Electrical Code) per the guidelines of that year's revision. When properly installed equipment meets Low Voltage, Class 2 classification of the NEC.

3.03 NAMING CONVENTIONS

A. Weather proof labels showing the corresponding camera number shall be applied to each camera's housing.

3.04 TESTING

A. The VSS system shall be tested in accordance with the following:

1. Conduct a complete inspection and test of all installed access control and security monitoring equipment. This includes testing and verifying connection to equipment of other divisions such as intrusion detection and access control systems.

2. Provide staff to test all devices and all operational features of the Security Management System for witness by the Owner's representative and authorities having jurisdiction as applicable.

3. Correct deficiencies until satisfactory results are obtained.

B. Submit written copies of test results.
Complete Checklist for Security VSS provided in Appendix A.

3.05 PROTECTION

A. Protect the Work of this section until Substantial Completion.

3.06 OWNER ORIENTATION (TRAINING)

A. Before contract closeout provide the following training and orientation:

1. Provide a minimum 48 hours training for facility designated representatives. The content of the training is advanced instruction on the use, programming, maintenance and troubleshooting of the video surveillance system, devices and components.

a. Materials shall include training manuals and hands-on lab exercises.

b. The training shall be provided at the equipment manufacturer's authorized training facility located in Los Angeles County.

c. Training shall consist of classroom instruction including intensive course work covering the following topics:

1) Product Features and Technical Specifications

2) Implementation and Design as–built documentation, including familiarization with drawing sets, symbols and notation as well as other record documents.

3) Complete understanding of the system architecture and design of implemented solution.

4) Complete function and feature analysis on implemented solution including programming, operation, trouble shooting, error messages, etc.

3.07 CLEANUP

A. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

END OF SECTION

SECTION 28 31 00 - FIRE DETECTION AND ALARM

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Fire alarm system shall consist of fire alarm control panel or networked nodes of the same make and be CSFM (California State Fire Marshall) listed for the application.
2. Labor, equipment, materials, connections, testing, and performance of operations in the installation of fire alarm system.

B. Related Requirements:

1. Division 01 General Requirements.
2. Section 14 24 23: Hydraulic Passenger Elevators.
3. Section 21 13 13: Fire Suppression Sprinkler Systems.
4. Section 23 80 00: Mechanical Equipment.
5. Section 26 05 00: Common Work Results for Electrical.
6. Section 26 05 13: Basic Electrical Materials and Methods.
7. Section 26 05 19: Low-Voltage Wire (600 Volt AC).
8. Section 26 05 26: Grounding and Bonding.
9. Section 26 05 33: Raceways, Boxes, Fittings, and Supports.
10. Section 27 53 13: Clock and Program Systems.
11. Section 27 51 16: Public Address and Intercommunication Systems.
12. Section 27 5129: Public Address Systems

1.02 SYSTEM REQUIREMENTS

A. Fire detection system shall continually supervise and monitor the following initiating, signaling, and monitoring circuits:

1. Manual fire-pull stations.
2. Smoke and heat detectors, duct detectors, multicriteria detectors, combination smoke/heat/CO Detectors, including detectors installed under other sections.
3. Fire sprinkler flow and tamper switches. In existing installations also include PIV tamper switches.
4. Alarm signaling circuits including alarm bells, horns and visual alarm units.
5. Annunciators.
6. Power supplies and batteries.
7. Interconnection with Central and Autonomous Public Address systems, telephone network system, Clock System-Classroom or Program schedule change, HVAC system where applicable, kitchen fire suppression system, Theatrical and House Lighting, elevator equipment for control of recall function and elevator circuit breaker shunt trip, and other systems required by code.

B. System controls shall be UL listed for power limited applications in accordance with California Electrical Code.

C. System shall be listed for Internet of Things (IoT) security in compliance with UL 2900.

D. The fire alarm devices and equipment shall be listed for installation for the fire alarm control panel to which they are being connected.

E. Complete installation shall conform to the version of NFPA 72, California Fire Code, California Building Code (CBC), and California Electrical Code (CEC) as approved by DSA on stamped drawings.

F. System labels and devices programming addresses shall be based on final signage and building labeling submittals. For existing facilities contractor shall obtain from Owner Authorized Representative a copy of the current site layout and building labeling designations.

1.03 CERTIFICATION

A. Certification: Installation of fire alarm system shall not begin until Shop Drawings, including State Fire Marshal listing numbers of fire alarm components, are submitted and reviewed by the Architect. Written certification by fire alarm equipment distributor or manufacturer shall be submitted to the Architect stating that system and its component parts are as approved and listed by the State Fire Marshal, and that the design conforms to requirements set forth in CBC.

1.04 PERFORMANCE

A. System shall be fully programmable, configurable, and expandable in the field without special tools or PROM programmers and shall not require replacement of memory ICs. Installer shall provide a CD of system installed software, site specific system programming and information and tools required to re-program or modify the system.

1.05 SYSTEM FUNCTIONAL OPERATION

A. When a fire alarm condition is detected by one of the system alarm initiating devices, the following functions shall occur:

1. System alarm LED shall flash.
2. Local sounding device in panel shall be activated.
3. The LCD display shall indicate type of device, custom label location label and point status alarm condition.
4. Appropriate change of status message shall be transmitted to remote annunciator(s).
5. Automatic programs assigned to alarm point shall be executed and associated indicating devices and relays activated.
6. In the event of a fire alarm control panel activation, manual and automatic electronic tone or electromechanical bell class passing signals shall be disabled.
7. In the event of a fire alarm condition the Central and Autonomous Public Address System shall be overridden.
8. UDACT (Universal Digital Alarm Communicator Transmitter) shall activate.
9. Provide necessary hardware and labor for a complete and tested interfacing of the fire alarm system with the lighting controls systems in Auditoriums, Multi-Purpose

rooms, and Gymnasiums; lighting in these areas shall be brought to full brightness in the event of a fire alarm.

B. Trouble and Supervisory Conditions.

1. When any trouble condition is detected the following functions shall occur:

a. System trouble LED shall flash.

b. Local sounding device in panel shall be activated.

c. The LCD display shall indicate the type of trouble and custom label location associated with the trouble condition and its location. Unacknowledged alarm messages shall have priority over trouble messages. If such an alarm is displayed, then trouble messages shall not be displayed.

d. Appropriate message shall be transmitted to remote annunciators.

e. UDACT shall activate.

C. When any supervisory condition occurs such as a sprinkler valve tamper, the following function shall occur:

1. System supervisory LED shall flash.

2. Local sounding device in panel shall be activated.

3. Appropriate message shall be transmitted to remote annunciators.

4. UDACT shall activate.

D. Activation of control panel ACKNOWLEDGE switch in response to a single new alarm, trouble or supervisory condition shall silence panel sounding device and change system alarm, trouble, or supervisory LED from flashing to steady-ON. If additional new alarm, trouble, or supervisory conditions exist in the system; activation of this switch shall advance display to next alarm, trouble, or supervisory condition that exists, and shall not silence local audible device or change LED to steady until new conditions have been so acknowledged. New alarm conditions shall always be displayed before new trouble conditions. Occurrence of a new alarm, trouble, or supervisory condition shall cause panel to resound, and sequences as described above, shall repeat.

E. Activation of the signal silence switch shall cause appropriate notification (indicating) appliances and relays to return to normal condition. Selection of notification appliance circuits and relays silenced by this switch shall be fully programmable.

F. Activation of system reset switch shall cause electronically latched initiating devices or zones, as well as associated output devices and circuits, to return to normal condition after sixty seconds of alarm. If alarm conditions exist in system after system reset switch activation, system shall then re-sound alarm conditions as indicated hereafter.

G. Activation of lamp test switch shall turn on LED indicators, LCD display, and local sounding device in panel, and then return to previous condition.

H. Fire alarm indicating appliances may be silenced or extinguished, after one minute, by operating signal silence switch at the FACP or by use of key supervised alarm silence switch at remote annunciators. A subsequent zone alarm shall reactivate signals. Audible indicating appliances shall be automatically silenced after no less than five nor more than ten minutes of operation. Visual indicating appliances shall be extinguished at system reset, or automatically after no less than five nor more than ten minutes of operation. Fire sprinkler flow alarm bells shall not silence until the contacts in the fire sprinkler flow switch return to the normal non-alarm state. Appropriate signage must be installed on or next to the sprinkler alarm bell.

I. Elevator lobby, machine room and hoistway smoke detectors shall, in addition to operations listed above, cause elevator cars to be recalled as follows:

1. Elevator cars shall be recalled to main level of egress through the use of a primary recall interface relay.

2. Elevator cars shall be recalled to predetermine alternate level if main lobby smoke detector is activated.

3. Fire Fighter's hat light indicator in elevators shall provide visual warning when elevator lobby, machine room, and hoistway smoke detectors are activated.

J. System's circuits including but not limited to initiation, indicating, and equipment interfacing shall be monitored for open or short circuit and ground fault conditions, these conditions shall be indicated on the Fire Alarm Control Panel and Annunciator displays while remaining circuits continue to operate normally.

K. Notification appliance circuits shall be silenceable for testing purposes by authorized persons. Protected pass-codes, keys, or another secure method that does not require entering into the system programming shall be used.

1.06 POWER REQUIREMENTS

A. The fire alarm control panel and remote power supply shall receive 120 VAC power, 60 Hz, through a dedicated 20 amps circuit. Circuit breaker protection for the dedicated fire alarm power circuits shall be equipped with a handle lock-on device; the breaker handle shall be colored red and labeled "FIRE ALARM". Clearly label the Electrical panel name, location and circuit number on the inside of the fire alarm control panel and remote power supplies using a p-touch style labeling system. Transient voltage surge suppression shall be provided at the 120VAC input terminal.

B. System shall be provided with sufficient battery capacity to operate entire system upon loss of normal 120 VAC power, in a normal quiescent mode, for a period of 24 hours with five minutes of alarm indication at end of this period. System shall automatically transfer to standby batteries upon power failure. Battery charging and recharging operations shall be automatic. Batteries, once discharged, shall recharge at a rate to provide a minimum of 70 percent capacity in 12 hours.

C. Circuits requiring system operating power shall be 24 VDC and shall be individually protected at control panel.

1.07 SUBMITTALS

A. Provide in accordance with Division 01.

B. Component Plan Submittal: Availability and listing for its application shall be verified for system components before presentation of the submittal. Include the following information and details as applicable:

1. Installer name, address, telephone number.

2. List of system components, equipment and devices, including manufacturer model numbers, quantity and California State Fire Marshal listing numbers, mounting heights, and symbols per symbol list.

3. Copies of manufacturer specification sheets for equipment and devices indicated. Highlight or identify the specific components on Catalog cut sheets.

4. Voltage Drop Calculations: Include the following information for the worst case:

a. Point-to-point or Ohms law calculations.

b. Zone used in calculations.

c. Voltage drop percent. Voltage drop shall not exceed manufacturer's requirements. If voltage drop exceeds ten percent, indicate manufacturer listed operating voltage ranges for equipment and devices.

5. Battery types, amp hours, and load calculations including the following:

a. Normal operation: 100 percent of applicable devices for 24 hours to equal control panel amps plus list of amps per device that draw power form the panel during standby power condition including, but not limited to, zone modules, detectors and devices as identified.

b. Alarm condition: 100 percent of applicable devices for five minutes to equal control panel amps plus list of amps per device that draw power from panel during alarm condition including, but not limited to, the following:

1) Zone modules.

2) Signal modules.

3) Detectors.

4) Signal devises.

5) Annunciator.

6) Other devices as identified.

c. Normal operation plus alarm operation load calculation shall include total amp hours required and total amp hours provided.

6. Provide one copy of testing procedures.

C. Shop Drawings: Provide Shop Drawings, in the same size as the design Drawings, include the following:

1. Provide drawing scale, elevations of system enclosures, and actual layout of the Fire Alarm Control Panel, power supply, annunciator, and main system components.

2. Site Plan indicating PIV and related fire sprinkler system devices and equipment to be monitored or supervised; such as water flow valves, and main equipment such as control panels, power supplies, annunciators, and components such as outdoor wall-mounted horns, sprinkler bells, pull boxes, underground pull boxes , wiring routes on buildings exteriors and underground locations. In each conduit or raceway run indicate conduit sizes, and quantities and type of wires.

a. In existing facilities make a distinction between existing and new installation.

3. Complete battery calculations, and voltage drop calculation shall be included; these calculations shall be based on the devices maximum UL current rating.

4. One line drawing for the entire system network indicating system components and wiring. The one line diagram shall show but not be limited to panel to panel interconnections, conductors gage and quantity, conduit size and type (designation) and specific function.

5. System panel one-line drawings indicating the quantity and type (designation) of conductors entering and exiting the fire alarm terminal cabinet in each building (enclosure) for initiating, notification, or other command control functions required for complete system operation:

a. Individual floor or building plan view drawings indicating device locations including end of line resistors “EOLR” in accordance with the legend provided.

b. Individual point addresses for initiation and notification devices.

c. Device “typical” wiring diagrams. These drawings shall indicate specific termination details for peripheral equipment and interface devices.

6. Provide interfacing with equipment furnished by others including voltages, and other required coordination items. Refer to 3.01-B.

7. Each of the pictorial diagrams included shall appear identical to the products they are intended to depict, in order to speed installation of the system, and to enhance the accuracy of the installation Work. Typical wiring diagrams or catalog sheets are not permitted.

8. Background Drawings with device locations of DSA approved drawings are available in electronic format and may be obtained from the Owner Authorized Representative (OAR). Contractor is solely responsible for the accuracy and completeness of shop drawings. Buildings that are not part of the contract shall be clearly identified “NOT IN CONTRACT”. Shop Drawings shall be prepared in the latest version of AutoCAD with three – CD ROM electronic copies submitted along with full sized Shop Drawings.

9. Other installation and coordination drawings specifically related to this section shall be included as follows:

a. Size A (8 ½ by 11) and size B (11 by 17) shall be bound into the manual.

b. Larger drawings shall be folded and inserted into transparent envelopes and bound into the manual.

10. Installation and coordination drawings for items in other sections shall be included with submittal of Shop Drawings. Submit blue line copies and one reproducible copy of installation and coordination drawings.

11. Samples: Provide Samples of material and equipment as required by the Architect. If Samples are requested, they shall be submitted within ten days from date of request.

D. In addition to the above requirements, provide submittals to meet any additional requirements of DSA.

E. Submittal of Equivalent Systems:

1. In addition to the submittal requirements of this section, if an equivalent system listed in Section 2.01A is submitted in lieu of the designed system shown on DSA approved drawings, the Contractor shall also submit a letter stating that the system is equivalent, and that device locations and quantities of devices are unchanged. Attached to this letter shall be a copy of the revised equipment schedule with corresponding CSFM numbers and a cut sheet for each item.

F. Modifications or additions to existing fire alarm systems shall be compatible and of the same manufacturer as the existing system. Contractor shall be solely responsible for engineering, plan check and any fees resulting from an installation that deviates from this requirement.

G. Prior to Substantial Completion submit to the Architect or Engineer of Record and to Owner Authorized Representative a complete updated set of the Shop Drawings showing changes made to the Fire Alarm System during construction. These drawings will become the System As-Built Drawing set for the Fire Alarm System Owner’s Manual.

1.08 QUALITY ASSURANCE

A. Installer shall have successfully completed at least five projects of equal scope in the past five years, and have been in business of furnishing and installing fire alarm systems of this type for at least five years.

B. Installer shall be a factory authorized distributor and service provider for the brand of equipment offered and shall provide documentation to the Architect upon request.

C. Installer shall maintain a fully equipped service organization capable of furnishing repair service to the equipment and shall maintain a spare set of major parts for the system at all times.

D. Installer shall furnish a letter from manufacturer of equipment certifying equipment has been installed according to factory standards and that system is operating properly.

E. Certifications: Installer shall submit certification from the equipment manufacturer indicating that installer is an authorized representative of the equipment manufacturer and is trained on network applications.

F. Materials and equipment installed shall be new.

G. Equipment in this specification shall be furnished and installed by the Authorized Factory Distributor of the equipment. Furnish a letter from the manufacturer of major equipment, which certifies that the installer is an authorized distributor and that the equipment has been installed according to factory intended practices. Furnish a written guarantee from the manufacturer that they will have a service representative assigned to this area for the life of the equipment.

H. Installer shall be Underwriters Laboratory (UL) listed company under the UUJS classification, and shall certify that the installation has been made in accordance with UL requirements.

I. The fire alarm contractor shall have a NICET II Certified Technician on staff in their facility directly involved with this project to ensure technical expertise to this project and adherence with these specifications.

J. Contractor or Installer's Electricians and fire and life safety technicians shall be certified in accordance with Labor Code sections 3099, and 3099.2, and section 209.0 of the California Code of Regulations.

K. System startup and testing shall be performed under the direct observation of the Project Inspector and OAR. Provide a legible half size reproduction of the original completed fire alarm red-line drawings (this copy will be retained by the Owner), an accurate copy of the fire alarm system points list, and a copy of the construction drawings on CD in AutoCad format.

L. At the time of installation the most current software package available shall be provided.

M. Provide at the time of Owner Acceptance of the installation, equipment, and updated software which is to include the appropriate operating system, pass-codes, electronic keys and program disks, manuals and cables employed in the installation of the system. These components shall be delivered to the OAR.

N. Provide a backup copy of the most current software revision, in disk format. This copy shall be delivered to the OAR

O. A software license agreement shall be made available for the responsible Owner representative to sign at the time of training.

1.09 WARRANTY

A. The Fire Alarm Equipment Manufacturer shall provide a three year material warranty. Installer shall provide a three year labor warranty.

B. Complete maintenance and repair service for the fire alarm system shall be available from a factory trained authorized representative of the manufacturer for a period of five years after expiration of the warranty.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Fire alarm equipment shall be standard products of the Simplex.

B. Catalog and model numbers listed are intended to establish type and quality of equipment and system design as well as operating features required. Deviations from intended functions of specified system are not permitted. Equipment shall not be ordered or installed until such equipment has been reviewed and approved by the Architect.

C. Products requirements indicated in articles 2.02 through 2.05 are based on Simplex system components. Refer to Attachment A – Fire Alarm Approved System Components for a complete list of approved products.

2.02 FIRE ALARM CONTROL PANEL (FACP) OR NETWORK NODES

A. Furnish Fire Alarm Control Panels as indicated on drawings.

B. Operator Control:

1. Acknowledge Switch: Activation of control panel acknowledge switch in response to a single new trouble or alarm condition shall silence panel sounding device and change system alarm or trouble LED from flashing to steady-ON. If additional new alarm or trouble conditions exist in system, activation of this switch shall advance display to next alarm or trouble condition that exists, and shall not silence local audible device or change LED to steady until new conditions have been so acknowledged. New alarm conditions shall always be displayed before new trouble conditions. Occurrence of a new alarm or trouble condition shall cause panel to resound, and sequences as described above, shall repeat.

2. Signal (Alarm) Silence Switch: Activation of the signal silence switch shall cause programmed alarm notification appliances and relays to return to the normal condition after an alarm condition. The selection of notification circuits and relays that are silenceable by this switch shall be fully fielded programmable within the confines of applicable standards at the job site. The FACP software shall include silence inhibit and auto-silence timers.

3. Alarm Activate (Drill) Switch: Alarm activate switch shall activate notification appliance circuits. The drill function shall latch until the panel is silenced or reset.

4. System Reset Switch: Activation of the System Reset switch shall cause electronically-latched initiating devices, appliances or software zone, as well as associated output devices and circuits, to return to their normal condition.

5. Lamp Test Switch: Switch shall activate local system LEDs, light each segment of the liquid crystal display and display the panel software revision for service personnel.

6. Hot Button Switch: Hot Button Key switch shall be provided in FACP to disable all output devices for testing or repair of system. Key switch shall silence all horn and

strobes, disable PA cutouts, HVAC shutdowns, door closures, and Autonomous PA systems. Key switch shall be password protected to enable function. LED indicator shall illuminate a trouble condition while Hot Button Switch is activated and shall turn off when system is re-enabled.

C. System Capacity and General Operation

1. The control panel or each network node shall provide or be capable of expansion to 636 minimum intelligent addressable devices in smaller systems, and 3180 intelligent addressable devices for larger systems.

2. The control panel or each network node shall include Form-C alarm, trouble, supervisory, and security relays rated at a minimum of two amps at 30 VDC. It shall also include four Class B (NFPA Style Y) or Class A (NFPA Style Z) programmable Notifications Appliance Circuits.

3. The control panel or each network node shall support up to eight output modules (signal or relay), each with eight circuits for a total of 64 circuits for the smaller capacity panels, and 12 output modules for a total of 96 circuits for the larger capacity panels. Programmable notification appliance circuits shall be class B.

4. The system shall include a full featured operator interface control and annunciation panel that shall include a backlit Liquid Crystal Display (LCD), individual color coded system status LEDs, and an alphanumeric keypad with easy touch rubber keys for the field programming and control of the fire alarm system.

5. The system shall be programmable, configurable, and expandable in the field without the need for special tools, PROM programmers or PC based programmers. It shall not require replacement of memory ICs to facilitate programming changes.

6. The system shall allow the programming of any input to activate any output or group of outputs. The FACP shall support up to 20 logic equations, including “and” “or” and “not”, or timed delay equations to be used for advanced programming. Logic equations shall require the use of a PC with software utility designed for programming.

7. The FACP or each network node shall provide the following features:

   a. Drift compensation to extend detector accuracy over life. Drift Compensation shall also include a smoothing feature, allowing transient noise signals to be filtered out.

   b. Detector Sensitivity tests, meeting requirements of NFPA 72 Chapter seven.

   c. Maintenance alert, with two levels (maintenance alert or maintenance urgent), to warn of excessive smoke detector dirt or dust accumulation.

   d. Nine sensitivity levels for alarm, selected by detector. The alarm level range shall be 0.5 to 2.35 percent per foot for photoelectric detectors and 0.5 to 2.5 percent per foot for ionization detectors. The system shall also support sensitive advance detection laser detectors with an alarm level range of 0.03 percent per foot to one percent per foot. The system shall also include up to nine levels of Pre- alarm, selected by detector, to indicate impending alarms to maintenance personnel.

   e. Circuit boards, programming, and interconnecting cables to enable the system to display or print system reports.

   f. Alarm verification, with counters and a trouble indication to alert maintenance personnel when a detector enters verification 20 times.

g. PAS pre-signal testing in accordance with California Fire Code (CFC) and NFPA 72 requirements.

h. Rapid manual station reporting (less than three seconds) shall meet CFC and NFPA 72 requirements for activation of notification circuits within ten Seconds of initiating device activation.

i. Periodic detector test, conducted automatically by the software.

j. Self-optimizing pre-alarm for advance fire warning, which allows each detector to learn its particular environment and set its pre-alarm level to just above normal peaks.

k. Cross zoning with the capability of counting: two detectors in alarm, two software zones in alarm, or one smoke detector and one thermal detector.

l. Walk test, with a check for two detectors set to same address.

m. Control-by-time for non-fire operations, with holiday schedules.

n. Day or night automatic adjustment of detector sensitivity.

o. RS 232 serial port to support a District supplied printer to be used for silent testing and certification of the system.

8. The FACP shall be capable of coding main panel(s) node notification circuits in temporal code (NFPA 72 A-2-2.2.2).The panel shall also provide a coding option that will synchronize specific strobe lights designed to accept a specific “sync pulse”.

9. Network Communication:

a. The network architecture shall be based on a Local Area Network (LAN), a firmware package that utilizes a peer-to-peer, inherently regenerative communication format and protocol. The protocol shall be based on ARCNET or equivalent non-proprietary protocol.

b. Failure of any node shall not cause failure or communication degradation of any other node or change the network communication protocol among surviving nodes located within distance limitations. A node may be an intelligent Fire Alarm Control Panel (FACP), Network Control Station PC (NCS) or Network Control Annunciator (NCA).

c. Each network node address shall be capable of storing Event Equations which shall be used to activate outputs on one network node from inputs on other network nodes.

D. System Display:

1. Utilize the 640-character display option. The design of the CPU shall provide for a configuration with the 640-character display mounted on the front of the unit in place of the standard 80-character display.

2. The 640-character display shall provide the controls and indicators used by the system operator: The 640 character display shall include the following operator control switches; Acknowledge, Alarm, Silence, Alarm Activate (drill), System Reset and Lamp Test.

3. The display shall annunciate status information and custom alphanumeric labels for intelligent detector, addressable modules, internal panel circuits, and software zones.

4. The 640-character display shall provide ten Light-Emitting-Diodes (LEDs) that indicate the status of the following system parameters: AC Power and Network Communication, Fire Alarm, Pre alarm Warning, Security Alarm, Supervisory Event, System Trouble, Alarm Silence, Disabled Points, CPU failure.

5. The 640-character display shall use ten “soft” keys for screen navigation or to accomplish dedicated programming functions. Full programming access shall require use of a laptop and the proper programming utility. The programming utility shall be provided to the OAR who will forward it to the local maintenance area representative.

6. The system shall support the display of battery charging current and voltage on the LCD display.

E. Network Control Annunciator:

1. When a networked system is installed a network controlled annunciator (NCA) shall be provided to display system intelligent points. The NCA shall be capable of displaying information for all possible points on the network.

2. The NCA shall include a minimum of 640 characters, backlit by a long life, solid-state LCD display. Additionally, the network display shall include ten soft keys for screen navigation and the ability to scroll events by type. i.e. Fire Alarm, Supervisory Alarm, Trouble, etc.

3. The NCA shall have the ability to display up to eight events in order of priority and time of occurrence. Counters shall be provided to indicate the total number of event by type.

4. The NCA shall mount in a Simplex ABS-2DB or equal keyed box; provide a key enable or disable switch for the network node fire alarm control panels. The network display may mount in a backbox designed for this use. The network shall support the NCAs.

5. The network control annunciator shall have an event history buffer capable of storing a minimum of 1000 events in nonvolatile memory. Additionally, the NCA shall have a fire alarm history buffer capable of storing a minimum of 200 events in nonvolatile memory.

6. The NCA shall include two EIA-232 ports for UL864 listed printers and CRT’s.

7. The NCA shall include control switches for system wide control of Acknowledge, Signal Silence, System Reset, Drill, and local Lamp Test. A mechanical means, by which the controls switches are locked out, such as a key, shall be provided.

8. The NCA shall include long life LEDs to display Power, Fire Alarm, Pre-Alarm, Security Alarm, System Trouble, Supervisory, Signals, Silenced, Disabled Prints, other (non-fire) Events, and CPU Failure.

9. The NCA shall include a Master Password and up to nine user Passwords. The Master password shall be required to access the programming and alter status menus. Each User password may have different levels of authorization assigned by the Master password. Passwords installed into the NCA shall be made available to the OAR who will forward them to the local maintenance area representative.

10. The NCA shall allow editing of label for points within the network, control on or off of outputs, enable or disable of network points, alter detector sensitivity, clear detector verification counters for any analog addressable detector within the network, clear any history log within the network, change the Time or Date settings, initiate a Walk Test.

11. The NCA shall include a time of day clock.

12. Each NCA shall support 80-character remote display annunciators for displaying network activity. These “Terminal Mode” displays will mimic the activity appearing on the corresponding NCA. There shall be only one annunciator or control system consisting of components manufactured by one manufacturer for the fire alarm system.

F. Signaling Line Circuits (SLC):

1. Each FACP or FACP network node shall support a minimum of one SLC for the smaller panels and ten SLC’s for the larger panels. Each SLC interface shall provide power to and communicate with up to 159 intelligent detectors (ionization, photoelectric or thermal) and 159 intelligent modules (monitor or control) for a loop capacity of 318 devices.

2. CPU shall receive analog information from intelligent detectors to be processed to determine whether normal, alarm, pre-alarm, or trouble conditions exist for each detector. The software shall automatically maintain the detector’s desired sensitivity level by adjusting for the effects of environmental factors including the accumulation of dust in each detector. The analog information shall also be used for automatic detectors testing and for the automatic determination of detector maintenance requirements.

G. Enclosures:

1. The control panel shall be housed in a UL-listed cabinet suitable for surface or semi-flush mounting. The cabinet and front shall be corrosion protected, given a rust-resistant prime coat, and manufacturer’s standard finish.

2. The back box and door shall be constructed of 0.030 steel with provisions for electrical conduit connections into the sides and top.

3. The supplied door shall include a key lock and shall include glass or other transparent opening for viewing of indicators. For convenience, the door may be site configured for either right or left hand hinging.

H. Power Supply:

1. An off-line switching power supply shall be available for the fire alarm control panel or network nodes.

2. Provisions shall be made to allow the audio-visual power to be increased as required by adding modular expansion audio-visual power supplies.

3. Over-current protection shall be provided on power outputs. The power supply shall provide an integral battery charger. Battery arrangement may be configured in the field.

4. The power supply shall continuously monitor field wires for earth ground conditions, and shall have the following LED indicators:

   a. Ground Fault LED.

   b. AC Power Fail LED.

   c. NCA-2 on LED (4).

5. The main power supply shall operate on 120 VAC, 60 Hz, and shall provide power for the FACP or network node(s).

6. The main power supply shall provide a battery charger using dual rate charging technology for fast battery recharge and be capable of charging batteries up to 60 AH for the smaller panels and 200 AH for larger panels.

2.03 REMOTE ANNUNCIATORS

A. A non-networked fire alarm system annunciator is required when there is only one FACP in the system. Provide alphanumeric display remote annunciator(s) per plans. A Network annunciator is required for any system that contains more than one fire alarm control panel (FACP) or network node. Display shall be back lit and be furnished with a maximum of 20 characters of 4 lines for the smaller panels, and 40 characters on 16 lines for the larger panels. Annunciators shall provide the following functions:

1. Control switches for system acknowledge, signal silence and system reset via a touchpad.
2. Time and date display field.
3. Local piezo sounder with alarm or trouble resound.
4. On-line green LED (flashing).
5. Evacuation and drill switches, via a touchpad.
6. Pre-signal hold via a touchpad.
7. System test at control panel and CTR.

B. Following additional features shall be furnished:

1. Device Fire Annunciation.
2. Device Trouble Annunciation.
3. System Operation Annunciation.
4. "Power On" LED.

C. Typewritten operating instructions and a site map shall be posted adjacent to remote annunciator(s). The site map shall be sized and include designations and devices as described in paragraph 3.02 N. of this specification. Project site map shall depict fire alarm devices in the building(s) in which they are installed. The instruction and site map shall be mounted in suitable document frames and attached to the wall with a minimum of two screws each. Contractor’s name and telephone number shall not be placed on either the instruction or the site map.

2.04 POWER SUPPLIES

A. Remote Notification Appliance Circuit (NAC) extender power supplies shall be furnished with main printed circuit board, transformers, lockable cabinet, and batteries. Unit shall be configured to drive 4 notification appliance circuits. The remote power supplies shall be configured with a monitor module to report trouble conditions to the controlling FACP via an SLC. Triggering of NAC inputs shall be directly controlled from the FACP without the use of addressable control or relay modules.

2.05 PERIPHERAL DEVICES AND EQUIPMENT

A. Manual Stations (interior): Manual pull stations shall be addressable semi-flush, non-breakable glass type for building interiors. Station housing shall be fabricated of die-cast aluminum with reset lock and key. Provide an addressable monitor module for each manual station.

B. Manual Stations (exterior): Manual stations shall be addressable semi-flush, non-breakable glass type for building exteriors. Station housing shall be fabricated of die-cast aluminum with reset lock and key. Provide an addressable monitor module for each manual station.

C. Smoke Detectors: Smoke Detectors shall be addressable. Detector shall be microprocessor based, using a combination of photoelectric, and thermal sensing technologies. The smoke detector shall have its loop number and electronic address permanently and clearly labeled onto the device base using a p-touch type labeling system. The label shall be visible without re moving the detector head.

D. Non-Explosion Proof Automatic Addressable Heat Detectors shall be combination rate-of-rise and fixed-temperature type. When fixed-temperature portion is activated, units shall provide visual evidence of such operation (LED). The location of the heat detector must be clearly marked below the ceiling and the detector must be readily accessible. The heat detector shall have its electronic address permanently and clearly labeled onto the device and be readily accessible. For spaces such as attics, where the ambient temperature can reach around 150^{o} degrees Fahrenheit in hot days, use detectors rated for the application. The heat detector shall have its loop number and electronic address permanently and clearly labeled onto the device using a p-touch labeling system. The label shall be visible without removing the detector head.

E. Explosion Proof Automatic Heat Detectors shall be rated for 135^{o} degree Fahrenheit alarm temperature. Mount the detector on a JL threaded hub cover manufactured by Killark Electric, or equivalent from other owner approved manufacturers. Seals, conduit type, and fittings shall be suitable for the hazardous zone and location where the device will be installed. Provide an appropriate wire protective cover over box and detector. Addressable module(s) associated with this type of devices shall be installed outside of the hazardous area.

F. Weatherproof Automatic heat Detectors: shall be rated for 135^{o} degree Fahrenheit alarm temperature. Detector shall be mounted horizontally in a two gang weatherproof box with cover manufactured by Hubbell/Bell or equivalent from other owner approved manufactures. Install an appropriate wire protective cover over box and detector. Conduit type and fittings shall be suitable for the environment where the device will be installed.

G. Duct Smoke Detectors: Duct smoke detectors shall be of solid-state photoelectric type and shall operate on light-scattering photodiode principle. The location of the duct detector must be clearly marked below the ceiling and the detector must be readily accessible. The duct smoke detector shall have its electronic address permanently and clearly labeled onto the device. The label shall be visible without removing the detector head. Duct smoke detectors that are already installed as part of packaged ventilation equipment that are not the detector specified above shall be connected to the fire alarm system via a monitor module. The existing power source shall be disconnected and resettable power from the FACP or Remote Power Supply shall be connected in place of the existing power source for fire alarm system resettable power and alarm initiation.

H. Projected Beam Infrared Type Smoke Detectors shall consist of a transmitter/ receiver unit and reflector to be used in accordance with manufacturer's recommendations. Each detector shall include six user-selectable sensitivity levels. Alignment shall be achieved with a signal strength meter incorporated into the beam detector. The detector shall feature automatic detection and adjustment to the optimum level for the specific environment. Provide remote System Sensor Model RTS-451KEY test stations with key lock for detectors or equal, locate test stations below ceiling.

I. Linear Heat Detectors: Linear detectors shall be Protectowire or equal. linear detectors shall be rated for 150-degree Fahrenheit installed ambient temperature and 190-degree Fahrenheit alarm temperature. Damaged detector due to excessive bending or kinking

during installation shall not be accepted. Interface the Protectowire detector with the FACP system via addressable monitor module(s) located on one extreme of the detector and an end of line resistor at the other extreme. End of line resistor shall be readily accessible for testing. Provide appropriate signs indicating the existence of linear heat detectors at the entrances of areas protected with this type of fire detection. Installation shall be done in accordance with applicable codes and standards, and manufacturer's published installation recommendations.

1. Provide a system that utilizes linear heat detectors in concealed or controlled access areas. The detection wire shall be installed within 20 inches of the underside of the building roof or the above floor as recommended by the manufacturer. In shallow areas install the detection wire within the upper part of the space to be protected.

    a. One circuit of linear heat detection shall be utilized for areas not exceeding 4,000 square feet above multiple rooms.

    b. Areas above Gymnasiums and Auditoriums exceeding 4,000 square feet shall be considered one zone.

    c. Areas divided by a fire rated wall shall be protected separately and considered an independent zone.

J. Multi-Criteria Fire Detectors (MS and HS Only): These Detectors shall be used on performing stages and surrounding areas of the performing stage and other locations where the use of special effect smoke systems may be used.

1. Multi-Criteria Fire Detector shall combine four separate sensing elements into one unit:

    a. Photoelectric chamber shall sense airborne particulate for smoke detection.

    b. Electrochemical cell technology shall monitor carbon monoxide.

    c. Infrared sensing shall measure ambient light levels and flame signatures.

    d. Thermal detection shall monitor temperature.

2. Multi-Criteria Detector shall be capable of generating only one alarm signal from at least two sensors of the four when positively confirming a fire. The sensor output shall be mathematically evaluated to determine when a signal is warranted.

3. Twin LED indicators shall provide 360 degree visibility.

K. Monitor Modules:

1. Monitor modules shall connect a supervised zone of conventional initiating devices, N.O. dry contact devices, including four-wire smoke detectors, to one of SLC loops. Monitor module shall install in a four-inch square by 2 1/8-inch deep electrical box. The module shall have its loop number, electronic address, and function label on the front cover using a P-Touch type or equal labeling system.

2. Monitor module shall provide address-setting means using rotary decimal switches and shall store an internal type of device. An LED shall be provided which shall flash under normal conditions indicating that monitor module is operational and in regular communication with control panel.

L. Control Modules:

1. Control modules shall be used to connect conventional indicating appliances or MR type isolation relays to one of the SLC loops. Control modules shall be installed in a standard four-inch square by 2 1/8-inch deep electrical box. Audio or visual or

relay power shall be provided by a separate loop from main control panel or from supervised remote power supplies. Each module shall have its loop number, electronic address, and function label on the front cover using a p-Touch type or equal labeling system. Provide Air Products PAM-3 Relay Model or equal power supervision relay to monitor 24-volt DC power.

2. Control module shall provide address-setting means using rotary decimal switches and shall store an internal identifying code which control panel shall use to identify type of device. An LED shall be provided which shall flash under normal conditions, indicating that control module is operational and in regular communication with control panel.

M. Relay Modules:

1. Relay Module shall be Simplex depending on requirements. Modules shall provide as a minimum one set of form “C” dry contacts and have its loop number, electronic address, and function labeled on the front cover using a P-Touch type labeling system.

2. Provide a buffer relay that is part of the control system if controlled circuit(s) exceeds the voltage or current rating of the relay module.

3. Relays used to interface control of other systems shall be electrically supervised and shall only be wired in a fail-safe mode of function during a power failure.

N. Isolator Modules:

1. Isolator module shall isolate wire-to-wire circuits on an SLC loop in order to limit number of other modules or detectors that are incapacitated by short circuit fault. If a wire-to-wire short occurs, isolator shall automatically open-circuit SLC loop. When short is corrected, isolators shall automatically reconnect isolated section of SLC loop.

2. Isolator module shall not require address setting, although isolators will electrically reduce capacity of loop by two detectors or module addresses. Isolator module will install in a standard 4-inch deep electrical box. It shall include a single LED that shall flash to indicate that isolator is operational and shall illuminate steadily to indicate that a short has been detected and isolated.

O. Speakers and Strobes: Speakers and strobes shall be products of the same manufacturer. In order to establish a standard of quality, items are specified from the products manufactured by System Sensor, acceptable manufacturers are Honeywell, Wheelock Inc., Gentex or District approved equal. Addressable or multifunction two wire indicating (Audible or Visual) appliances shall not be acceptable.

1. Alarm speakers shall be polarized and operated by 24 VDC. Entire unit shall be red finish. Speaker assemblies shall be furnished with separate wire leads for in or out wiring for legs of associated signal circuits. T tapping of signal device conductors to signal circuit conductors is not permitted. Suitable gaskets shall be provided for weatherproof installation. Speakers shall provide a minimum sound pressure level of 100 dB at 10 feet. Speakers shall be mounted on manufacturer’s recommended outlet boxes. Provide speakers with a back box skirt on indoor surface mount outlet boxes.

2. Speaker/strobe shall be wall mounted or ceiling mounted Simplex or equal. Speaker/strobe shall operate on two separate two wire 24 VDC polarized circuits and shall be provided with a semi-flush mounting plate. Entire unit shall be red finish. Strobe light shall have a clear Lexan lens. The word "FIRE" shall be printed on the two sides of the strobe body. Speaker shall provide a minimum sound output

of 100 dB at 10 feet. The strobe shall provide a selectable minimum light intensity of 15, 30, 60, 75, 90, 110, 135, 150, or 185 Candela as indicated on Drawings to meet or exceed requirements of CBC, CHAPTER 11B AND ADAAG and UL 1971. Speaker/Strobes shall be mounted on manufacturer recommended outlet boxes. Weather proof speaker shall be Simplex. Provide a model No. BBS-2 back box skirt on indoor surface mounted outlet boxes.

3. Strobe indicating appliances shall be System Sensor or equal. Devices shall be UL listed and shall be wall-mounted. Entire unit shall be red finish. Strobe light shall have a clear Lexan lens. The word "FIRE" shall be printed on two sides of the strobe body. Strobes shall meet CBC, CHAPTER 11B AND ADAAG and UL 1971 requirements. The strobe shall provide a selectable minimum light intensity of 15, 30, 60, 75, 90, 110, 135, 150, or 185 Candela as indicated on the Drawings to meet or exceed requirements of CBC, CHAPTER 11B AND ADAAG and UL 1971. Strobes shall be mounted on manufacturer recommended outlet boxes. Weather proof strobe shall be Simplex. Provide a model No. BBS-2 back box skirt on indoor outlet boxes.

4. Strobe synchronization modules if required shall be System Sensor or equal, to be installed in conjunction with two or more strobes located in same room or corridor or as indicated on Drawings. (Strobe synchronization modules must be compatible with installed strobes).

P. Electromagnetic Door Holder: Electromagnetic door holders shall be installed on doors as indicated on Drawings or as required. Electromagnetic Doors shall consist of a wall-mounted electromagnet and a door-mounted armature with an adjustable contact plate. Electromagnets shall provide a force of attraction of 35 pounds when energized and less than three pounds residual with power disconnected. Armature contact plates shall provide a horizontal adjustment of 25 degrees. The holding force of Electromagnetic Doors shall be totally electromagnetic and without the use of mechanical linkage or other moving parts. Electromagnetic Door Holders shall normally be energized, and a release shall be accomplished by interrupting the circuit. Door holders shall be Reliable Security Group DH Serie or Altronix. The power supply shall be equipped with a failsafe input trigger circuit and five individually protected outputs. (Electromagnetic Door holders shall not be powered by an FACP or remote NAC power supplies).

Q. Bells shall be Cooper Notification polarized type and operated by 24 VDC. Bell shall be powered from FACP or Remote NAC power supply. When used as a notification appliance to indicate fire sprinkler water flow the bell shall be directly controlled by contacts in the associated flow switch. Addressable relays or control modules shall not be used to supervise sprinkler bells. Bell assemblies shall provide separate wire leads for in or out wiring for legs of associated signal circuits. Bells shall be vibrating type providing a minimum sound pressure level output of 84 - 87 dB at ten feet. Bells shall be ten inches in diameter, finished with baked-on red enamel paint, UL listed for fire alarm installation, and suitable for surface or semi-flush mounting. Provide a sign adjacent to the water flow bell with one inch tall and 3/8 inch stroke white lettering on a bright red background. The sign shall read: “NOTIFY FIRE DEPARTMENT WHEN ALARM SOUNDS”.

R. Water-flow Switches:

1. Water-flow switches shall be Potter Electric or equal. Vane-type water-flow switches shall be installed on system piping as designated on Drawings or as required. Detectors shall install on clear pipe spans of appropriate nominal size, either a vertical or horizontal run, at least six inches from fittings or valves which may change water direction, flow rate or pipe diameter, and not closer than 24 inches to valves or drains. Detector shall respond to water-flow in specified direction after a preset time delay that is field adjustable. Actuation mechanism shall include a polyethylene vane inserted through a hole in the pipe and

connected by a mechanical linkage to delay mechanism. Output shall consist of ten amps (dual SPDT switches form-C contacts). A conduit entrance for standard electrical conduit fittings shall be provided on detectors. Detectors shall be listed by UL for indoor or outdoor installation. No more than 18 inches of seal-tight flex may be used to connect the water flow or tamper switch to the site conduit system at any one location.

2. Sprinkler valve tamper switches shall be System Sensor for use with outside screw-and-yoke valves or for use with post indicating valves or equal, as indicated. Supervisory switch shall be installed on valves as designated on Drawings or as required. Switches shall be installed to not interfere with normal valve operation and shall be adjusted to operate within two revolutions of valve control or when stem has moved no more than 1/5 of distance from its normal position. Mechanism shall be housed in a weatherproof die cast metal enclosure, also providing a 3/4 inch tapped conduit entrance to incorporate necessary facilities for attachment to valve. Switch mechanism shall be furnished with a minimum rated capacity of ten amps at 125 VAC and 2.5 amps at 24 VAC. Entire installed assembly shall be tamper-resistant. Tamper switches shall be UL listed. No more than 18 inches of seal-tight flex may be used to connect the water flow or tamper switch to the site conduit system at any one location.

S. Universal Digital Alarm Communicator Transmitter shall be Simplex.The UDACT is an interface for communication of digital information between a fire alarm control panel and a UL-Listed central station.

1. The UDACT shall be compact in size, mounting in a standard module position of the fire alarm control cabinet. Optionally, the UDACT shall have the ability for remote mounting, up to 6000 feet from the fire alarm control panel. The wire connections between the UDACT and the control panel shall be supervised with one pair for power and one pair for multiplexed communication of overall system status.

2. The UDACT shall include connections for dual telephone lines (with voltage detect), per UL or NFPA or FCC requirements. It shall include the ability for split reporting of panel events between up to three different telephone numbers.

3. It shall be completely field programmable from a built in keypad or laptop computer, and shall be capable of transmitting events in multiple formats.

4. Communication shall include vital system status such as:

   a. Independent Zone (Alarm, trouble, non-alarm, supervisory.

   b. Independent Addressable Device Status.

   c. AC (Mains) and Earth Fault.

   d. System Off Normal.

   e. 12 and 24 Hour Test Signal.

   f. Abnormal Test Signal (per UL requirements).

   g. EIA-485 Communications Failure.

   h. Phone Line Failure.

5. The UDACT shall support independent zone or point reporting when used in the Contact ID format. This enables the central station to have exact details concerning the origin of the fire or response emergency.

6. The UDACT shall be supplied with two eight conductor, two to six foot long line cords. One end of the cords shall plug into the jacks on the UDACT. The other end of the cords shall plug into industry standard RJ-31X surface mounted telephone jacks. Install jacks in a screw cover box adjacent to the FACP if sufficient space is not available within the FACP, or adjacent fire alarm terminal cabinet. The line cords shall be installed in conduit when it is necessary to locate the jacks remotely from the FACP enclosure. The jacks shall be mounted to the rear of the box. The telephone number for each line shall be labeled on its respective jack.

T. Voice Evacuation System:

1. The Voice Evacuation Control (EVAC) Panel. The self-contained control panel shall be equipped with dual 25-watt audio amplifiers each with a single style Y (Class B) supervised 25 Vrms output circuit. The EVAC panel shall have the ability to record a minimum of two field-programmable messages of up to 60 seconds total duration with an integral microphone or an external source via an audio input jack. The messages shall be stored digitally onto a non-volatile EEPROM. The message(s) shall be individually field programmable for three, four, six, eight, or indefinite repeat while triggered by the host FACP. Any message being delivered at the time of the trigger circuit(s) reset shall not stop in mid-sentence but shall be completed to the end of the message. A tone generator shall be provided capable of emulating a field programmable lead-in or trailing alert tone or an Audible Emergency Evacuation Signal (Temporal Pattern). The EVAC panel shall be capable of electrically supervising in both active and standby conditions, the amplifier outputs, field wiring, message generator, tone generator, microphone and primary or secondary power supplies to an internal trouble relay(s). The trouble relay(s) contacts shall be accessible via a terminal strip and be configured and connected to report internal or external trouble conditions to the host FACP via the trigger circuit or a separate monitor module. The minimum of two trigger circuits shall be individually field-configurable for triggering with a NAC circuit or a supervised dry contact. The control panel shall be equipped with LED indicator lights for Power On, System Trouble, Message Generator Trouble, Tone Generator Trouble, Microphone Trouble, Battery Trouble, Charger Trouble, Ground Fault, Output Circuit Trouble and Amplifier Supervisory. The panel shall be equipped with an internal monitor speaker for reviewing the field recorded messages. The primary power supply shall operate at 120 VAC through a dedicated 20 amp. circuit and shall be capable of charging 18 AH lead acid batteries. Provide two 12 volt batteries that will provide a secondary power source for the same or longer duration than is required by the host FACP. An auxiliary 24 volt DC power output shall be provided for use by an associated addressable control module. The EVAC control panel shall be triggered either directly by the associated FACP with a NAC circuit or by an addressable control module. Provide 3/8 inch minimum P Touch labeling on the window in front of the built in microphone indicating that “THE INTERNAL MICROPHONE IS TO BE USED FOR THE RECORDING OF ANNOUNCEMENTS ONLY. NOT FOR USE BY STAFF OR FIRE DEPARTMENT PERSONNEL.”

2. Ceiling Mounted eight-inch EVAC Speakers shall be mounted in a Simplex Model CBB-8 back box or equal. The speaker assembly shall be supplied with a white 12 inch round metal grill. The 8 inch speaker shall have an impedance of 8 ohms, minimum 9.5 ounce magnet and an attached 25 volt audio line matching transformer with 1/8, 1/4, 1/2, 1, 2, 4 and 8 watt tap settings and DC blocking capacitor. Wattage shall be selectable by the use of a jumper or shunt. Audio levels shall be 75, 78, 81 87, 90 or 93 dba at ten feet. Input or output terminals that will accommodate 12 to 18 AWG wire shall be provided. Speakers orientated in the same direction shall be connected in phase with each other. Multiple speakers

in areas such as Auditoriums or Gymnasiums shall be divided into two circuits in a checker board pattern and connected separately to the two audio output circuits.

3. Wall Mount four-inch EVAC Speakers shall be mounted on a manufacture recommended outlet box. When mounted on a surface mount outlet box, Provide a Model No. BBS-SP201R surface mount backbox skirt. The speaker assembly shall be supplied with a square high impact red grill. The four inch speaker shall have an attached 25 volt audio line matching transformer with 1/4, 1/2, 1 and 2 watt tap settings and a DC blocking capacitor. Wattage shall be selectable by the use of a jumper or shunt. Audio levels shall be 80, 84, 86 or 89 dba at ten feet. Input or Output terminals that will accommodate 12 to 18 AWG wire shall be provided. Speakers orientated in the same direction shall be connected in phase with each other; but when installed facing opposite directions they shall be connected out of phase.

U. Network Cables or SLC or Annunciator Data or Audio Output Cables: The construction and physical characteristics such as aqua-seal water block, wire gage, insulation and jacket types, etc. shall not be altered. Equivalent cables must be specifically approved and recommended by the manufacturer of the fire alarm system equipment. Substitutions will require review from the Architect or Engineer of Record.

V. The cable types listed below are based and specified on the recommendations of Simplex Fire Alarm Systems. If the submitted fire alarm system requires a different cable configuration with additional conductors, multi-conductor versus twisted pairs, etcetera, other than as is specified above, then request a substitution to supply and install the configuration of cables by the make and model of the fire alarm system that is to be installed.

1. Indoor Network and EVAC System Audio Output Circuit(s) applications shall be in conduit or in surface mounted raceway as indicated on drawings: West Penn No. D980, one pair 18 gage solid copper, unshielded, Copolene II insulated and PVC jacketed, or equal.

2. Indoor SLC applications in conduit or in surface mounted raceway where it is indicated on drawings: West Penn No. D990, one pair 16 gage solid copper, unshielded, Copolene II insulated and PVC jacketed, or equal.

3. Indoor Annunciator applications in conduit or in surface mounted raceway where it is indicated on drawings: West Penn No. D975, one pair 18 gage solid copper, shielded, Copolene II insulated and PVC jacketed, or equal.

4. Outdoor or Underground Network Applications: West Penn AQ224, two-conductor 18 gage stranded copper, unshielded, water-blocked construction and PVC insulated, or equal.

5. Outdoor or Underground SLC applications: West Penn AQ225, 2-conductor 16 gage, AQ226, 2 conductor 14 gage, or AQ227, 2 conductor 12 gage stranded copper, unshielded water-blocked construction and PVC insulated, or equal.

6. Outdoor or Underground Annunciator applications: West Penn AQ293, 2 conductors, 18 gage stranded copper, shielded water-blocked construction and PVC insulated, or equal.

W. Protective Covers

1. Provide protective covers for pull stations, smoke and heat detectors, and audible and visual devices located in areas occupied by students that can be subjected to vandalism such as gyms, restrooms, locker and shower rooms, and all hallways and corridors associated with these spaces. Installation of cover must not protrude over current ADA limitations.

PART 3 - EXECUTION

3.01 GENERAL

A. Fire alarm system shall not be used for any purpose other than fire alarm functions.

B. Fire alarm shall be interconnected but not limited to the following systems:

1. Systems required by code to be connected to the fire alarm systems shall be connected.
2. Public address system for disabling the manual and automatic bell or tone class passing signals. Manual and automatic class passing signals shall not be operable during alarm conditions.
3. Ventilation systems where required for the purpose of fan shutdown
4. Damper control or smoke management systems.
5. Water based fire sprinkler systems.
6. Chemical fire extinguisher systems.
7. Central and Autonomous PA system(s).
8. Theatrical lighting control system.
9. Elevator controls for the purpose of elevator cab Phase 1 recall and shunt trip control, circuit supervision and shunt trip power supervision.
10. Fire pump controller for required signaling and trouble supervision.

C. Fire alarm system shall not be interconnected to any of the following:

1. Sump warning systems,
2. Carbon monoxide detection systems.
3. Methane gas detection systems.
4. Elevator car alarm bell circuit.
5. Other unrelated system.

3.02 SYSTEM INSTALLATION

A. Install required conductors to devices indicated on Drawings. Provide required conductor terminations to devices for a complete system to function as specified and indicated on Drawings. Refer to Section 26 0519: Low-Voltage Wire (600 Volt AC), for installation and color coding requirements.

B. Splices are not allowed in junction boxes. Terminations shall be in terminal cabinets or on equipment terminals.

C. Conductors shall be installed within conduits, boxes, and terminal cabinets in a totally enclosed installation. Furnish and install conductors required to connect incoming and outgoing circuits, including spare conductors, to terminal strips within terminal cabinets.

D. Wiring within equipment and terminal cabinets shall be installed to conform to contract documentation and NFPA 72 standards, and shall be terminated on terminal blocks having terminals for required connections. Wiring shall be cabled, laced, and securely fastened in place so that no weight is imposed on equipment or terminals.

E. Install required terminal blocks within terminal cabinets. Terminal blocks shall be installed on inside back of cabinets only, not on side. Incoming wiring shall be terminated on the left

side of terminal blocks; outgoing wiring shall be terminated on the right side of the terminal blocks.

F. Conductors shall be color-coded per specification section 26 0519 Low Voltage wires and tagged with code markers at terminal cabinets, and equipment. A wire index shall be typed and installed on terminal cabinet doors. Index shall be covered with clear plastic adhesive covers. Wiring shall be identified as to building and location of devices in the index.

G. Wiring within equipment and terminal cabinets shall be carefully strapped, and shall be formed in rectangular configuration. Wires shall be properly numbered in numerical order and shall maintain same number throughout the Project site.

H. Complete installation shall comply with local building codes and applicable provisions of the California Electrical Code, California Fire Code and the NFPA 72 National Fire Alarm Code.

I. Location of outlet boxes and equipment on Drawings is approximate, unless dimensions are indicated. Do not scale Drawings to determine locations and routing of conduits and outlet boxes. Location of outlet boxes and equipment shall conform to architectural features of the building and other Work already in place, and must be ascertained in the field before the start of Work.

J. Drawings generally indicate Work to be provided, but do not indicate all bends, transitions or special fittings required to clear beams, girders or other Work already in place. Investigate conditions where conduits are to be installed, and furnish and install required fittings.

K. Provide P-touch label of approximately one inch wide with red lettering for each initiating device that is hidden from view. Tags shall indicate the name and type of device: Heat Detector, or Duct Smoke Detector. Tags shall be permanently attached on access panel or t-bar grid which is used to access a hidden device.

L. Provide smoke and heat detectors in elevator hoist-ways if a fire sprinkler head is located at the top of the elevator hoist-way. Provisions shall be made for access to the detector without entering the elevator hoist-way. Access shall be provided through an approved enclosure with self-locking fire rated door. The detectors shall be so placed as to allow service to them without the service personnel having to reach into the hoist-way in the way of travel of the elevator car. Access to elevator hoist-ways and machine rooms (including escalators) must be supervised by the Owner’s licensed elevator or escalator maintenance contractor. OAR is responsible for coordinating access in accordance with Contractor’s schedule. Contractor shall provide a minimum of 48 hours’ notice.

M. Provide adjacent to each annunciator a neatly typewritten copy of the Fire Alarm Operating Instructions. The instructions shall reflect the installed and programmed features of the system. Instructions that include information on non-installed or programmed features will not be acceptable. The instructions shall be placed into a suitably sized dark colored wood or metal frame with a glass document face cover. The frame shall be attached to the wall with a minimum of two screws into the wall material with appropriate anchors.

N. Provide adjacent to each annunciator a neatly drawn site map showing rooms with designations and buildings with names as programmed into the system. This map shall be sized to allow (normal vision) reading of the designations, names etc. A map so reduced in size to the point of not being readable will not be acceptable. This map shall include symbols indicating the locations of installed fire sprinkler flow switches, riser shut off valves, post indicating valves and manual pull stations. Provide a symbol list on the map for the symbols used. The site map shall be placed into a suitably sized dark colored wood or metal frame with a glass document face cover. The frame shall be attached to the wall with a minimum of two screws into the wall material with the appropriate anchors.

3.03 SYSTEM PROGRAMMING

A. Programming shall be performed in accordance with District requirements set forth in this section – the local authority having jurisdiction and applicable codes. If a conflict arises or a clarification is required, the contractor through the project's OAR shall contact the Districts Fire Life Systems Testing Group (FLSTG) for clarification

B. As part of the 50 percent construction completion label devices and locations in the manner indicted in the attached guidelines on a separate copy of the shop drawings. Request a meeting with OAR, Project Inspector, and representative of FLSTG to review, finalize and obtain approval of the proposed device, equipment and location descriptors that will be programmed into the system. The District may at time of substantial completion request minor changes to program descriptors if needed to conform to site conditions.

C. The following functions and features as required by the site or system configuration and installed peripheral equipment and systems shall be programmed into the campus fire alarm systems. The definition of programming shall include but not be limited to the use of a built in keyboard, the use of a connected PC with the appropriate software, dip or rotary switches, wiring or installable or removable jumpers as required or provided in the fire alarm equipment.

1. Signal Silence Switch Inhibit: The audible signal silence switch located on the remote fire alarm annunciator(s) or any fire alarm control panel(s) shall be programmed to not silence the audible or extinguish the visual alarm circuits during the first minute (60 seconds) of alarm activation. Activation of this switch shall silence only the audible signals. Enabling or disabling this feature shall be allowed only if approved by the local Fire Marshal and District's Supervising Electrical Engineer, and authorized District maintenance personnel. The activation feature shall be protected by a maintenance level password.

2. Fire Sprinkler Water Flow Audible Appliance: The fire sprinkler water flow appliance (bell) shall not require any programming but shall be directly controlled by a set of dry contacts within the associated sprinkler water flow switch(s). The 24 volt DC auxiliary power for the sprinkler water flow audible appliances shall be supplied by an FACP or a remote power supply. This audible appliance shall operate continuously during the detection of fire sprinkler water flow and shall not be coded in any manner nor silenced automatically by any FACP or manually by any user controls at any FACP or remote annunciator.

3. Fire Sprinkler Water Flow Switch: Fire sprinkler water flow switches shall be programmed in a manner that shall prevent the above Signal Silence Switch from silencing the audible coded signals or visual signals after the initiation of an alarm by a fire sprinkler flow switch.

4. Audible Notification Appliance Circuits: Audible notification appliance circuits shall be programmed to emulate the temporal code (ANSI S 3.41) from fire alarm audible appliances (horns). This coding shall originate and be controlled by a single coder residing within the FACP(s). The use of coders within remote power supplies either mounted adjacent to an FACP or at a remote location or directly by an audible notification appliance will not be permitted. Programmable audible notification appliances shall be configured to emulate a steady tone at approximately 1000 Hz. Audible notification appliance circuits shall be programmed to be silenced as described above. Notification appliance circuits throughout the site shall be activated by any alarm initiating device. Coded audible signals shall be controlled by a single synchronized FACP.

5. Visual Notification Appliance Circuits: Visual notification appliance circuits shall be programmed to provide steady non-coded power to the visual appliances (strobes). As required by code and the system configuration, a synchronization

signal shall be superimposed onto the NAC by the FACP, a remote power supply or an add-on synchronization module. Visual notification appliance circuits shall be programmed to be extinguished as described above. Visual notification appliance circuits throughout the site shall be activated by any alarm initiating device.

6. System Reset Button: The system reset button located on FACPs and remote annunciators in addition to resetting the fire alarm system and silencing or extinguishing notification appliances except for the sprinkler water flow appliances shall be programmed to reset analog and addressable smoke detectors, duct detectors, beam detectors and relays, addressable control modules and addressable relay modules used to interface to other systems and equipment. Each installed system reset button shall be programmed to operate as a “single point of reset” for the complete system.

7. HVAC Shutdown: Relays and addressable relay modules used to interface to HVAC equipment dampers, and supply and exhaust fan motors shall be programmed to shut down this equipment only within the same building where the detection of smoke, heat, carbon monoxide or fire sprinkler water flow has taken place. Manual pull stations within any building shall not affect the operation of the HVAC equipment. These relays shall return to normal only after the system is reset.

8. Elevator Recall: The addressable relay modules for the primary and alternate elevator recall function shall be programmed to activate only with the detection of smoke by a detector located in the elevator machine room, elevator hoistway or the main floor or alternate floor landing(s) smoke detector associated with that elevator or bank of elevators. Recall of an elevator shall be on a per-elevator or on a per-bank of elevators basis. Activation of other initiating devices shall not cause the recall of an elevator.

9. Fire Fighter Warning: In conjunction with the above elevator recall function, an additional addressable relay module shall be programmed to operate only with the detection of smoke by a detector located in an elevator machine room or elevator hoistway to provide a warning signal to fire fighters attempting to use the phase II elevator function.

10. Elevator Shunt Trip: The addressable control module or MR control relay for the elevator shunt trip shall only be activated by the heat detector located within the elevator machine room or elevator hoistway for each elevator or bank of elevators. Circuit integrity, and AC and DC power to the MR control relay shall be electrically supervised. Activation of other initiating devices shall not operate the shunt trip.

11. Smoke Detector Maintenance Alert: Addressable smoke detectors shall be programmed with the capability of initiating a maintenance alert when any one detector becomes obscured by dust or any other contaminates at approximately 10 percent below the level of obstruction that would initiate an alarm.

12. Disabling Class Passing Signals: The relay or addressable relay module shall be programmed to disable the class passing signals during any alarm condition at the site. This relay or addressable module shall return to normal only after the system is reset.

13. Disabling Audio of a Public Address System: The relay or addressable relay module shall be programmed to mute the audio output of the associated public address system during any activation of an audible notification appliance circuit or a voice evacuation announcement. This or these relays shall automatically restore to normal upon the silencing of the audible NACs and the voice evacuation announcement.

14. Release of Electro-Magnetically Held Doors: The relay or addressable relay module shall be programmed to open or close the control circuit as needed of the 24 volt DC door holder power supply. This relay(s) shall operate during any alarm condition within the same building as the door holders. The contacts shall return to normal only after system reset.

15. Illumination of House Lighting: The relay or addressable relay module shall be programmed to turn on to full brilliance the house lighting of an Auditorium, MP Room, etc. during any alarm condition at the site. This relay or addressable module shall return to normal only after the system is reset.

16. UDACT: The FACP and the associated Universal Digital Alarm Communication Transmitter shall be programmed to transmit to the central monitoring station separate indications for General Alarm, Fire Sprinkler Water Flow Alarm, System Trouble and Supervisory Conditions. These indications shall be in addition to any indications initiated by the UDACT itself.

17. Voice Evacuation Panel: The NAC originating at, or the addressable control module controlled by the associated FACP that is controlling the EVAC panel shall be programmed to emulate the above paragraph “E” Audible Notification Appliance Circuits except that it shall be non-coded. Trouble conditions at the EVAC panel shall report back to the associated FACP via the controlling NAC or addressable control module or a separate addressable monitor module. Transformer taps at the EVAC speakers shall be selected to provide the proper balance of audio volume in larger and smaller areas. The message shall be programmed in a female voice in the English language as follows: A minimum of two but no more than three cycle sounding of an approximate 1000 Hz tone in the pattern of the NFPA required temporal code followed by: “May I have your attention please. May I have your attention please”. The fire alarm has been activated in the building. The fire alarm has been activated in the building. Please proceed to the nearest exit and leave the building.” The sounding of the temporal patterned signal followed by the indicated message shall repeat indefinitely until the controlling NAC is reset.

18. Power Failure Reporting Time Delay: Main and remote NAC power supplies shall be programmed to delay the reporting of a site AC power failure for a minimum of 6 hours.

D. Device Descriptors:

1. Descriptors shall enable responding personnel to identify the location of a fire quickly and accurately, and shall indicate the status of emergency equipment or fire safety functions that might affect the safety of occupants. The minimum required information for devices intended to report smoke, fire, or fire sprinklers water flow include, but may not be limited to: Building, floor (if multiple floors exist in the building), room or space description, and device type and digital address (Smoke detector, Heat detector, Fire sprinkler water flow switch, etc.)

   a. Building: The building must always be included in the descriptor, even if there is only one building one the site. Additional building(s) may be added at a later date creating the possibility of confusion by similar designated spaces, such as “Work room” or “Staff restroom” if more than one building has these similar designated spaces. The building designation in the descriptor must be what the site-based personnel call the building. The building should be provided with signage to aid fire department personnel in the identification of the building.

   b. Floor: In multi-floor buildings the floor designation (1st, 2nd, etc.) must be included in the descriptor.

c. Room Description: The room or space description must be unique. Using the same designation for multiple spaces, such as “Workroom”, “Counselor’s Office”, or “Men’s restroom”, etc. is not acceptable. If, during a project, the room numbers or the use of the room changes then the room or space descriptor must be changed to agree with the change. Proper signage should be provided for each space to aid fire department personnel in the identification of the room or space.

d. Device Type, Address and Compass Designations: The device type and digital address must be included with the descriptor, such as smoke detector or heat detector, etc. Some systems provide this information automatically in the descriptor. Compass designations, (N, S, E, and W) are required in spaces such as corridors where there are multiple detectors and this information would be helpful to responding fire department personnel in locating the device reporting alarm. It is not necessary to include compass designations in smaller spaces where there are multiple detectors located in close proximity to each other.

E. ACCEPTABLE ABBREVIATIONS

Rm.- Room	Bldg.- Building	Smk. - Smoke
Corr.- Corridor	Lby- Lobby	Asst. - Assistant
Eng.- English	N – North	Nrs. - Nurse
Flr.- Floor	S – South	Cnclr - Counselor
Ht.- Heat	E – East	Off. - Office
Lib.- Library	W – West	PE – Physical Education
Lkr. – Locker	Kit- Kitchen	RR- Rest Room
Stu Str – Student Store	Sci - Science	By = near
Stor Rm – Store Room	Café - Cafeteria	PM – Plant Manager
1st- First	2nd- Second	3rd- Third
Hopr Rm – Hopper Room	Det - Detector	Elev - Elevator
Prin – Principal	Blr Rm – Boiler Room	Conf – Conference
Park – Parking	Bsmt –Basement	MPR.- Multi-Purpose room

3.04 SYSTEM OPERATION

A. Unless otherwise specified, but not limited to actuation of manual stations, smoke detectors, heat detectors, linear heat or smoke detectors, or water-flow switches shall cause the following operations to occur, refer to Attachment B:

1. Activate audible circuits.

2. Actuate strobe units until the panel is reset or strobe circuit time-out.
3. Release magnetic door holders to doors to adjacent zones on the floor from which the alarm was initiated.
4. Where required, return elevators to the primary or alternate floor of egress.
5. Smoke detectors in elevator lobbies shall, in addition to the above functions, return elevators to the primary or alternate floor of egress.
6. Smoke detectors in elevator machine rooms or tops of hoist-ways shall return elevators to the primary or alternate floor. Smoke detectors or heat detectors installed to shut down elevator power shall perform this function in accordance with ANSI A 17.1 requirements and shall be coordinated.
7. Duct type smoke detectors shall, in addition to the above functions, shut down the ventilation system or close associated control dampers as required.
8. Activation of fire sprinkler system low-pressure switches, post indicator valve or tamper switches shall initiate a system supervisory alarm indication.
9. UL listed central station shall be notified via – Universal Digital Alarm Communicator Transmitter (UDACT).

3.05 TESTING

A. A 48 hour notice shall be provided to the Project Inspector before final testing.

B. Testing of fire detection system shall be as required by the State Fire Marshal and local authorities having jurisdiction. Installer is responsible for identifying required testing, coordinating, scheduling, and conducting tests before Substantial Completion. Tests shall include the following:

1. Operation of signal-initiating devices (smoke detectors, heat detectors, pull stations etc.).
2. Operation of indicating devices (alarm horns, alarm bells and alarm strobes).
3. Operation of system features under normal operation.
4. Operation of system supervisory features.
5. Operation of system features on standby power, with primary power turned off.
6. Before energizing the cables and wires, check for correct connections and test for short circuits, ground faults, continuity, and insulation.
7. Close sprinkler system flow valves and verify proper supervisory alarm at the FACP.
8. Verify activation of flow switches.
9. Open initiating device circuits and verify that trouble signal actuates.
10. Open signaling line circuits and verify that trouble signal actuates.
11. Open and short notification appliance circuits and verify that trouble signal actuates.
12. Open and short (wire only) network communications and verify that trouble signals are received at network annunciators or reporting terminals.
13. Ground initiating device circuits and verify response of trouble signals.
14. Ground signaling line circuit and verify response of trouble signals.

15. Ground notification appliance circuit and verify response of trouble signals.

16. Check alert tone to alarm notification devices.

17. Check installation, supervision, and operation of intelligent smoke detectors.

18. Alarm conditions that the system is required to detect shall be introduced on the system. Verify the proper receipt and the proper processing of the signal at the FACP and the correct activation of the control points.

19. When the system is equipped with optional features, consult the manufacturer manual to determine proper testing procedures.

20. Theatrical lighting house light control override.

21. Central and Autonomous PA systems for muting during the sounding of the audible notification appliances and voice evacuation announcements.

22. Disabling electronic tone or electromechanical bell class passing signals until system reset.

C. Upon completion of installation of fire alarm equipment, provide to the OAR a signed, written statement confirming that fire alarm equipment was installed in accordance with the Specifications, Shop Drawings, instructions and directions provided by the manufacturer.

D. Demonstrate in presence of the Project Inspector that circuit and wiring tests are free of shorts and grounds and that installation performs as specified herein and within manufacturer's guidelines.

E. Software Modifications:

1. Provide the services of a factory trained and authorized technician to perform system software modification, upgrades or changes. Response time of the technician to the Project site shall not exceed 24 hours.

2. Provide hardware, software, programming tools, and documentation necessary to modify the fire alarm network on the Project site. Modification includes: addition and deletion of devices, circuits, zones and changes to system operation and custom label changes for devices or zones. The system structure and software shall place no limit on the type or extent of software modification on-site. Modification of software shall not require power-down of the system or loss of system fire protection while modifications are being provided.

F. Complete the inspection and testing form as required by NFPA 72, and submit one copy of the completed form to the Architect and Project Inspector.

3.06 SERVICE MANUALS

A. Deliver to OAR, three copies of the service manuals. Each manual shall include the following:

1. Installation manuals, programming manuals and user manual if applicable for every control panel, control panel power supply, FACP input or output or relay or control module, auxiliary power supply, UDACT, remote NAC extender power supply, door holder power supplies, installed annunciators, initiating and indicating devices and addressable monitor, relay and control modules. Catalog cut sheets are not acceptable.

2. A printed copy of the system configuration as programmed, including system labeling codes, and passwords.

3. An electronic copy on compact disk of the system configuration program

4. Final test report.

5. Detailed explanation of the operation of the system.

6. Instructions for routine maintenance.

7. Detailed wiring diagram for the connection of relays, addressable monitor, and control or relay modules as applied in the interfacing of peripheral systems or equipment to the fire alarm system. Updated shop drawings shall include revisions made in the field via plan changes, RFIs, Field Change Directives, and any other construction change documents including interface details with ancillary systems.

8. An electronic copy (CD) of the posted site or fire alarm map in Auto-Cad and pdf formats.

9. Provide a CD ROM electronic copy of the updated system As-Built Drawings to the OAR, prepare this copy in the latest version of AutoCAD; along with the electronic copy provide a full size bond copy. Include one CD-ROM of the up-dated As-Built Drawings into each of the Service Manuals. CD and folded drawings shall be secured and inserted into the Service Manuals via a three-hole punched protective CD case and protective envelopes for the drawings.

10. Provide codes and passwords for fire alarm system at testing.

3.07 SPARE PARTS

The following new spare parts shall be furnished in unopened boxes:

1. Five percent spare pull stations including the associated monitor module (minimum one spare pull station per type).

2. Five percent spare smoke and heat detectors (minimum one spare smoke and heat detector per type).

3. Five percent spare audible devices (minimum one spare audible device per type).

4. Five percent spare strobe devices (minimum one spare strobe device per type).

3.08 SYSTEM USER AND MAINTENANCE PERSONNEL TRAINING

A. Before Substantial Completion, provide one instruction period for the Project site based Owner operators and system users. The instruction period shall be scheduled and coordinated by the OAR.

B. Training materials and required deliverables shall be submitted to the OAR.

1. Prior to beginning the operational demonstration, notify Central monitoring Station that an instructional activity is beginning; inform them that it includes setting and resetting the system in test mode. After the demonstration is completed and the system restored, notify the Central Monitoring Station that the system has been restored and it is back on line for continuous monitoring.

C. User Instruction and Training

1. Before substantial completion and with a fully functional fire alarm system installed at the site, the contractor shall provide a minimum of four hours of user training for site based staff. The date and time for this training shall be coordinated by the project OAR.

D. Instruction period training for site based staff shall consist of the following:

1. Overview:

a. Explain the fire system is “addressable” which means every device-smoke detector, heat detector, sprinkler water flow switch, manual pull station, etc. has a unique address or identity. This makes it possible to positively identify the exact device causing an alarm, trouble or supervisory condition.

b. Explain the fire alarm control panel also controls the horns and strobes throughout the campus or building.

c. Explain that the fire alarm system is interconnected to various other systems and equipment throughout the site such as:

1) Elevators to recall them to the main floor or to an alternate floor and as an option dependent circumstances turn off the power to the elevators.

2) Heating and air conditioning equipment to turn off fans and close dampers to stop the spread of smoke throughout a building.

3) The class passing signaling system to disable the bells or tones to not accidentally signal students and staff to return to the buildings.

4) Magnetically held doors to close them to stop the spread of smoke.

5) To turn up house lighting in an occupied Auditorium or Multi-Purpose room to provide adequate egress lighting.

6) The Central and Autonomous PA systems to mute them during the sounding of the alarm signal.

d. Explain the fire system has a battery backup in case of power failure and that it will continue to function for a minimum of 24 hours after a total power failure.

e. Explain that the fire alarm system components and wiring are monitored to report a malfunction, damage or vandalism. When this occurs, a trouble indication will appear on the fire alarm annunciator and FACP and this indication will be transmitted to the central monitoring station.

f. Explain that other equipment and systems are monitored for abnormal conditions such as the fire sprinkler water being turned off. When this occurs, a supervisory condition is created. A supervisory indication will appear on the fire alarm annunciator and FACP and this indication will be transmitted to the central monitoring station.

g. Explain that the fire system in addition to notifying the occupants of a possible fire condition also transmits an alarm indication to the central monitoring station that will in turn notify and dispatch the local fire department to your site.

2. Basic:

a. Hand out the SYSTEM OPERATION instructions to attendees.

b. Point out the Fire Alarm Control Panel and have them observe the normal LED status (one green LED only should be on):

1) GREEN = Normal.

2) YELLOW = Trouble.

3) RED = ALARM.

c. Have the attendees observe the LCD display that should be indicating a SYSTEM NORMAL message.

d. Point out the Fire Alarm System Annunciator and have attendees observe the LCD display that should be indicating a SYSTEM NORMAL message.

3. Operation and Demonstration:

a. After putting the system or having someone put the system central station monitoring into the test mode demonstrate the following:

b. Activate a Manual Pull Station to demonstrate ALARM.

1) Demonstrate audible and visual notification appliances and if installed the voice evacuation signal announcement.

2) Demonstrate panel or annunciator sounder tone for ALARM.

3) Have staff SILENCE system.

4) Show LCD display and LED of alarm.

5) Demonstrate and have staff reset the manual pull station.

6) Have staff RESET fire system.

c. Activate Smoke Detector with canned smoke to demonstrate address identification:

1) Have staff SILENCE system.

2) Show LCD and display LED of ALARM.

3) Have staff RESET fire system.

d. Remove Smoke Detector to demonstrate SYSTEM TROUBLE.

1) Demonstrate panel or annunciator sounder tone for TROUBLE.

2) Have staff SILENCE system.

3) Show LCD display and LED of TROUBLE.

4) Replace the smoke detector.

5) Have staff RESET fire system.

e. Remove power to demonstrate function during power failure.

1) Have staff SILENCE system.

2) Show LCD display and LED of TROUBLE.

3) Activate Manual Pull station to demonstrate audible or visual functions in power failure mode.

4) Reset manual pull station.

5) Reset fire system.

6) If applicable, point out sprinkler riser and shut off valves.

7) Show location of a water flow switch.

8) Show location of a valve tamper switch.

9) Point out valves must always be OPEN or fully counter clock wise.

10) Point out PIV (Post Indicator Valves) if applicable.

11) Have water flow through the inspectors test valve and point out the ringing water flow bell.

12) After the horns are silenced by an assistant, show that the water flow bell is ringing continuously indicating water flow.

13) Have the assistant turn off the inspectors test valve to show that water flow alarm bell turns off.

14) Reset system.

15) Unlock and turn off a PIV or riser valve to show a supervisory condition.

16) Turn valve back on, lock the valve open and demonstrate the end of the indication of a supervisory condition.

4. Training documentation.

a. Insure fire panel is reset and indicates normal and central station monitoring is taken off of the test mode.

b. Have staff attendees sign off training sheet and provide a copy to the PROJECT INSPECTOR.

3.09 PROTECTION

A. Protect the Work of this section until Substantial Completion.

3.10 CLEANUP

A. Remove rubbish, debris, and waste materals and legally dispose of off Project site.

END OF SECTION

DIVISION 31
EARTHWORK

SECTION 31 10 00 - SITE CLEARING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Protecting existing vegetation to remain.
2. Removing existing vegetation.
3. Clearing and grubbing.
4. Stripping and stockpiling topsoil.
5. Removing above- and below-grade site improvements.
6. Disconnecting, capping or sealing, and removing/abandoning site utilities

B. Related Sections:

1. Division 01 Specifications apply to this section.
2. Division 02 Section and “Site Demolition” for demolition of site improvements.

1.3 DEFINITIONS

A. Subsoil: All soil beneath the topsoil layer of the soil profile and typified by the lack of organic matter and soil organisms.

B. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil; but in disturbed areas such as urban environments, the surface soil can be subsoil.

C. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil and is the zone where plant roots grow.

D. Tree-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction, and indicated on Drawings.

E. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.4 MATERIAL OWNERSHIP

A. Except for stripped topsoil and other materials indicated to be stockpiled or otherwise remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.5 INFORMATIONAL SUBMITTALS

A. Existing Conditions: Documentation of existing trees and plantings, adjoining construction, and site improvements that establishes preconstruction conditions that might be misconstrued as damage caused by site clearing.

1. Use sufficiently detailed photographs or videotape.
2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plants designated to remain.

B. Record Drawings: Identifying and accurately showing locations of capped utilities and other subsurface structural, electrical, and mechanical conditions. Provide copy to Engineer of Record.

1.6 QUALITY ASSURANCE

A. Pre-installation Conference: Conduct conference at project site.

1.7 PROJECT CONDITIONS

A. Existing Improvements: Provide protections necessary to prevent damage to existing improvements indicated to remain in place.
1. Protect improvements on adjoining properties, public right-of-way and on Owner's property.
2. Restore damaged improvements to their original condition, as acceptable to property owners. The full width of pavements damaged due to construction access and other construction-related activities shall be replaced with a structural section (pavement and base) at least equal to the adjacent existing section.
3. Protect existing utility lines indicated to remain. Notify Architect immediately of any damage to or encounter with an unknown existing utility line. Immediately repair damage to existing utility lines.

B. Existing Trees and Vegetation: Protect existing trees and other vegetation indicated to remain in place against unnecessary cutting, breaking or skinning of roots, skinning or bruising of bark, smothering of trees by stockpiling construction materials or excavated materials within drip line, excess foot or vehicular traffic, or parking of vehicles within drip line. Provide temporary guards to protect trees and vegetation to be left standing.
1. Water trees and other vegetation to remain within limits of contract work as required to maintain their health during course of construction operations.
2. Provide protection for roots over 1-1/2 inch in diameter that are cut during construction operations. Coat cut faces with an emulsified asphalt or other acceptable coating formulated to use on damaged plant tissues. Temporarily cover exposed roots with wet burlap to prevent roots from drying out; cover with earth as soon as possible.

3. Repair or replace trees and vegetation indicated to remain that are damaged by construction operations in a manner acceptable to Architect. Employ a licensed arborist to repair damage to trees and shrubs.
4. Replace trees that cannot be repaired and restored to full-growth status, as determined by arborist.

C. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.

D. Improvements on Adjoining Property: Authority for performing site clearing indicated on property adjoining Owner's property will be obtained by Owner before award of Contract.

1. Contractor shall delineate with construction stakes, the property line along the southeast side of the project.

2. Contractor shall document the pre-construction condition and photograph the existing CMU retaining wall along the southeast property line.

3. Do not proceed with work on adjoining property until directed by Architect.

E. Salvable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises per owner’s direction.

F. Utility Locator Service: Notify UNDERGROUND SERVICE ALERT for area where Project is located before site clearing.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in Division 31 Section "Earthwork."

1. Obtain approved borrow soil material off-site when satisfactory soil material is not available on-site.

B. Tree Wound Paint: Bituminous based paint of standard manufacture specially formulated for the intended use.

PART 3 - EXECUTION

3.1 SITE CLEARING

A. Remove trees, shrubs, grass, and other vegetation, improvements, or obstructions, as required, to permit installation of new construction. Remove similar items elsewhere on site or premises as specifically indicated. Removal includes digging out and off-site disposal of stumps and roots.
   1. Cut minor roots and branches of trees indicated to remain in a clean and careful manner where such roots and branches obstruct installation of new construction.
   2. Unless specifically designated to remain, strip the upper two inches (minimum) of soil containing vegetation and root growth within the Limits of Work shown on the Drawings.

B. Removal of Improvements: Remove existing above-grade and below-grade improvements as indicated and as necessary to facilitate new construction.
   1. Abandonment or removal of certain underground pipe or conduits may be indicated on mechanical or electrical drawings. Removing abandoned underground piping or conduits interfering with construction is included under this Section.
   2. Contractor shall refer to the project's Asbestos Abatement Report for removal of asbestos containing materials and other potential hazardous materials.

C. Clearing and Grubbing: Clear site of trees, shrubs, and other vegetation, except for those indicated to be left standing.
   1. Completely remove stumps, roots, and other debris protruding through ground surface.
   2. Use only hand methods for grubbing inside drip line of trees indicated to remain.
   3. Fill depressions caused by clearing and grubbing operations with satisfactory soil material, unless further excavation or earthwork is indicated.
      a. Place fill material in horizontal layers not exceeding 6 inches loose depth, and thoroughly compact each layer and compact in accordance with the requirements specified in Section 31 "Earthwork" to make the new surface conform with the existing adjacent surface of the ground.
   4. Trim trees, designated to be left standing within the cleared areas, of dead branches 1-1/2 inches or more in diameter; and trim all branches to heights and in a manner as indicated. Neatly cut limbs and branches to be trimmed close to the bole of the tree or main branches. Paint cuts more than 1-1/4 inches in diameter with specified tree-wound paint.

D. Topsoil is defined as friable clay loam surface soil found in a depth of not less than 4 inches. Satisfactory topsoil is reasonably free of subsoil, clay lumps, stones, and other objects over 2 inches in diameter, and without weeds, roots, and other objectionable material.
   1. Strip topsoil to whatever depths encountered in a manner to prevent intermingling with underlying subsoil or other objectionable material. Remove heavy growths of grass from areas before stripping.
      a. Where existing trees are indicated to remain, leave existing topsoil in place within drip lines to prevent damage to root system.
   2. Stockpile topsoil in storage piles in areas indicated or directed. Construct storage piles to provide free drainage of surface water. Cover storage piles, if required, to prevent wind and sediment erosion.
   3. Dispose of unsuitable or excess topsoil as specified for disposal of waste material.

E. Protect and maintain benchmarks and survey control points from disturbance during construction.

F. Locate and clearly identify trees, shrubs, and other vegetation to remain.

3.2 EXISTING UTILITIES

A. Arrange with Owner for disconnecting and sealing of all overhead and underground utilities that serve adjoining existing structures before site clearing.

1. Verify that utilities have been disconnected and capped before proceeding with site clearing.

B. Locate, identify, disconnect, and seal or cap utilities indicated to be abandoned in place.

1. Arrange with utility companies to shut off indicated utilities.
2. Arrange with owner scheduling of utilities shut off.

C. Locate, identify, and disconnect utilities indicated to be removed.

D. Interrupting Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Architect not less than two days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Architect's written permission.

E. Excavate for and remove underground utilities indicated to be removed.

F. Contractor shall note that various unknown and undocumented underground utilities exist at the project site. Contractor shall ensure that utilities are inactive or shut off prior to removal or abandonment. Contractor shall document all found underground utilities and notify engineer of record for further direction.

3.3 SITE IMPROVEMENTS

A. Remove existing above- and below-grade improvements as indicated and necessary to facilitate new construction.

B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.

1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut along line of existing pavement to remain before removing adjacent existing pavement. Saw-cut faces vertically.
2. Paint cut ends of steel reinforcement in concrete to remain with two coats of antirust coating, following coating manufacturer's written instructions. Keep paint off surfaces that will remain exposed.

3.4 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.

B. Separate recyclable materials produced during site clearing from other nonrecyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities. Do not interfere with other Project work.

END OF SECTION

SECTION 31 20 00 - EARTHWORK

PART 1 - GENERAL

1.1 Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Preparing and grading subgrades for slabs-on-grade, walks, pavements and landscaping
2. Excavating and backfilling for buildings and structures.
3. Drainage and moisture-control fill course for concrete slabs-on-grade.
4. Base course for concrete walks, asphalt and pavements.
5. Subsurface drainage backfill for walls and trenches.
6. Excavating and backfilling trenches for utilities and appurtenances outside building lines.

B. Related Sections:

1. Division 01 Section "Temporary Facilities and Controls" for temporary controls, utilities, and support facilities.
2. Division 03 Section "Cast-in-Place Concrete" for granular course beneath the slab-on-grade.
3. Division 31 Section "Site Clearing" for site stripping, grubbing, and removal of above- and below-grade improvements and utilities.

1.3 REFERENCE SPECIFICATION

A. Perform all work in accordance with applicable provisions of "Standard Specifications for Public Works Construction", 2018 Edition, City of Los Angeles Ordinances and Amendments, latest editions, 2019 CBC. Unless otherwise noted, mention herein of section numbers refers to sections of the Reference Specification. Where Reference Specification refers to "Agency", substitute the word "Owner". Where Reference Specification refers to "Engineer", substitute the word "Architect". Where Reference Specification is in conflict with these Specifications, these Specifications shall govern.

B. The recommendations found in the Geotechnical Exploration Report prepared by Atlas Technical Consultants LLC dated July 7, 2021 and subsequent addendum reports apply to this Section.

1.4 DEFINITIONS

A. Backfill: Soil material or controlled low-strength material used to fill an excavation.

1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Base Course: Aggregate layer placed between the subbase course and the surface pavement in paving system.

C. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.

D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill when sufficient approved soil material is not available from excavations

E. Drainage Fill: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

F. Excavation: Removal of material encountered to subgrade elevations and the re-use or disposal of materials removed.

1. Authorized Additional Excavation: Excavation below subgrade elevations as directed by Architect.
2. Unauthorized Excavation: Excavation below subgrade elevations without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be without additional compensation.

G. Fill: Soil materials used to raise existing grades.

H. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

I. Subbase Course: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.

J. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.

K. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within building lines.

L. Compaction: Any method of mechanically stabilizing a material by increasing its density at a controlled moisture condition. "Degree of Compaction" is expressed as a percentage of the maximum dry density obtained by the test procedure described in ASTM D 1557 for general soil types abbreviated in this Specification as 90 percent of maximum dry density".

M. Hard Material: Weathered rock, dense consolidated deposits or conglomerate materials which are not included in the definition of "rock" but which usually require the use of heavy excavation equipment, ripper teeth, or jack hammers for removal

N. Lift: A layer or course of soil placed on top of previously prepared or placed soil in a fill or embankment.

O. Unsatisfactory Material: Soil or other material identified as having insufficient strength or stability to carry intended loads without excessive consolidation or loss of stability.

1.5 SUBMITTALS

A. Product Data: For each type of the following manufactured products required:
1. Warning Tape
2. Geotextile
3. Water Quality Filter Media

B. Location of Borrow Materials.

C. Material Test Reports

D. Pre-excavation Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by earth moving operations. Submit before earth moving begins.

1.6 QUALITY ASSURANCE

A. Codes and Standards: Perform earthwork complying with requirements of authorities having jurisdiction

B. Testing and Inspection Service: Owner will employ a qualified independent geotechnical engineering testing agency to classify proposed on-site and borrow soils to verify that soils comply with specified requirements and to perform required field and laboratory testing.

C. Pre-excavation Conference: Before commencing earthwork, meet with representatives of the governing authorities, Owner, Architect, consultants, Geotechnical Engineer, independent testing agency, and other concerned entities. Review earthwork procedures and responsibilities including testing and inspection procedures and requirements. Notify participants at least 3 working days prior to convening conference. Record discussions and agreements and furnish a copy to each participant.

1.7 PROJECT CONDITIONS

A. Existing Utilities: Do not interrupt existing utilities serving facilities occupied by the Owner or others except when permitted in writing by the Architect and then only after acceptable temporary utility services have been provided.

1. Provide a minimum 48-hours' notice to the Architect and receive written notice to proceed before interrupting any utility.

B. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies and owner to shutoff services if lines are active.

C. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth moving operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.

D. Improvements on Adjoining Property: Authority for performing earth moving indicated on property adjoining Owner's property will be obtained by Owner before award of Contract.

1. Do not proceed with work on adjoining property until directed by Architect.

E. Utility Locator Service: Notify UNDERGROUND SERVICE ALERT for area where Project is located before beginning earth moving operations.

F. Do not commence earth moving operations until temporary erosion/sedimentation control measures, specified in Division 01 are in place.

G. Perched Groundwater was encountered at 46 feet below the ground surface during exploration.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

B. Satisfactory Soils: Soil materials imported or excavated on the property determined to be suitable as referenced in the project Geotechnical Investigation Report; and approved by the Geotechnical Engineer.

C. Unsatisfactory Soils: Soil Classification Groups GC, SC, CL, ML, OL, CH, MH, OH, and PT according to ASTM D 2487 or a combination of these groups.

1. Refer to Geotechnical Investigation Report, for unsuitable materials and disposal methods for unsatisfactory soils.

D. Backfill and Fill Materials: Satisfactory soil materials.

E. Base Material: Shall conform to crushed aggregate base or crushed miscellaneous base, as specified on plan, in accordance with section 200-2.2 or 200-2.4, respectively, of the Reference Specification, and compacted to at least 95% of the maximum dry density as determined by ASTM Test Method D 1557.

F. Engineered Fill: Base Materials and compacted fill materials

G. Bedding Material: Shall be 1 sack slurry per soils report.

H. Drainage Fill: Washed, evenly graded mixture of crushed stone, or crushed or uncrushed gravel, ASTM D 448, coarse aggregate grading size 57, with 100 percent passing a 1-1/2-inch sieve and not more than 5 percent passing a No. 8 sieve

I. Filtering Material: Evenly graded mixture of natural or crushed gravel or crushed stone and natural sand, with 100 percent passing a 1-1/2-inch sieve and 0 to 5 percent passing a No. 50 sieve.

J. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.

2.2 GEOTEXTILES – NOT USED

2.3 ACCESSORIES

A. Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of the utility; colored as follows:

1. Red: Electric.
2. Yellow: Gas, oil, steam, and dangerous materials.
3. Orange: Telephone and other communications.
4. Blue: Water systems.
5. Green: Sewer systems.
6. White: Steam systems

B. Detectable Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches (750 mm) deep; colored as follows:

1. Red: Electric.
2. Yellow: Gas, oil, steam, and dangerous materials.
3. Orange: Telephone and other communications.
4. Blue: Water systems.
5. Green: Sewer systems.
6. White: Steam Systems

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth moving operations.

B. Provide erosion control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

C. Tree protection is specified in the Section 31 10 00 "Site Clearing". Refer to landscape architectural plans for instructions.

D. Prepare subgrade and place base materials in accordance with sections 301-1.2 and 301-2, respectively, of the Reference Specification.

3.2 DEWATERING

A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.

B. Dewatering shall be done in accordance with NPDES waste discharge requirements. Contractor shall obtain all necessary Dewatering permits from state and local jurisdictions.

C. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.

1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.

3.3 EXPLOSIVES

A. Explosives: Do not use explosives.

3.4 EXCAVATION, GENERAL

A. General: Excavation shall be to the contours, elevations and dimensions indicated. Keep excavations free from water and debris while construction is in progress. Notify the Owner immediately in writing where it becomes necessary to remove hard, soft, weak, or wet material to a depth greater than indicated. Unless otherwise indicated, concrete placed below grade will be formed and excavations shall allow for placement and removal of forms. Side cuts shall be cribbed and shored as required.

B. Unclassified Excavation: Excavation is unclassified and includes excavation to required subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions as described in the referenced Geotechnical Investigations Report.

1. If excavated materials intended for fill and backfill include unsatisfactory soil materials, replace with satisfactory soil materials.

2. Earth excavation includes excavating pavements and obstructions visible on surface; underground structures, utilities, and other items indicated to be removed; together with soil, boulders, and rocks.

3. Rock fragments greater than 3 inches in diameter shall be taken off-site or placed in accordance with the recommendations of the Geotechnical Engineer in areas designated as suitable for rock disposal.

3.5 STABILITY OF EXCAVATIONS

A. Comply with local codes, ordinances, and requirements of authorities having jurisdiction to maintain stable excavations.

B. Unshored Temporary Excavations:
1. Unshored temporary excavations may be sloped back at 1 to 1 (horizontal to vertical) or flatter up to 5 feet in height. Where sloped embankments are used, the tops of the slopes should be barricaded to prevent vehicles and storage loads within seven feet of the tops of the slopes. If the temporary construction slopes will be maintained during the rainy season, construct berms along the tops of the slopes where necessary to prevent run-off water from entering the excavation and eroding the slope faces.

3.6 EXCAVATION FOR STRUCTURES

A. Excavation Limits: Shall be to a tolerance of plus-or-minus 0.10 foot and shall extend 5 feet laterally beyond the building footing limits at the excavation level and 5 feet below existing grade, or deeper to excavate existing fill. The excavation side slopes shall not exceed a slope ratio of 1.5 to 1, horizontal to vertical, up to 5 feet in height, unless they are positively retained by shoring or other approved methods. Over-excavation side slopes may be vertical, as long as they are no higher than allowed by the State of California Construction Safety Orders, in which case they shall be no steeper than 1.5 to 1. If cut below depths indicated, excavations shall be filled with concrete when the foundations or footings are placed. Revise first subparagraph below if footings and foundations are placed on engineered fill.

1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.
2. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 0.10 foot. Do not disturb bottom of excavations intended as bearing surfaces.

B. Excavations at Edges of Tree- and Plant-Protection Zones:

1. Excavate by hand to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.

3.7 EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.8 EXCAVATION FOR UTILITY TRENCHES

A. Excavation made with power-driven equipment is not permitted within two feet of any known utility or subsurface construction. For work immediately adjacent to or for excavations exposing a utility or other buried obstruction, use hand or light equipment excavation. Start hand or light equipment excavation on each side of the indicated obstruction and continue until the obstruction is uncovered or until clearance for the new grade is assured. Support uncovered lines and other existing work affected by the excavation work of this Section until approval for backfill is granted by the geotechnical engineer. Immediately report damage to utility lines or subsurface construction to the Owner.

B. Where unidentified existing utilities are encountered, determine whether these are active or abandoned. Remove interfering portions of abandoned utilities and cap or plug open ends of pipe to remain. The cap or plug must seal the opening in such a manner that would permit remaining portions of the utility to be reactivated. Notify Owner for instructions on utilities which are determined to be active. Do not proceed without instructions, except to correct an immediate hazard or emergency condition. Relocation work performed on an active utility without obtaining prior approval from Owner shall be done at the Contractor's expense and liability.

C. In areas where compacted backfill has been placed, additional consolidation may occur after completion due to changes in moisture content and surcharge. Utility connections crossing this backfill, and improvements adjoining the building at the backfill line shall be installed taking into account this additional consolidation, or sufficient time shall be scheduled between backfilling operations and such improvements to allow this consolidation to take place. Damage to utilities or other improvements due to Contractor's negligence in regard to this paragraph shall be repaired at the Contractor's expense

D. Protect newly backfilled areas and adjacent structures, slopes, or grades from traffic, erosion settlement, and any other damage. Repair and re-establish damaged or eroded grades and slopes and restore surface construction prior to acceptance

E. Cutting Pavement, Curbs, and Gutters: Saw cut with neat, parallel, straight lines one foot wider than trench width on each side of trenches and one foot beyond each edge of pits. If an existing pavement joint or cracked area is within two feet outside of a designated sawcut line

shown on the Drawings, removal and resurfacing shall be to that joint, and/or shall include the crack or cracked area, unless otherwise approved by Architect.

F. Contractor shall pothole at all identifiable crossings of existing utilities prior to any trenching operations and provide Architect with a survey of the top elevations (and bottom elevations, if applicable), of possible interferences so that an evaluation of necessary adjustments to the current profile or alignment may be made. Additionally, Architect shall be given the opportunity to view possible conflicts in the field prior to providing revised designs.

G. Provide a minimum cover from grade of 3 feet for water mains and gas mains unless otherwise indicated on plans and details. Storm drains and sewers shall be to the depths indicated. Where settlements greater than the tolerance allowed herein for grading occur in trenches and pits due to improper compaction, excavate to the depth necessary to rectify the problem, then backfill and compact the excavation as specified herein and restore the surface to the required elevation.

H. Keep excavations free from water while construction is in progress.

I. Notify the Owner immediately in writing if it becomes necessary to remove rock or hard, unstable, or otherwise unsatisfactory material to a depth greater than indicated. Excavate large rock, boulders, and other unyielding material to depth at least 6 inches below the bottom of the pipe, conduit, duct and appurtenances, unless otherwise indicated or specified. Over-excavate soft, weak, or wet excavations to a depth at least 6 inches below the bottom of the pipe, conduit, duct or appurtenances unless otherwise indicated or specified.

J. Excavate trenches to indicated slopes, lines, depths, and invert elevations.

K. Excavate trenches to uniform widths to provide a working clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit, except where sloping of sides is allowed. Sides of trenches shall not be sloped from the bottom of the trench up to the elevation of the top of the pipe. See plans for detail.

L. At the option of the Contractor, the excavations may be overcut to depth of not less than 4 inches and refilled to required grade as specified.

M. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove stones and sharp objects to avoid point loading.

1. For pipes or conduit less than 6 inches in nominal diameter and flat-bottomed, multiple-duct conduit units, hand-excavate trench bottoms and support pipe and conduit on an undisturbed subgrade.

2. For pipes and conduit 6 inches or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe circumference. Fill depressions with tamped sand backfill.

3. Dig bell holes and depressions for joints after trench has been graded. Dimension of bell holes shall be as required for properly making the particular type of joint to ensure that the bell does not bear on the bottom of the excavation.

3.9 APPROVAL OF SUBGRADE

A. Notify Architect when excavations have reached required subgrade.

B. If and when Architect determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.

C. Roll subgrade below the building slabs and pavements with a pneumatic-tired roller to identify soft pockets and areas of excess yielding. Do not roll wet or saturated subgrades.

1. Completely roll subgrade in one direction**,** repeating rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph (5 km/h).
2. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.

D. Unforeseen additional excavation and replacement material will be paid for according to Contract provisions for Changes in Work.

E. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect, without additional compensation.

3.10 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavation under foundations or wall footings by extending indicated bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill may be used to bring elevations to proper position when acceptable to the Architect.

1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by Architect.

3.11 STORAGE OF SOIL MATERIALS

A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.12 SOIL TREATMENT

A. All chemical applications used for soil treatment are subject to the approval of the Owner.

B. Recommended termiticide: Chlorpyrifos “Dursban TC”, or “Permetrin Torpedo” or “Dragnet”, or approved equal.

C. Do not apply soil treatment solution until excavating, filling and grading operations are completed and prior to any membrane being placed beginning concrete placement or other construction activities.

D. To ensure penetration, do not apply soil treatment to excessively wet soils or during inclement weather. Comply with handling and application instruction of soil toxicant manufacturer.

E. Remove foreign matter which could decrease effectiveness of treatment on areas to be treated. Loosen, rake, and level soil to be treated, except previously compacted areas under foundations.

F. Apply soil treatment solution at rates recommended by soil toxicant manufacturer.

G. Allow not less than 12 hours for drying after application, before beginning concrete placement or other construction activities

H. Reapply soil treatment solution to areas disturbed by subsequent excavation or other construction activities following application.

3.13 BACKFILL

A. Place and compact backfill in excavations promptly, but not before completing the following:

1. Acceptance of construction below finish grade including, where applicable, subdrainage, damp-proofing, waterproofing, and perimeter insulation.
2. Surveying locations of underground utilities for Record Documents.
3. Testing and inspecting underground utilities.
4. Removing concrete formwork.
5. Removing trash and debris.
6. Removing temporary shoring and bracing, and sheeting.
7. Installing permanent or temporary horizontal bracing on horizontally supported walls.

B. Place backfill on subgrades free of mud, frost, snow, or ice.

3.14 UTILITY TRENCH BACKFILL AND COMPACTION

A. Backfilling of exterior utility trenches shall not be undertaken until geotechnical engineer has received 24-hours notice, until required tests and inspections have been completed, and until as-built location notes have been furnished. Remove uninspected backfill in accordance with requirements of this specification. Use hand-operated, plate-type, vibratory, or other suitable

hand tampers in areas not accessible to larger rollers or compactors. Avoid damaging pipes and protective pipe coatings.

B. Place backfill material in accordance with Section 306-1.3.2 of the Reference Specifications and achieve at least 90% of the maximum density. The top 12 inches of backfill in the building or paved areas shall be compacted to 95% of maximum density.

C. Compaction by ponding or flooding will not be permitted.

D. Place and compact bedding course on rock and other unyielding bearing surfaces and to fill unauthorized excavations. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

E. Concrete backfill trenches that carry below or pass under footings and that are excavated within 18 inches of footings. Place concrete to level of bottom of footings

F. Provide 4-inch-thick concrete base slab support for piping or conduit less than 2'-6" below surface of roadways. After installation and testing, completely encase piping or conduit in a minimum of 4 inches of concrete before backfilling or placing roadway base.

G. Place and compact initial backfill of satisfactory soil material or base material, free of particles larger than 1 inch, to a height of 12 inches over the utility pipe or conduit.

1. Carefully compact material under pipe haunches and bring backfill evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of utility system.

3.15 FILL

A. Preparation: Scarify and remove vegetation, topsoil, debris, wet, and unsatisfactory soil materials, obstructions, and deleterious materials from ground surface prior to placing fills.
1. The scarified ground shall be brought to optimum moisture, mixed as required, and compacted as specified. If the scarified zone is greater than 12 inches in depth, the excess shall be removed and placed in lifts restricted to six inches.
2. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.

B. Place and compact fill material in layers to required elevations as follows:

1. Under grass and planted areas, use satisfactory soil material.
2. Under walks and pavements, use satisfactory soil material.
3. Under steps and ramps, use base materials
4. Under building slabs, use base materials
5. Under footings and foundations, use drainage fill materials.

C. Place soil fill on subgrades free of mud, frost, snow, or ice.

3.16 SOIL MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.

1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.
   a. Stockpile or spread and dry removed wet satisfactory soil material.

3.17 COMPACTION OF SOIL BACKFILLS AND FILLS

A. Place backfill and fill soil materials in layers not more than 6-8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 6 inches in loose depth for material compacted by hand-operated tampers.

B. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure. Keep rollers and other heavy equipment at least 18 inches from footings, foundations, piers and walls of buildings and accessory construction. Use mechanical and hand tampers weighing at least 90 pounds with a maximum face area of 48 inches square to compact backfill within 18 inches of construction and where access is restricted.

C. Percentage of Maximum Dry Density Requirements: Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 1557:

1. For general site fills, compact each layer of backfill or fill material at 92 percent maximum dry density.

2. Under structures, building slabs, and steps, scarify and recompact top 8 inches below footing or slab and each layer of backfill or fill soil material at 90 percent maximum dry density.
3. Under walkways and concrete paving, scarify and recompact top 12 inches below subgrade and compact each layer of backfill or fill soil material at 95 percent maximum dry density.
4. Under asphalt paving, scarify and recompact top 18 inches below subgrade and compact the bottom 6 inches of backfill or fill soil material at 90 percent maximum dry density. Compact the top 12 inches of backfill or fill soil at 95 percent maximum dry density.

3.18 GRADING

A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.

1. Provide a smooth transition between adjacent existing grades and new grades.

2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
3. If necessary, the Contractor's selected equipment and construction procedure shall be altered, changed or modified in order to meet the specified compaction requirements. Flooding and water jetting is prohibited.

B. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:

1. Lawn or Unpaved Areas: ± 0.10 foot, unless otherwise indicated.
2. Concrete Walks: ± 0.025 foot.
3. Pavements:
   a. Concrete: 0.025 foot minus, with no high spots.
   b. Asphalt: 0.05 foot minus, with no high spots.

C. Grading inside Building Lines: Finish subgrade to a tolerance of ½ inch when tested with a 10-foot straightedge.

3.19 SUBSURFACE DRAINAGE

A. Subdrainage Pipe: Specified in Division 33 Section "Storm Drainage."

B. Subsurface Drain: Place subsurface drainage geotextile around perimeter of subdrainage trench. Place a 6-inch course of filter material on subsurface drainage geotextile to support subdrainage pipe. Encase subdrainage pipe in a minimum of 12 inches x 12 inches of filter material, placed in compacted layers 6 inches thick, and wrap in subsurface drainage geotextile, overlapping sides and ends at least 6 inches.

1. Compact each filter material layer to 90 percent of maximum dry unit weight

C. Drainage Backfill: Place and compact filter material over subsurface drain, in width indicated, to within 12 inches of final subgrade, in compacted layers 6 inches thick. Overlay drainage backfill with one layer of subsurface drainage geotextile, overlapping sides and ends at least 6 inches.

1. Compact each filter material layer to 90 percent of maximum dry unit weight
2. Place and compact impervious fill over drainage backfill in 6-inch thick compacted layers to final subgrade.

3.20 BASE COURSES UNDER PAVEMENTS AND WALKS

A. Place base course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place base course under pavements and walks as follows:

1. Compact base courses at optimum moisture content to required grades, lines, cross sections and thickness to not less than 95 percent of ASTM D 4254 relative density.

2. Shape base to required crown elevations and cross-slope grades.

3. When thickness of compacted base course is 6 inches or less, place materials in a single layer.

4. When thickness of compacted base course exceeds 6 inches, place materials in equal layers, with no layer more than 6 inches thick or less than 3 inches thick when compacted.

3.21 PAVEMENT REPAIR

A. Repair or patch asphalt pavement as specified in Section 32 12 16 Asphalt Paving. Repair or patch concrete pavement, curbs and gutters as specified in Section 32 1313 Concrete Paving. Do not repair pavement until trench has been backfilled and compacted as herein specified. As a minimum, maintain one-way traffic on roads and streets crossed by trenches.

3.22 FIELD QUALITY CONTROL

A. Testing Agency Services: Allow testing agency to inspect and test each subgrade and each fill or backfill layer. Do not proceed until test results for previously completed work verify compliance with requirements.
   1. Perform field in-place density tests according to ASTM D 1556 (sand cone method), ASTM D 2167 (rubber balloon method), or ASTM D 2937 (drive cylinder method), as applicable.
      a. Field in-place density tests may also be performed by the nuclear method according to ASTM D 2922, provided that calibration curves are periodically checked and adjusted to correlate to tests performed using ASTM D 1556. With each density calibration check, check the calibration curves furnished with the moisture gages according to ASTM D 3017
      b. When field in-place density tests are performed using nuclear methods, make calibration checks of both density and moisture gages at beginning of work, on each different type of material encountered, and at intervals as directed by the Architect.

B. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Architect.

C. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, perform at least one field in-place density test for every 2,000 sq. ft. or less of paved area or building slab, but in no case fewer than three tests.

D. Foundation Wall Backfill: In each compacted backfill layer, perform at least one field in-place density test for each 100 feet or less of wall length, but no fewer than two tests along a wall face.

E. Trench Backfill: In each compacted initial and final backfill layer, perform at least one field in-place density test for each 150 feet or less of trench, but no fewer than two tests.

F. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.

3.23 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

1. Scarify or remove and replace soil material to depth as directed by Architect; reshape and recompact at optimum moisture content to the required density.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.

1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.24 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

B. Transport surplus satisfactory soil to designated storage areas on Owner's property. Stockpile or spread soil as directed by Architect.

1. Remove waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION

SECTION 31 22 19 - FINISH GRADING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This section includes the following:
   1. Weeding.
   2. Finish grading of lawn and planting areas.

B. Related Sections include the following:
   1. 32 90 00: Section: Landscape Planting
   2. 32 8101: Landscape Irrigation System
   3. 31 20 00: Earthwork

1.3 DEFINITIONS

A. Finish grading: finish grading shall consist of adjusting and finishing soil surfaces with site or imported topsoil, raking grades to a smooth, even, uniform plane. Remove and legally dispose of all extraneous matter off site. Facilitate natural run-off water and establish grades and drainage indicated as part of the contract work.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Topsoil: Refer to Section 32 90 00 Landscape Planting.

B. Obtain imported topsoil from approved local sources.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of conditions: Prior to commencing the finish grading, review the installed work of other trades and verify that their work is complete.
   1. Rough Grading: Grading in planting areas (except raised planter areas) shall be established to within plus or minus 0.10 foot prior to beginning of finish grading.

B. Import topsoil only when necessary to supplement site soil to achieve grades shown on drawings, or if site soil is unsuitable for planting.

3.2 PREPARATION

A. Weeding: Before finish grading, weeds and grasses shall be dug out by the root or sprayed with an herbicide and disposed of off-site. This procedure is outlined under the Landscape Planting Section.

B. Debris: Remove stones and debris 1 inch in diameter and greater and clumps of earth that do not break up. Dispose of off-site.

3.3 INSTALLATION

A. General: When rough grading and weeding have been completed, and the soil has dried sufficiently to be readily worked, lawn and planting areas shall be graded to the elevations indicated on the Drawings.
   1. Grades indicated on Drawing are grades that will result after thorough settlement and compaction of the soil.
   2. Grades not otherwise indicated shall be uniform finish grades and, if required, shall be made at the direction of the Architect.
   3. Finish grades shall be smooth, even, and a uniform plane with no abrupt change of surfaces.
   4. Soil areas adjacent to buildings shall slope away from the building to allow a natural run-off of water, and surface drainage shall be directed as indicated on the drawings by remodeling surfaces to facilitate the run off water at 2% minimum grade.
   5. Low spots and pockets shall be graded to drain properly.

B. Drainage: Finish grade with proper slope to drains.
   1. Flow lines, designated or not, shall be graded and maintained to allow free flow of surface water.
   2. If any drainage problems arise during construction period due to Contractor's work (such as, but not limited to, low spots, slides, gullies and general erosion), the Contractor shall be responsible for repairing these areas to a condition equal to their original condition, and in so doing shall prevent further drainage problems from occurring.

C. Toe of slope: To prevent soil creep or erosion across pavement, where pavement (walk, curb, etc.) is at the toe of a slope, finish grade is to level out or swale slightly at least 6” before reaching pavement.

D. Moisture Content: The soil shall not be worked when the moisture content is so great that excessive compaction occurs, nor when it is so dry that dust may form in the air or that clods do not break readily. Water may be applied, if necessary, to provide moisture content for tilling and planting operations. It is the Contractor’s responsibility to control dust that is spread as a result of grading operations.

E. Grades: The finish grade in areas to be planted with turf shall be 2 inches below grade of adjacent pavement and walks unless shown otherwise on landscaping plans and details.

F. Compaction: Soils in planted areas shall be loose and friable, yet firm enough that no settling occurs from normal foot traffic or irrigation.

3.4 FIELD OBSERVATION

A. It is the Contractor's responsibility to contact the Architect 48 hours or two working days in advance of each agreed observation or conference.

B. Schedule for On-Site Reviews: at completion of finish grading and prior to any planting operations.

END OF SECTION

DIVISION 32
EXTERIOR IMPROVEMENTS

SECTION 32 12 16 - ASPHALT PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
1. Hot-mix asphalt paving.
2. Hot-mix asphalt patching.
3. Hot-mix asphalt overlays.
4. Asphalt surface treatments:
   a. Fog seals.
   b. Slurries.
5. Pavement-marking paint.

B. Related Sections include the following:
1. Section 31 20 00 "Earthwork" for aggregate subbase and base courses and aggregate pavement shoulders.
2. Section 32 13 13 “Concrete Paving” for pavement marking on portland cement concrete pavement and herbicide treatment under portland cement concrete paving.

1.3 SYSTEM DESCRIPTION

A. Provide hot-mix asphalt pavement according to the materials, workmanship, and other applicable requirements of the standard specifications of the state or of authorities having jurisdiction.
1. Reference Specification: Perform all work in accordance with applicable provisions of "Standard Specifications for Public Works Construction", 2018 Edition. Unless otherwise noted, mention herein of section numbers refers to sections of the Reference Specification. Where Reference Specification refers to "Agency", substitute the word "Owner". Where Reference Specification refers to "Engineer", substitute the word "Architect". Where Reference Specification is in conflict with these Specifications, these Specifications shall govern.
2. Measurement and payment provisions and safety program submittals included in Reference Specifications do not apply to this Section.

1.4 SUBMITTALS

A. Product Data: For each product specified. Include technical data and tested physical and performance properties.

B. Job-Mix Designs: Certification, by authorities having jurisdiction, of approval of each job mix proposed for the Work.

C. Job-Mix Designs: For each job mix proposed for the work.

D. Shop Drawings: Indicate pavement markings, lane separations, and defined parking spaces. Indicate dedicated handicapped spaces with international graphics symbol.

E. Samples: 12 by 12 inches (300 by 300 mm) minimum, of paving fabric.

F. Qualification Data: For firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

G. Material Test Reports: Indicate and interpret test results for compliance of materials with requirements indicated.

H. Material Certificates: Certificates signed by manufacturers certifying that each material complies with requirements.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced installer who has completed hot-mix asphalt paving similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.

B. Manufacturer Qualifications: Engage a firm experienced in manufacturing hot-mix asphalt similar to that indicated for this Project and with a record of successful in-service performance.
1. Firm shall be a registered and approved paving mix manufacturer with authorities having jurisdiction or with the DOT of the state in which Project is located.

C. Testing Agency Qualifications: Demonstrate to Architect's satisfaction, based on Architect's evaluation of criteria conforming to ASTM D 3666, that the independent testing agency has the experience and capability to satisfactorily conduct the testing indicated without delaying the Work.

D. Regulatory Requirements: Conform to applicable standards of authorities having jurisdiction for asphalt paving work on public property.

E. Asphalt-Paving Publication: Comply with AI's "The Asphalt Handbook," except where more stringent requirements are indicated.

F. Preinstallation Conference: Review methods and procedures related to asphalt paving including, but not limited to, the following:
1. Review proposed sources of paving materials, including capabilities and location of plant that will manufacture hot-mix asphalt.
2. Review condition of substrate and preparatory work performed by other trades.
3. Review requirements for protecting paving work, including restriction of traffic during installation period and for remainder of construction period.
4. Review and finalize construction schedule for paving and related work. Verify availability of materials, paving Installer's personnel, and equipment required to execute the Work without delays.
5. Review inspection and testing requirements, governing regulations, and proposed installation procedures.
6. Review forecasted weather conditions and procedures for coping with unfavorable conditions.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver pavement-marking materials to Project site in original packages with seals unbroken and bearing manufacturer's labels containing brand name and type of material, date of manufacture, and directions for storage.

B. Store pavement-marking materials in a clean, dry, protected location and within temperature range required by manufacturer. Protect stored materials from direct sunlight.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not apply asphalt materials if substrate is wet or excessively damp or if the following conditions are not met:
   1. Prime and Tack Coats: Minimum surface temperature of 60 deg F (15.5 deg C).
   2. Slurry Coat: Comply with weather limitations of ASTM D 3910.
   3. Asphalt Base Course: Minimum surface temperature of 40 deg F (4 deg C) and rising at time of placement.
   4. Asphalt Surface Course: Minimum surface temperature of 60 deg F (15.5 deg C) at time of placement.

B. Pavement-Marking Paint: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 40 deg F (4 deg C) for oil-based materials, 50 deg F (10 deg C) for water-based materials, and not exceeding 95 deg F (35 deg C).

PART 2 - PRODUCTS

2.1 AGGREGATES

A. General: Use materials and gradations that have performed satisfactorily in previous installations.

B. Coarse Aggregate: Sound; angular crushed stone; crushed gravel; or properly cured, crushed blast-furnace slag; complying with ASTM D 692.

C. Fine Aggregate: Sharp-edged natural sand or sand prepared from stone; gravel, properly cured blast-furnace slag, or combinations thereof; complying with ASTM D 1073.
   1. For hot-mix asphalt, limit natural sand to a maximum of 20 percent by weight of the total aggregate mass.

D. Mineral Filler: Rock or slag dust, hydraulic cement, or other inert material complying with ASTM D 242.

2.2 ASPHALT PAVEMENT MATERIALS

A. Asphalt Pavement Leveling Course: Conform to Viscosity Grade B-PG 64-10 in section 203-1.2 and section 203-6 of the Reference Specification.

B. Asphalt Pavement Wearing (Surface) Course: Conform to Viscosity Grade III C2-PG 64-10, C3-PG 64-10 in section 203-1.2 and section 203-6 and section 400-4 to be used with Class III asphalt of the Reference Specification.

C. Prime Coat: Grade SC-70 liquid asphalt conforming to section 203-2 of the Reference Specification.

D Tack Coat: Emulsified asphalt grade SS-1h conforming to section 203-3 of the Reference Specification.

E. Asphalt Paint: Conform to ASTM D41 or D43 per section 203-8 of the Reference Specification.

F. Slurry Seal: Emulsified asphalt grade [SS-1h] [CSS-1h] and aggregate conforming to section 203.5 of the Reference Specification.

G. Asphalt Cement: ASTM D 3381 for viscosity-graded material; ASTM D 946 for penetration-graded material.

H. Asphalt Cement: ASTM D 3381 for viscosity-graded material.

I. Undersealing Asphalt: ASTM D 3141, pumping consistency.

J. Prime Coat: ASTM D 2027; medium-curing cutback asphalt; MC-30, MC-70, or MC-250.

K. Prime Coat: Asphalt emulsion prime conforming to state DOT requirements.

L. Prime Coat: ASTM D 977, emulsified asphalt or ASTM D 2397, cationic emulsified asphalt, slow setting, factory diluted in water, of suitable grade and consistency for application.

M. Tack Coat: ASTM D 977, emulsified asphalt or ASTM D 2397, cationic emulsified asphalt, slow setting, factory diluted in water, of suitable grade and consistency for application.

N. Fog Seal: ASTM D 977, emulsified asphalt or ASTM D 2397, cationic emulsified asphalt, slow setting, factory diluted in water, of suitable grade and consistency for application.

O. Water: Potable.

2.3 AUXILIARY MATERIALS

A. Herbicide: Commercial chemical for weed control, registered by Environmental Protection Agency (EPA). Provide granular, liquid, or wettable powder form.

B. Sand: ASTM D 1073, Grade Nos. 2 or 3.

C. Paving Geotextile: Nonwoven polypropylene, specifically designed for paving applications, resistant to chemical attack, rot, and mildew.

D. Pavement-Marking Paint: Alkyd-resin type, ready-mixed, complying with FS TT-P-115, Type I, or AASHTO M-248, Type N.

E. Pavement-Marking Paint: Latex, water-base emulsion, ready-mixed, complying with FS TT-P-1952.
1. Color: As indicated.
2. Color: White (for parking stalls, other than handicapped).
2. Color: Yellow (for parking stalls, other than handicapped).
3. Color: Blue (for pavement markings identifying handicap parking)
4. Color: Red (for “No Parking” areas as shown)

F. Glass Beads: AASHTO M-247.

2.4 MIXES

A. Hot-Mix Asphalt: Provide dense, hot-laid, hot-mix asphalt plant mixes approved by authorities having jurisdiction; designed according to procedures in AI's "Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types"; and complying with the following requirements:
1. Provide mixes with a history of satisfactory performance in geographical area where Project is located.
2. Base Course: As indicated.
3. Surface Course: As indicated.

B. Hot-Mix Asphalt: Provide dense, hot-laid, hot-mix asphalt plant mixes approved by authorities having jurisdiction and designed according to procedures in AI's "Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types."
1. Provide mixes with a history of satisfactory performance in geographical area where Project is located.

2. Provide mixes complying with the composition, grading, and tolerance requirements of ASTM D 3515 for the following nominal, maximum aggregate sizes:
   a. Base Course: 1 inch (25 mm).
   b. Surface Course: 1/2 inch (13 mm).

C. Emulsified-Asphalt Slurry: ASTM D 3910, consisting of emulsified asphalt, fine aggregates, and mineral fillers and as follows:
1. Composition: Type 1.
2. Composition: Type 2.
3. Composition: Type 3.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that subgrade is dry and in suitable condition to support paving and imposed loads.

B. Subgrade, Subbase, and Base:
1. Proof-roll prepared subgrade and base using heavy, pneumatic-tired rollers to locate areas that are unstable or that require further compaction.

C. Notify Architect in writing of any unsatisfactory conditions. Do not begin paving installation until these conditions have been satisfactorily corrected.

3.2 COLD MILLING

A. Clean existing paving surface of loose and deleterious material immediately before cold milling. Remove existing asphalt pavement, including hot-mix asphalt and, as necessary, unbound-aggregate base course, by cold milling to grades and cross sections indicated.
1. Repair or replace curbs, manholes, and other construction damaged during cold milling.

B. Cold mill existing asphalt concrete pavement in accordance with section 302-5.2 of the Reference Specification.

3.3 PATCHING AND REPAIRS

A. Patching: Saw cut perimeter of patch and excavate existing pavement section to sound base. Recompact new subgrade. Excavate rectangular or trapezoidal patches, extending 12 inches (300 mm) into adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically.
1. Tack coat faces of excavation and allow to cure before paving.
2. Fill excavation with dense-graded, hot-mix asphalt base mix and, while still hot, compact flush with adjacent surface.
3. Partially fill excavation with dense-graded, hot-mix asphalt base mix and compact while still hot. Cover asphalt base course with compacted, hot-mix surface layer finished flush with adjacent surfaces.

B. Portland Cement Concrete Pavement: Break cracked slabs and roll as required to reseat concrete pieces firmly.
1. Pump hot undersealing asphalt under rocking slabs until slab is stabilized or, if necessary, crack slab into pieces and roll to reseat pieces firmly.
2. Remove disintegrated or badly broken pavement. Prepare and patch with hot-mix asphalt.

C. Leveling Course: Install and compact leveling course consisting of dense-graded, hot-mix asphalt surface course to level sags and fill depressions deeper than 1 inch (25 mm) in existing pavements.

1. Install leveling wedges in compacted lifts not exceeding 3 inches (75 mm) thick.

D. Crack and Joint Filling: Remove existing filler material from cracks or joints to a depth of 1/4 inch (6 mm). Refill with asphalt joint-filling material to restore watertight condition. Remove excess filler that has accumulated near cracks or joints.

E. Asphalt paint: Apply uniformly to existing surfaces of previously constructed asphalt or Portland cement concrete paving and to surfaces abutting or projecting into new, hot-mix asphalt pavement. Apply at a uniform rate of 0.05 to 0.15 gal./sq. yd. (0.2 to 0.7 L/sq. m) of surface.
1. Allow asphalt paint to cure undisturbed before paving.
2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

3.4 SURFACE PREPARATION

A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.
1. Sweep loose granular particles from surface of unbound-aggregate base course. Do not dislodge or disturb aggregate embedded in compacted surface of base course.

B. Herbicide Treatment: Apply herbicide according to manufacturer's recommended rates and written application instructions. Apply to dry, prepared subgrade or surface of compacted-aggregate base before applying paving materials.
1. Mix herbicide with prime coat when formulated by manufacturer for that purpose.

C. Prime Coat: Apply uniformly over surface of compacted-aggregate base at a rate of 0.15 to 0.50 gal./sq. yd. (0.7 to 2.3 L/sq. m). Apply enough material to penetrate and seal, but not flood, surface. Allow prime coat to cure for 72 hours minimum.
1. If prime coat is not entirely absorbed within 24 hours after application, spread sand over surface to blot excess asphalt. Use just enough sand to prevent pickup under traffic. Remove loose sand by sweeping before pavement is placed and after volatiles have evaporated.
2. Protect primed substrate from damage until ready to receive paving.

D. Prime Coat: Comply with section 302-5.3 of the Reference Specification. Apply primer at a rate of between 0.20 and 0.25 gallons per square yard to top surface of base course prior to asphalt placement.

E. Tack Coat: If a leveling course has been used for construction traffic, apply tack coat to all leveling course surfaces in accordance with section 302-5.4 of the Reference Specification at a rate of 0.10 gallons per square yard.

3.5 HOT-MIX ASPHALT PLACING

A. Machine place hot-mix asphalt mix on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand to areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness, when compacted.
1. Place hot-mix asphalt base course in number of lifts and thicknesses indicated.
2. Place hot-mix asphalt surface course in single lift.
3. Spread mix at minimum temperature of 250 deg F (121 deg C).
4. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes, unless otherwise indicated.
5. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.

B. Place paving in consecutive strips not less than 10 feet (3 m) wide, except where infill edge strips of a lesser width are required.
   1. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Complete asphalt base course for a section before placing asphalt surface course.

C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

D. The asphalt pavement shall be completed in phases; the leveling course during construction for temporary construction traffic and storage of materials and; the wearing (surface) course just prior to turnover to Owner; unless the entire paving operation is completed just prior to turnover to the Owner such that no construction traffic or storage of materials shall be allowed on the finished pavement surface after its completion. Contractor shall schedule final surface course paving operations so that the required waiting period specified in the Division 2 Section “Pavement Marking” will allow project completion within the specified time.

E. Construct asphalt pavement in accordance with section 302-5 of the Reference Specification and as shown on the Drawings.

F. Two Layer Method: The leveling course shall be installed to elevations which will allow the future placement of a wearing (surface) course no thinner than 1-1/2 inches. Prior to placing the wearing (surface) course, repair all areas damaged during construction use, thoroughly clean the leveling course of all loose material and place a tack coat pursuant to paragraph 3.4 D. herein.

3.6 JOINTS

A. Construct joints to ensure continuous bond between adjoining paving sections. Construct joints free of depressions with same texture and smoothness as other sections of hot-mix asphalt course.
   1. Clean contact surfaces and apply tack coat.
   2. Offset longitudinal joints in successive courses a minimum of 6 inches (150 mm).
   3. Offset transverse joints in successive courses a minimum of 24 inches (600 mm).
   4. Construct transverse joints by bulkhead method or sawed vertical face method as described in AI's "The Asphalt Handbook."
   5. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.
   6. Compact asphalt at joints to a density within 2 percent of specified course density.

3.7 COMPACTION

A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or vibratory-plate compactors in areas inaccessible to rollers.
   1. Complete compaction before mix temperature cools to 185 deg F (85 deg C).

B. Breakdown Rolling: Accomplish breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Repair surfaces by loosening displaced material, filling with hot-mix asphalt, and rerolling to required elevations.

C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling, while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to at least 95 percent of the Hveem density (ASTM D 2726-05a).

D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.

E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while still hot, with back of rake or smooth iron. Compact thoroughly using tamper or other satisfactory method.

F. Repairs: Remove paved areas that are defective or contaminated with foreign materials. Remove paving course over area affected and replace with fresh, hot-mix asphalt, with a thickness one inch greater than the existing, and to match existing finish surface grades such that no local ponding of water will result. Compact by rolling to specified density and surface smoothness.

G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.

H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.8 INSTALLATION TOLERANCES

A. Thickness: Compact each course to produce the thickness indicated within the following tolerances:
1. Leveling Course: ±1/2 inch (13 mm).
2. Surface Course: Plus 1/4 inch (6 mm), no minus.

B. Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot (3-m) straightedge applied transversely or longitudinally to paved areas:
1. Leveling Course: 1/4 inch (6 mm).
2. Surface Course: 1/8 inch (3 mm).
3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch (6 mm).

3.9 SURFACE TREATMENTS

A. Fog Seals: Apply fog seal at a rate of 0.10 to 0.15 gal./sq. yd. (0.45 to 0.70 L/sq. m) to existing asphalt pavement and allow to cure. Lightly dust areas receiving excess fog seal with a fine sand.

B. Slurry Seals: Apply slurry coat in a uniform thickness according to ASTM D 3910 and allow to cure.
1. Roll slurry seal to smooth ridges and provide a uniform, smooth surface.
2. Slurry seal to be applied min. 30 days after completion of asphalt pavement.

C. Slurry seals: Apply in accordance with section 302-4 of the Reference Specification.

3.10 PAVEMENT MARKING

A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect.

B. Allow paving to cure for 30 days before starting pavement marking.

C. Sweep and clean surface to eliminate loose material and dust.

D. Apply paint with mechanical equipment to produce pavement markings of dimensions indicated with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils (0.4 mm).
   1. Broadcast glass spheres uniformly into wet pavement markings at a rate of 6 lb/gal. (0.72 kg/L).

E. Comply with paint manufacturer's maximum drying time requirements to prevent undue softening of bitumen and pick-up, displacement, or discoloration of pavement marking by vehicular traffic.

F. Paint pavement, curbs and other surfaces, as shown on the Drawings. Painting shall be straight, uniform, exact and sharp without blobs at the start and finish. Edges shall be even, accurate, symmetrical and free of fuzziness.

G. Apply markings for disabled access symbols in accordance with State of California Building Code, Part 2, Title 24, CCR.

H. Where work consists of modifications of, or additions to existing parking striping, match existing color and width of lines as closely as possible.

3.11 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing agency to perform field inspections and tests and to prepare test reports.
   1. Testing agency will conduct and interpret tests and state in each report whether tested Work complies with or deviates from specified requirements.

B. Additional testing, at Contractor's expense, will be performed to determine compliance of corrected Work with specified requirements.

C. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined according to ASTM D 3549.

D. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.

E. Perform flood tests on asphalt paved areas to determine if surface grades allow proper runoff of surface water and if drainage devices function properly. Such tests shall be conducted in the presence of the Architect and the Owner. Promptly correct paving work found to be defective due to ponding of water or improper drainage.

F. In-Place Density tests will be performed using nuclear gauge (ASTM D 2950-05) to verify at least 95 percent relative compaction of the Hveem density has been achieved. Representative samples of the AC will be collected and tested in the laboratory for Hveem density (ASTM D 2726-05a), theoretical maximum density (ASTM D 2041-03a), stability (ASTM D 1560-05), gradation (ASTM C 136-05), and asphalt content (ASTM D 6307-05).

G. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

END OF SECTION

SECTION 32 13 00 - ARCHITECTURAL CONCRETE PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes:

1. Enriched (colored and/or special finish) concrete paving finishes.

B. Related Sections

1. Base Courses, Section 321000.
2. Site Work Concrete, Section 321600.
3. Structural Concrete, Division 3.
4. Sealants and caulking: Division 7.

1.3 QUALITY CONTROL

A. Manufacturer's Directions:

1. Manufacturer's directions and drawings shall be followed in all cases where the manufacturers of articles used in the Section furnish directions covering points not shown in the Drawings and Specifications.

1.4 INSPECTION OF THE SITE

A. Verify conditions at site that affect work of this Section, and take field measurements as required. Report any major discrepancies between drawings and field dimensions to the Architect prior to commencing work.

1.5 SUBMITTALS

A. Comply with Division 1.

B. Product Data:

1. Submit manufacturer's catalog data for all products used in this Section.
2. Submit color chart or samples for expansion joint sealant.

A. Shop Drawings:

1. Contractor shall submit shop drawings for expansion joints, cold joints, and decorative score line layout.

1.5 SUBSTITUTIONS

A. Substitutions shall be in accordance with Division 1.

B. Specific reference to manufacturer's names and products specified in this Section are used as standards of quality. This implies no right of the Contractor to substitute other materials without prior written approval.

C. Any materials installed without written approval may be rejected and the Contractor shall at his own cost remove such materials from the site.

1.6 SAMPLES

A. Design Samples: Provide up to 3 separate and individual samples of each type of color and finish of exposed finished concrete as indicated or as requested by the Architect. The purpose of this is to accommodate refinement and changes of the color and finish selection(s).

1. Design Samples shall be a minimum of 12" square and shall be warranted to represent results achievable at the site, but need not be prepared at the site.

B. Field Samples:

1. Provide 100 square feet of each type of concrete paving, score line and finish type for review by the Architect.

2. Field samples must match Design samples. Unacceptable field samples shall be demolished and removed from the site. New field samples shall be made until an acceptable sample is presented. Acceptable field samples may be retained in the Work.

PART 2 - PRODUCTS

2.1 PAVING TYPES

A. Paving Type ‘1’ (plaza paving and walkways):
Color: Natural Gray
Finish: Light Sandblast (alternate Top-Cast No.3 retarder)
Joints: Sawcut 3/16”

B. Paving Type ‘2’ (plaza paving highlight enriched panels where shown on the plans):
Color: Natural Gray
Seeded Aggregate: Hand seeded dark gray 3/8” pebble 50% coverage, trowel into surface
Finish: Heavy Sandblast (No Top-Cast alternate)
Joints: Sawcut 3/16”

2.2 CONCRETE MATERIALS

A. Portland Cement: Refer to Site Work Concrete, Section 321600.

B. Aggregate: Refer to Site Work Concrete, Section 321600.

C. Water: Refer to Site Work Concrete, Section 321600

D. Expansion Joint Materials:

1. Pre-molded expansion joint filler shall conform to ASTM D1751-6B size per plans, by Sonofoam or approved equal.

2. Joint sealant compound shall be two part polyurethane sealant as manufactured by Sonneborn or approved equal. Sealant color as selected by Architect.

3. Submit color chart or color samples.

E. Reinforcement and Dowels: Refer to Site Work Concrete, Section 321600, except as follows:

1. Slip Dowels: Dowels shall be #4 rebar x 12" long and free of dirt, grease and oils. 50% of each dowel shall be encased in a plastic sleeve called "Speed Dowel" to allow parallel lateral movement of the dowel. Speed Dowel is distributed through Aztec Concrete Accessories at (909)829-2765.

2. Alternative proprietary cold joint systems may be proposed subject to Division 1 requirements for substitutions.

2.3 ADMIXTURES AND RETARDERS

A. Air Entrainments: Conforming to ASTM C260.

B. Chemical Admixtures: Conforming to ASTM C494 and ASTM C1017.

C. Water Reducing Admixtures:

1. Shall conform to ASTM C260, Type A and not contain more than 0.1% chloride ions.

D. Top Surface Retarder:

1. “Top-Cast” by Grace Construction Products, or approved equal.

2.4 READY MIXED CONCRETE

A. Refer to Site Work Concrete, Section 321600. 0.50 water to cement ratio maximum.

PART 3 - EXECUTION

3.1 PREPARATORY WORK

A. Verification of Conditions:

1. Examine areas and conditions under which work is to be installed.

2. Correct conditions detrimental to proper and timely completion of the work.

3. Starting the work constitutes acceptance of existing conditions.

B. Acceptance of Field Samples:

1. Install field samples of each type of concrete paving prior to commencing the work. The Architect will review for appearance, finish and joint accuracy.

3.2 DESIGN OF MIXES AND PROPORTIONING

A. Refer to Site Work Concrete, Section 321600.

3.3 FORMING, PLACING AND CURING CONCRETE

A. Refer to Site Work Concrete, Section 321600.

3.4 FINISHES

A. Finishes shall be as detailed on the drawings.

1. All exterior ramps shall be finished with a coarse hand trowel finish.
2. Finishes shall match approved field samples.

B. Top-cast Finish: Procedures per manufacturer recommendations.

C. Slip Resistance:

1. For slopes less than 6% surfaces shall be as slip resistant as that described as medium broom finish.
2. For slopes 6% or greater shall be as slip resistant as described as heavy broom finish.

3.5 JOINTING

A. Expansion and Construction Joints:

1. Construct in concrete paving as shown on the Drawings. 1/4" thick felt expansion joint material shall extend the full depth of the concrete being placed. The top of joint shall be flush with the specified grade.
2. All expansion joint filler strips shall be installed vertically, and extend to the full depth and width of the work in which they are installed, and be constructed perpendicular to straight curb or radially to the line of the curb constructed on a curve. During placing and tamping of the concrete, the expansion joint shall be held rigidly and securely in proper position.
3. Foam expansion joint material, 1/2" thick X 3" high with 1/2" high removable portion, (to be removed prior to sealing). Install per manufacturers instructions. Deck-O-Foam is available from DCF Company, 13340 South Central Avenue, Los Angeles, California 90059, (213) 636-1214 or approved equal.
4. Caulk expansion joints with two-part polyurethane, non-sagging compound. Color of caulking shall match adjacent concrete color. Install per manufacturers instructions.
5. While the caulking is still tacky, apply a layer of sand matching concrete color and brush away any excess.

B. Control Joints:

1. Shall be 3/16" wide by 1 1/2" deep. All joints to be cut in a straight line with minimal over-cut. Use straightedge guide for alignment. At the edges of all saw cutting, i.e. curbs, walls, bands, etc., hand cut as necessary to achieve minimal over-cut.

3.6 CLEANING

A. Remove excess material from the site.

B. Remove concrete stains from adjacent surfaces.

END OF SECTION

SECTION 32 13 13 - CONCRETE PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes exterior Portland cement concrete paving for the following:
   1. Curbs and gutters.
   2. Walkways.
   3. Driveways
   3. Concrete pavement.
   4. Concrete wheel stops

B. Related Sections: The following Sections contain requirements that relate to this Section:
   1. Section 31 20 00: Earthwork for subgrade preparation, grading and base course.
   2. Section 03 30 00: Cast-in-Place Concrete for general building applications of concrete.

1.3 SYSTEM DESCRIPTION

A. Provide concrete pavement according to the materials, workmanship, and other applicable requirements of the following standard specifications:
   1. Reference Specification: Perform all work in accordance with applicable provisions of "Standard Specifications for Public Works Construction", 2018. Unless otherwise noted, mention herein of section numbers refers to sections of the Reference Specification. Where Reference Specification refers to "Agency", substitute the word "Owner". Where Reference Specification refers to "Engineer", substitute the word "Architect". Where Reference Specification is in conflict with these Specifications, these Specifications shall govern.
   2. Measurement and payment provisions and safety program submittals included in Reference Specifications do not apply to this Section.

1.4 SUBMITTALS

A. General: Submit the following according to the Conditions of the Contract and Division 1 Specification Sections.

B. Design mixes for each class of concrete. Include revised mix proportions when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments.

C. Description of Methods and Sequence of Placement. For each type of specially-finished concrete provide description of methods and sequence of placement.

D. Submit manufacturer's product data for the following:
   1. Form release agent.
   2. Concrete coloring additive.
   3. Prefabricated control joint.
   4. Preformed joint filler.
   5. Sealants.
   6. Slip plane joint.
   7. Concrete mix design.

1.5 QUALITY ASSURANCE

A. Concrete Standards: Comply with provisions of the following standards, except where more stringent requirements are indicated.
   1. American Concrete Institute (ACI) 301, "Specifications for Structural Concrete for Buildings."
   2. ACI 318, "Building Code Requirements for Reinforced Concrete."
   3. Concrete Reinforcing Steel Institute (CRSI) "Manual of Standard Practice."
   4. Standard specifications for PWC (Green Book) latest edition, section 201-1.

B. Concrete Manufacturer Qualifications: Manufacturer of ready-mixed concrete products complying with ASTM C 94 requirements for production facilities and equipment.

C. Paving work, base course etc., shall be done only after excavation and construction work, which may damage them, have been completed. Damage caused during construction shall be repaired before acceptance.

D. Existing paving area shall, if damaged or removed during the course of this project, be repaired or replaced under this section of the specification. Workmanship and materials for such repair and replacement, except as otherwise noted, shall match as closely as possible those employed in existing work.

E. Pavement, base, or subbase shall not be placed on a muddy subgrade.

F. Provide sawcut control joints as required to construct 100 sq. ft. maximum panel sizes, unless otherwise called on the plans.

G. Concrete Testing Service: Engage a qualified independent testing agency to perform materials evaluation tests and to design concrete mixes.

1.6 PROJECT CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

1.7 TESTING AND INSPECTION

A. The owner reserves the right to inspect and test paving and associated work.

PART 2 - PRODUCTS

2.1 FORMS

A. Form Materials: Plywood, metal, metal-framed plywood, or other acceptable panel-type materials to provide full-depth, continuous, straight, smooth exposed surfaces.
   1. Use flexible or curved forms for curves of a 100-foot or less radius.

B. Form Release Agent: Provide commercial formulation form-release agent with a maximum of 350 g/L volatile organic compounds (VOCs) that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
   1. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:

a. Debond Form Coating, L & M Construction Chemicals.
b. Crete-Lease 880 VOC, Cresset Chemical Company.

2.2 REINFORCING MATERIALS

A. Reinforcing Bars and Tie Bars: ASTM A 615, Grade 40 for #3 bars and Grade 60 for bars larger than #3, deformed.

B. Plain, Cold-Drawn Steel Wire: ASTM A 82.

C. Joint Dowel Bars: Plain steel bars, ASTM A 615, Grade 60. Cut bars true to length with ends square and free of burrs.

D. Dowel Sleeves: Speed Dowel, Aztec Concrete Accessories, Inc.

E. Hook Bolts: ASTM A 307, Grade A bolts, internally and externally threaded. Design hook bolt joint assembly to hold coupling against pavement form and in position during concreting operations, and to permit removal without damage to concrete or hook bolt.

F. Supports for Reinforcement: Chairs, spacers, dowel bar supports and other devices for spacing, supporting, and fastening reinforcing bars, welded wire fabric, and dowels in place. Use wire bar-type supports complying with CRSI specifications.
1. Use supports with sand plates or horizontal runners where base material will not support chair legs.

G. Welded wire fabric reinforcement shall conform to the applicable requirements of ASTM A185. Fabric reinforcement shall be furnished in flat sheets. Fabric reinforcement in rolls will not be permitted.

2.3 CONCRETE MATERIALS

A. Portland Cement: ASTM C 150, Type II
1. Use one brand of cement throughout Project. Coordinate with Division 3 Section "Cast-In-Place Concrete."

B. Normal-Weight Aggregates: ASTM C 33, Class 4M non-reactive, and as follows. Provide aggregates from a single source.
1. Maximum Aggregate Size: 1-inch.
2. Do not use fine or coarse aggregates that contain substances that cause spalling.
3. Local aggregates not complying with ASTM C 33 that have been shown to produce concrete of adequate strength and durability by special tests or actual service may be used when acceptable to Architect.

C. Water: Potable.

D. Admixtures: Comply with requirements specified in Division 3 Section "Cast-In-Place Concrete."
1. Do not use admixtures containing calcium chloride or chloride ions.

2.4 COLOR ADMIXTURE

A. Color admixture shall be suitable for flatwork concrete and shall meet or exceed the requirements set by Portland Cement Association (PCA) and ATSM C 494.

B. Color admixture shall be of a type and quality which will not adversely affect workability, setting, or strength of concrete. Color pigments shall consist of chemically inert, non-fading,

alkali-fast mineral oxides, finely ground and specially prepared for the use in both cement and mortar. Admixture shall not contain calcium chloride.

C. Color admixture shall be Chromix admixture, manufactured by L.M. Scofield Company, Los Angeles, CA 90040, or approved equal.

D. Mix design shall conform to manufacturer's recommendations, and directions of the Architect to achieve proposed color. Strictly monitor additive / cement ratio throughout job to ensure uniform color.

2.5 CURING MATERIALS

A. Absorptive Cover: Burlap cloth made from jute or kenaf, weighing approximately 9 oz. per sq. yd., complying with AASHTO M 182, Class 2.

B. Moisture-Retaining Cover: One of the following, complying with ASTM C 171.
1. Waterproof paper.
2. Polyethylene film.
3. White burlap-polyethylene sheet.

C. Liquid Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B. Moisture loss not more than 0.55 kg/sq. meter in 72 hours when applied at a rate of 200 sq. ft./gal.
1. Provide material that has a maximum volatile organic compound (VOC) rating of 350 g/L.
2. Products: Subject to compliance with requirements, provide one of the following or approved equal:
   a. L & M Cure R, L & M Construction Chemicals, Inc.
   b. 1100-Clear, W.R. Meadows, Inc.
3. Do not use sodium silicate type curing agents.

D. Evaporation Control: Monomolecular film-forming compound applied to exposed concrete slab surfaces for temporary protection from rapid moisture loss.
1. Products: Subject to compliance with requirements, provide one of the following or approved equal:
   a. Eucobar; Euclid Chemical Co.
   b. E-Con; L&M Construction Chemicals, Inc.
   c. Confilm; Master Builders, Inc.

2.6 RELATED MATERIALS

A. Bonding Agent: Acrylic or styrene butadiene, complying with ASTM C 1059, Type 2.

B. Epoxy Adhesive: ASTM C 881, two-component material suitable for dry or damp surfaces. Provide material type, grade, and class to suit requirements.

C. Products: Subject to compliance with requirements, provide one of the following or approved equal:
1. Bonding Agent:
   b. SBR Latex; Euclid Chemical Co.
   c. Daraweld C; W.R. Grace & Co.
   d. Everbond; L&M Construction Chemicals, Inc.
   e. Acryl-Set; Master Builders Inc.
2. Epoxy Adhesive:
   a. Burke Epoxy M.V., The Burke Co.
   b. Concresive Standard Liquid; Master Builders, Inc.
   c. Rezi-Weld 1000; W.R. Meadows, Inc.

D. Concrete Sealer: Water-based, deep penetrating, non-staining, non-darkening silane micro emulsion.
   1. Positive chloride-ion screening, prevents water intrusion, minimizes rebar corrosion and potential concrete spalling, and protects against damaging effects of alkalis and other contaminants.
   2. Provide material that has a maximum volatile organic compound (VOC) rating of 350 g/L.
   3. Available Products: Subject to compliance with requirements, products that may be incorporated in the work include, but are not limited to the following:
      a. Pentane WB, L & M Construction Chemicals, Inc. This product is intended to establish the characteristics and level of quality intended for this Project.

D. Expansion and Isolation Joint Fillers: ASTM D 1751, cellulosic fiber.

2.7 CONCRETE MIX

A. Prepare design mixes for each type and strength of normal-weight concrete by either laboratory trial batch or field experience methods as specified in ACI 301. For the trial batch method, use a qualified independent testing agency for preparing and reporting proposed mix designs.
   1. Do not use the Owner's field quality-control testing agency as the independent testing agency.

B. Proportion mixes according to ACI 211.1 and ACI 301 to provide normal-weight concrete with the following properties:
   1. Compressive Strength (28-Day): 2500 psi for concrete for sidewalks; 3200 psi for concrete in traffic areas, curbs and gutters.
   2. The minimum cement content shall be 5-1/4 sacks per cubic yard.
   3. The maximum concrete slump shall be 3 inches ±1/2 inch, for all walks; and 4 inches ±1 inch for all other Portland cement concrete paving.
   4. Water/Cement Ratios:
      a. 0.50 maximum for all site concrete.

C. Adjustment to Concrete Mixes: Mix design adjustments may be requested by Contractor when characteristics of materials, project conditions, weather, test results, or other circumstances warrant.

D. Admixtures: Comply with requirements specified in Division 3 Section "Cast-In-Place Concrete".

2.8 CONCRETE MIXING

A. Ready-Mixed Concrete: Comply with requirements and with ASTM C 94.
   1. When air temperature is between 85 deg F (30 deg C) and 90 deg F (32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

2.9 GROUT

A. Grout shall be mixed in the proportions of one part Portland cement to two parts sand, by volume. Only sufficient water shall be used to enable grout to barely hold its shape when squeezed into a ball in the hand. Sand for grout shall be "Fine Aggregate", conforming to ASTM C 33.

B. Non-shrink grout shall be pre-mixed non-shrinking, high strength grout. Compressive strength in 28 days shall be 5,000 psi minimum, but in no case less than the specified strength of the adjacent concrete. Manufacturer shall provide evidence that the material meets the requirements of the COE CRD-C 621 (558). Grout permanently exposed to view shall be non-oxidizing; metallic grout may be used in other locations.

1. Non-shrink grout shall be one of the following or approved equal:

Manufacturer	Product
Gifford-Hill Co.	Supreme
Master Builders Co.	Embeco
U.S. Grout Corporation	Five Star Grout

2.10 SANDBLASTING MATERIAL

A. Material for sandblasting shall be 16/20 mesh sand.

2.11 HERBICIDE TREATMENT

A. Commercial chemical for weed control, registered by Environmental Protection Agency. Provide granular, liquid, or wettable powder form.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the work include, but are not limited to the following:
   a. Ciba-Geigy Corp.
   b. Dow Chemical U.S.A.
   c. E.I. Du Pont de Nemours & Co., Inc.
   d. FMC Corp.
   e. Thompson-Hayward Chemical Co.
   f. U.S. Borax and Chemical Corp.

PART 3 - EXECUTION

3.1 SURFACE PREPARATION

A. Areas to be paved shall be compacted and brought to subgrade elevation per soils report before work of this section is performed. Final fine grading, filling, and compaction of areas to receive paving, as required to form a firm, uniform, accurate, and unyielding subgrade at required elevations and to required lines, shall be done under this Section.

B. Existing subgrade material which will not readily compact as required shall be removed and replaced with satisfactory materials. Additional materials needed to bring subgrade to required line and grade and to replace unsuitable material removed shall be material conforming to this Section.

C. Subgrade of areas to be paved shall be re-compacted per soils report.

D. Excavation required in pavement subgrade shall be completed before fine grading and final compaction of subgrade are performed. Where excavation must be performed in completed subgrade, base, or pavement, subsequent backfill and compaction shall be performed per soils report.

E. Areas being graded or compacted shall be kept shaped and drained during construction. Ruts greater than or equal to 2 in. deep in subgrade, shall be graded out, reshaped as required, and re-compacted before placing pavement.

F. Materials shall not be stored or stockpiled on subgrade.

G. Disposal of debris and other material excavated under this section, and material unsuitable for or in excess of requirements for completing work of this section shall be disposed of off-site.

H. Prepared subgrade will be inspected by Soils Engineer. Subgrade shall be approved before installation of gravel base course. Disturbance to subgrade caused by inspection procedures shall be repaired under this section of the specification.

I. Proof-roll subgrade or base surface prepared by others to check for unstable areas and verify need for additional compaction. Do not begin paving work until such conditions have been corrected and are ready to receive paving.

J. Herbicide Treatment: Apply chemical weed control agent in strict compliance with manufacturer's recommended dosages and application instructions. Apply to compacted, dry subgrade prior to installation of base course.

3.2 EDGE FORMS AND SCREED CONSTRUCTION

A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides for paving to required lines, grades, and elevations. Install forms to allow continuous progress of work and so that forms can remain in place at least 24 hours after concrete placement.

B. Check completed formwork and screeds for grade and alignment to following tolerances:
1. Top of Forms: Not more than 1/8 inch in 10 feet.
2. Vertical Face on Longitudinal Axis: Not more than 1/4 inch in 10 feet.

C. Clean forms after each use and coat with form release agent as required to ensure separation from concrete without damage.

3.3 PLACING REINFORCEMENT

A. General: Comply with Concrete Reinforcing Steel Institute's recommended practice for "Placing Reinforcing Bars" for placing and supporting reinforcement.

B. Clean reinforcement of loose rust and mill scale, earth, or other bond-reducing materials. Where there is delay in placing concrete after reinforcement is in place, bars shall be re inspected and cleaned when necessary.

C. Any bar showing cracks after bending shall be discarded.

D. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.

E. Install fabricated bar mats in lengths as long as practicable. Handle units to keep them flat and free of distortions. Straighten bends, kinks, and other irregularities or replace units as required before placement. Set mats for a minimum 2-inch overlap to adjacent mats.

F. After forms have been coated with form release agent, but before concrete is placed, reinforcing steel anchors shall be securely wired in the exact position called for, and shall be maintained in that position until concrete is placed and compacted. Chair bars and supports shall be provided in a number and arrangement satisfactory to the Architect.

3.4 JOINTS

A. General: Construct contraction, construction, and isolation joints true to line with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to the centerline, unless indicated otherwise.
   1. When joining existing paving, place transverse joints to align with previously placed joints, unless indicated otherwise.
   2. Make joints, including sawed joints, full depth required and from edge to edge of paving.

B. Control Joints: Provide weakened-plane control joints, sectioning concrete into areas as shown on Drawings. Construct control joints for a depth equal to at least 1/4 of the concrete thickness, as follows:

   1. Tooled Joints: Form control joints in fresh concrete by grooving and finishing each edge of joint with a radiused jointer tool.
   2. Sawed Joints: Form control joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into hardened concrete when cutting action will not tear, abrade, or otherwise damage surface and before development of random contraction/shrinkage cracks.
   3. Inserts: Form control joints by inserting pre-molded plastic, hardboard, or fiberboard strips into fresh concrete until top surface of strip is flush with paving surface. Radius each joint edge with a jointer tool. Carefully remove strips or caps of two-piece assemblies after concrete has hardened. Clean groove of loose debris.

C. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than 1/2 hour, unless paving terminates at isolation joints.

   1. Continue reinforcement across construction joints unless indicated otherwise. Do not continue reinforcement through sides of strip paving unless indicated.
   2. Provide tie bars at sides of paving strips where indicated.
   3. Use bonding agent on existing concrete surfaces that will be joined with fresh concrete.

D. Isolation Joints: Form isolation joints of preformed joint filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, walks, other fixed objects, and where indicated.

E. Expansion Joints: Form expansion joints of preformed joint filler strips.

   1. Install dowel bars and support assemblies at joints where indicated. When no sleeves are used, lubricate or asphalt-coat one half of dowel length to prevent concrete bonding to one side of joint.
   2. Where spacing is not shown, locate expansion joints at 32-foot maximum spacing or less to fit the control joints pattern.

F. Installation of joint fillers and sealants is specified in Section "Joint Sealants".

   1. Extend joint fillers full width and depth of joint, not less than 1/2 inch or more than 1 inch below finished surface where joint sealant is indicated. Place top of joint filler flush with finished concrete surface when no joint sealant is required.

   2. Furnish joint fillers in one-piece lengths for full width being placed wherever possible. Where more than one length is required, lace or clip joint filler sections together.
   3. Protect top edge of joint filler during concrete placement with a metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.

G. Where plastic "zip strips" are used to construct concrete joints, cut and remove, as a minimum, the top 1/4 inch of these strips after concrete has cured, and coordinate installation of joint filler as specified in Section “Joint Sealants”.

3.5 CONCRETE PLACEMENT

A. Inspection: Before placing concrete, inspect and complete formwork installation, reinforcing steel, and items to be embedded or cast in. Notify other trades to permit installation of their work.

B. Moisten subgrade or base to provide a uniform dampened condition at the time concrete is placed. Do not place concrete around manholes or other structures until they are at the required finish elevation and alignment.

C. Comply with requirements and with ACI 304R for measuring, mixing, transporting, and placing concrete.

D. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.

E. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

F. Consolidate concrete by mechanical vibrating equipment supplemented by hand-spading, rodding, or tamping. Use equipment and procedures to consolidate concrete complying with ACI 309R.

1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand-spreading and consolidation. Consolidate with care to prevent dislocating reinforcing, dowels, and joint devices.

G. Screed paved surfaces with a straightedge and strike off. Use bull floats or darbies to form a smooth surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces prior to beginning finishing operations.

H. Curbs and Gutters: When automatic machine placement is used for curb and gutter placement, submit revised mix design and laboratory test results that meet or exceed requirements. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing as specified for formed concrete. If results are not acceptable, remove and replace with formed concrete.

I. Cold-Weather Placement: Comply with provisions of ACI 306R and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
1. When air temperature has fallen to or is expected to fall below 40 deg F (4 deg C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F (10 deg C) and not more than 80 deg F (27 deg C) at point of placement.
2. Do not use frozen materials or materials containing ice or snow.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise accepted in mix designs.

J. Hot-Weather Placement: Place concrete complying with ACI 305R and as specified when hot weather conditions exist.
1. Cool ingredients before mixing to maintain concrete temperature at time of placement to below 90 deg F (32 deg C). Mixing water may be chilled or chopped ice may be used

to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.

2. Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that steel temperature will not exceed the ambient air temperature immediately before embedding in concrete.
3. Fog spray forms, reinforcing steel, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.6 CONCRETE FINISHING

A. Float Finish: Begin floating when bleed water sheen has disappeared, and the concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats, or by hand-floating if area is small or inaccessible to power units. Finish surfaces to true planes within a tolerance of 1/4 inch in 10 feet as determined by a 10-foot-long straightedge placed anywhere on the surface in any direction. Cut down high spots and fill low spots. Refloat surface immediately to a uniform granular texture.
   1. Burlap Finish: Drag a seamless strip of damp burlap across concrete, perpendicular to line of traffic, to provide a uniform gritty texture finish.
   2. Medium-to-Fine-Textured Broom Finish: Draw a soft bristle broom across concrete surface perpendicular to line of traffic to provide a uniform fine line texture finish.
   3. Medium-to-Coarse-Textured Broom Finish: Provide a coarse finish by striating surface 1/16 inch to 1/8 inch deep with a stiff-bristled broom, perpendicular to line of traffic.
   4. Do not use troweling machines within 12 inches of electrical junction and outlet boxes which are set to finish flush with concrete slabs. Float and trowel such areas by hand with wood floats and steel trowels, taking care to see that concrete is finished flush with box cover and matches adjacent surfaces.

B. Slip-Resistant Aggregate Finish: Before final floating, spread slip-resistive aggregate finish on pavement surface in accordance with manufacture’s written instructions
   1. Cure concrete with curing compound recommended by slip-resistive aggregate manufacturer. Apply curing compound immediately after final finishing.
   2. After curing, lightly work surface with a steel wire brush or abrasive stone and water to expose non-slip aggregate

C. Finishing formed surfaces:
   1. Curb forms shall leave a smooth face.
   2. Remove all fins.

D. Provide steel trowel finish on tops of curbs and flow lines of curbs, gutters and integral curb and gutters.

E. Final Tooling: Tool edges of paving, gutters, curbs, and joints formed in fresh concrete with a jointing tool to the following radius. Repeat tooling of edges and joints after applying surface finishes. Eliminate tool marks on concrete surfaces.
   1. Radius: 1/4 inch.
   2. Radius: 3/8 inch.

F. Finish surfaces to produce a uniform appearance throughout area involved and throughout adjacent areas with the same treatment.

G. Sandblast finish shall be consistent finish throughout and match approved mock-up.

H. Where concrete finishing occurs adjacent to finished metal or other surfaces, particularly where serrated or indented surfaces occur, remove all traces of cement film before allowing to harden.

I. Apply integral wood float and broom finish to the all concrete pavements and walkways, unless otherwise shown on the Drawings.
   1. After screeding and compacting, finish with a wood float using a circular motion to produce a uniform texture and finish throughout.
   2. For vehicular traffic areas, the finish shall be coarse enough to provide a non-slip surface with a minimum static friction coefficient of 0.6.
   3. For pedestrian traffic areas, finish shall be a non-slip surface with a minimum static coefficient of friction of 0.6.
      a. For ramps, the static coefficient of friction shall be a minimum of 0.8. Ramps are defined as any sloping path of travel with a slope in the direction of travel of 5.0%, or greater.
   4. Tests for coefficient of friction shall be either ASTM C-1028 (field test) or ASTM D-2047 (laboratory test).

3.7 CONCRETE PROTECTION AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with the recommendations of ACI 306R for cold weather protection and ACI 305R for hot weather protection during curing.

B. Evaporation Control: In hot, dry, and windy weather, protect concrete from rapid moisture loss before and during finishing operations with an evaporation-control material. Apply according to manufacturer's instructions after screeding and bull floating, but before floating.

C. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.

D. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound, or a combination of these as follows:
   1. Moisture Curing: Keep surfaces continuously moist for not less than 7 days with the following materials:
      a. Water.
      b. Continuous water-fog spray.
      c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with a 12-inch lap over adjacent absorptive covers.
   2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
   3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's directions. Recoat areas subjected to heavy rainfall within 3 hours after initial application. Maintain continuity of coating and repair damage during curing period.

E. Spray-apply concrete sealer to all concrete pavement. Comply with sealer manufacturer's application instructions.

3.8 CURING COLORED CONCRETE

A. Colored concrete shall not, under any circumstances, be cured using water fog misting or ponding, burlap, plastic sheeting, or other wet covering.

B. Curing material and method shall be in strict conformance with manufacturer's guidelines and recommendations.

C. Only if additional protection is absolutely required, the surface should remain uncovered for at least 4 days, after which time new and unwrinkled non-staining reinforced waterproof kraft curing paper may be used.

3.9 FIELD QUALITY CONTROL TESTING

A. The Owner will employ a qualified testing and inspection agency to sample materials, perform tests, and submit test reports during concrete placement. Sampling and testing for quality control may include the following:
   1. Sampling Fresh Concrete: ASTM C 172, except modified for slump to comply with ASTM C 94.
      a. Slump: ASTM C 143; one test at point of placement for each compressive-strength test but no less than one test for each day's pour of each type of concrete. Additional tests will be required when concrete consistency changes.
      b. Air Content: ASTM C 231, pressure method; one test for each compressive-strength test but no less than one test for each day's pour of each type of air-entrained concrete.
      c. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F (4 deg C) and below and when 80 deg F (27 deg C) and above, and one test for each set of compressive-strength specimens.
      d. Compression Test Specimens: ASTM C 31; one set of four standard cylinders for each compressive-strength test, unless directed otherwise. Mold and store cylinders for laboratory-cured test specimens except when field-cured test specimens are required.
      e. Compressive-Strength Tests: ASTM C 39; one set for each day's pour of each concrete class exceeding 5 cu. yd. but less than 25 cu. yd., plus one set for each additional 50 cu. yd. Test one specimen at 7 days, test two specimens at 28 days, and retain one specimen in reserve for later testing if required.
   2. When frequency of testing will provide fewer than five strength tests for a given class of concrete, conduct testing from at least five randomly selected batches or from each batch if fewer than five are used.
   3. When total quantity of a given class of concrete is less than 50 cu. yd., Architect may waive strength testing if adequate evidence of satisfactory strength is provided.
   4. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, evaluate current operations and provide corrective procedures for protecting and curing the in-place concrete.
   5. Strength level of concrete will be considered satisfactory if averages of sets of three consecutive strength test results equal or exceed specified compressive strength and no individual strength test result falls below specified compressive strength by more than 500 psi.

B. Test results will be reported in writing to Architect, concrete manufacturer, and Contractor within 24 hours of testing. Reports of compressive strength tests shall contain the Project identification name and number, date of concrete placement, name of concrete testing agency, concrete type and class, location of concrete batch in paving, design compressive strength at 28 days, concrete mix proportions and materials, compressive breaking strength, and type of break for both 7-day and 28-day tests.

C. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted but shall not be used as the sole basis for acceptance or rejection.

D. Additional Tests: The testing agency will make additional tests of the concrete when test results indicate slump, air entrainment, concrete strengths, or other requirements have not been met, as directed by Architect. Testing agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42, or by other methods as directed.

E. Manufacturer's Field Service: When placing integral colored concrete, arrange for the services of a qualified technical representative of the color pigment manufacturer, equipped with wet-batch color control test devices to ensure concrete of uniform color and matching approved mock-up.

3.10 REPAIRS AND PROTECTION

A. Remove and replace concrete paving that is broken, damaged, or defective, or does not meet the requirements of this Section. Concrete which is not true to line and plane, which is not thoroughly troweled and properly surfaced as required, which varies in excess of 1/4-inch along a 10-foot straight edge, which is scuffed or has a rough top surface, except where required, or which does not connect properly to adjoining work, does not slope as required for drainage or is not properly cured, will be deemed defective.
   1. General: Patch defective areas immediately following form removal. Remove defective concrete to a width and depth necessary for proper patching, but in no case less than 1 inch deep. Make the walls of the cut area perpendicular to the surface and do not feather out the edge. Dampen the patch area and the adjacent area 6 inches around the patch area.
   2. Exposed concrete: Prepare a patching mortar of one part Portland cement, adjusted to match the color of the surrounding concrete, and 2-1/2 parts sand with the least water required to produce a workable mass. Re-work this mortar until it is the stiffest consistency that will permit placing. Brush the patch area with a bond of neat cement and water paste and apply patching mortar when the water sheen is off the bond. Strike off the mortar slightly higher than the surrounding surface, let set for 1 hour and finish flush with the surrounding surface.

B. Drill test cores where directed by Architect when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory pavement areas with Portland cement concrete bonded to paving with epoxy adhesive.

C. Protect concrete from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.

D. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep concrete paving not more than 2 days prior to date scheduled for Substantial Completion inspections.

END OF SECTION

SECTION 32 31 22 – PVC-CLAD CHAIN LINK FENCING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. PVC Chain link perimeter fences (F-1).
2. Manually operated swing and sliding gates, including new gate in existing chain link fence.
3. Privacy slats.

B. Related work:

1. Division 03 for concrete post footings and for installation of gate track set in concrete.

1.2 SUBMITTALS

A. Data: Manufacturer product data for fabric, posts and accessories.
B. Shop drawings: Show fence layout, footings size and reinforcement, gate details, and typical elevations.
C. Samples:

1. Twenty-four-inch square samples of PVC coated chain link fabric.

a. Polymer-Coated Components: In 6-inch lengths for components and on full-sized units for accessories.
b. Provide privacy slats in the chain-link fabric sample. Include colors as called for in the Drawings.

2. Full-size sample of each type of gate hardware.

1.3 QUALITY ASSURANCE

A. The applicable provisions of the Chain Link Fence Manufacturers Institute (CLFMI) Product Manual govern the work of this Section.
B. This requirement does not limit manufacture of the fencing components to CLFMI members.

1.4 HANDLING

A. Handle and store components to avoid damaging the finish.
B. Store off the ground in a protected location.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Framework: Roll-formed Cee sections produced from steel with a minimum yield strength of 45,000 psi and meeting the strength and protective coating requirements of ASTM F 1043.

B. Tubular members:

1. Type I: ASTM F 1083, Schedule 40, galvanized with a zinc coating of not less than 1.8 oz./square ft. minimum.
2. Type II: ASTM F 1083, Group IC, having a minimum yield strength of 50,000 psi and an external zinc coating complying with Type B, zinc with polymer film, 0.90 oz./square-foot minimum, or Type D, zinc pigmented, 81 percent nominal coating with 0.30 mils minimum thickness.

C. Finish: Coat with fusion bonded black PVC. Apply PVC over cleaned and pre-treated surfaces to a minimum thickness of 10 mils DFT.

D. Chain link fabric: Complying with CLFMI standards and the following with a Class 1 zinc coating weight classification.

1. One piece width, 2-inch mesh, 9-gage.
2. Knuckled edge at both selvage.
3. Fusion-bonded PVC coating 7 to 12 mils thick, of the color selected by the Architect, complying with ASTM F 668, Class 2B.

E. Accessories, general: Galvanized and coated with PVC matching the chain link fabric, complying with ASTM A 153, except that the coating weight may comply with the requirements of CFLMI standards for coating thickness.

1. Tension wire: 7-gage high strength steel wire.
2. Stretcher bars: One piece length equal to full height of fabric with a minimum cross section of 3/16-inch by 3/4-inch. Provide one stretcher bar for each gate and end post, and 2 for each corner and pull post.
3. Stretcher bar bands: Heavy pressed steel to secure stretcher bars to intermediate, corner and gate posts.
4. Post tops: Steel or malleable iron designed as a weathertight closure cap. Design caps with opening to permit passage of the top rail, when rail is provided.

F. Wire ties: For tying fabric to line posts, use 11-gage steel wire clips spaced 14-inch o.c. For tying fabric to tension wire use 11-gage hog rings.

2.2 GATES

A. Fabricate gate frames of welded steel tubes in compliance with ASTM F 900. Provide additional horizontal and diagonal members to insure that gates stay square and operate properly, and for attachment of fabric, hardware and accessories.

B. Weld gate frames:

1. Use same fabric as for fencing, installed with stretcher bars at vertical edges.
2. Tie fabric to top and bottom edges. Attach stretcher bars to gate frame at not more than 15 inches o.c.
3. Attach hardware with rivets or by other means that will provide security against removal and breakage.

C. Provide manufacturer standard galvanized heavy-duty hardware.

1. For swinging gate provide the following:

a. Hinges: One pair of steel hinges, non-lift-off type offset to permit 180-degree gate opening.
b. Latch: Designed to provide operation from either side of gates and equipped with padlock eye.
c. Keeper: Designed to automatically engage and hold the leaf open until manually released.

2. For sliding gate provide the following:

a. Track, ball bearing hanger sheaves, guides, rails, stays, bracing and other accessories required for a complete installation.

b. Sealed, pre-lubricated bearings, heavy duty polymer or machined gray iron wheels with guards, mounted on ductile iron brackets, by Aruvil (800.688.1574) or Logical Decisions, Inc. (800.676.5537).

2.3 PRIVACY SLATS

A. Tubular Polyethylene Slats: Minimum 0.023-inch (0.58-mm)-thick tubular polyethylene, manufactured for chain-link fences from virgin polyethylene with UV inhibitor, sized to fit mesh specified for direction indicated, with vandal-resistant fasteners and lock strips.

1. See Drawings for colors.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify conditions and measurements affecting the work of this Section at site.
B. Correct detrimental conditions before proceeding with installation.

3.2 INSTALLATION

A. General: Comply with ASTM F 567 and the following.
B. Posts: Provide corner, end, and intermediate posts. Erect posts plumb and level, in straight alignment, and set in concrete footings. Support and brace until concrete sets.
C. Post cap: Provide on each post.
D. Tension wire: Install before stretching fabric and tie to each post with ties or clips.
E. Fence fabric:

1. Install within 2-inch of grade or paving on security side of fencing and on inside of tennis courts.and anchor to framework so that fabric remains in tension after pulling force is released.
2. Pull taut and tie to posts, rails, and tension wire.

F. Stretcher bars: Thread through fabric and secure to posts with steel bands.
G. Gates: Install plumb, level, square, free of rack and secure for full opening without interference. Adjust hardware for smooth operation.
H. Fasteners: Install nuts for tension bands and carriage bolts on the side of fence opposite the fabric side.[Peen ends of bolts or score threads to prevent removal of nuts.]
I. Privacy Slats: Install slats in direction indicated, securely locked in place.

1. Diagonally for privacy factor of 80 to 85.

3.3 BRACING

A. Brace gates, corner, end, and pull posts to the nearest post with a horizontal brace used as a compression member and a diagonal truss rod and truss tightener used as a tension member.

3.4 TOUCHUP

A. Touchup damaged PVC coating with matching air-drying materials, when the results are acceptable to the Architect; otherwise remove and replace damaged components.

END OF SECTION

SECTION 32 33 13 – EXTERIOR BICYCLE RACKS AND LOCKERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Exterior bicycle racks.
2. Interior bicycle racks.
3. Accessories and installation materials.

1.2 SUBMITTALS

A. Data:

1. Manufacturer Product Data for bicycle racks, including finish. anchors, including test results for anchors in concrete.
2. Samples of sufficient size showing proposed finish on base metal.

B. Shop Drawings: At 1/8-inch scale minimum, show exact location of racks. Dimension from column lines or adjacent work.

C. Samples: Samples of sufficient size showing proposed finish on base metal.

D. Maintenance Data: For each bicycle rack.

1. Include recommended methods for repairing damage to the finish.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed installation of bicycle racks similar in material, design, and extent to that indicated for this project and whose work has resulted in construction with a record of successful in-service performance.

B. Manufacturer Qualifications: A firm experienced in manufacturing bicycle racks similar to those required for this project and with a record of successful in-service performance.

C. Source Limitations: Obtain each color, finish, shape and type of bicycle rack from a single source with resources to provide components of consistent quality in appearance and physical properties.

D. Product Options: Drawings indicate size, shape and dimensional requirements of bicycle racks and are based on the specific system indicated.

1.4 HANDLING

A. Upon delivery, before signing for shipment, inspect for any damages and notate on the B.O.L.

B. Store bicycle racks in original undamaged packages and containers until ready for installation

C. Handle bicycle racks with sufficient care to prevent any scratches or damage to the finish.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Bike rack:

1. Provide bicycle racks manufactured by AAA Ribbon Bike Rack Co., a division of Brandir Internationals, Inc., www.ribbonrack.com.
2. Or equal.

B. Bike Lockers:

1. Provide bicycle lockers manufactured by Dura Bike Locker, a Division of Hannan Specialties Inc.
2. Or equal.

2.2 EXTERIOR BICYCLE RACKS

A. The Original Ribbon Rack.

2.3 EXTERIOR BICYCLE LOCKERS

A. Model DLSS by Dura Bike Locker, a Division of Hannan Specialties Inc. or equal
B. Size: 30-inches by 75-inches by 48-inches high.

2.4 MATERIALS

A. The Original Ribbon Bike Rack:

1. 2.375-inches OD X 0.154-inch wall thickness, schedule 40 ASTM A53/A500 hot dipped galvanized.
2. Installation Methods: In-ground mount is embedded into concrete base, as detailed.

B. Single bike lockers, surface-mounted on concrete.

1. Material:

a. G-90 galvanized steel bicycle locker.
b. Door and body: 16-gauge sheet metal.
c. Frames: 14-gauge sheet metal.
d. Perforations: Provide perforated doors and back walls.
e. Full length door hinge (ASTM A314): 16 gauge stainless steel.
f. 3-Point Locking bar Mechanism (ASTM A314): 1 inch wide by 1/4 inch thick stainless steel flat bar running beyond the full length of the door frame and into the top, threshold, and jamb (3-Points to insure Maximum Security).
g. Fasteners shall be zinc coated steel and shall be fastened from the inside.
h. Numbers: High Performance Black Vinyl Numbers.

C. Fasteners: Select anchors with capability to sustain, without failure, a load equal to 4 times the load imposed when installed in concrete, as determined by testing per ASTM E 488.

1. Drilled-in expansion anchors: Expansion anchors complying with FS FF-S-325, Group VIII (anchors, expansion,), Type I (internally threaded tubular expansion anchor); and machine bolts complying with FS FF-B-575, Grade S, by Hilti, Inc., ITW Ramset/ Red Head, Star Expansion Co. or The Rawlplug Co., Inc.
2. Chemical anchors: Chem-Stud by Rawlplug Co., Inc. or HIT C-100 System by Hilti used with machine bolts complying with FS FF-B-575, Grade S.

2.5 LOCKING SYSTEM

A. Stainless steel padlock style handle (padlock not included).

2.6 FINISH

A. The Original Ribbon:

1. Hot-dipped galvanized finish after fabrication.

B. The bike lockers: Graphite

1. TGIC powder-coat.
2. Color: Black.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify conditions and measurements affecting the work of this Section at site.
B. Correct detrimental conditions before proceeding with installation.

3.2 INSTALLATION

A. Bike rack:

1. In-ground mount: Install as detailed on Drawings and manufacturer’s recommendations.
2. Coordinate installation of bike racks with the work of Section 32 13 13.

B. Bike lockers:

1. Install in accordance with the manufacturer's instructions.
2. Locate where shown on drawings. Assemble and anchor in accordance with the manufacturer's instructions.
3. Set bicycle lockers secured to construction, level and true to line, in correct relationship to adjacent structure and improvements.
4. Fasteners to secure lockers to concrete shall be located inside locker.

C. Install at locations indicated on Drawings in compliance with rack manufacturer's instructions and recommendations, plumb, level and securely anchored.
D. Touchup damaged galvanized surfaces as specified in Section 05 50 00.

END OF SECTION

SECTION 32 81 00

LANDSCAPE IRRIGATION SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Supply all work and materials, appliances, tools, equipment, facilities, transportation, and services necessary for and incidental to performing all operations in connection with furnishing, delivery, and installation of Landscape Irrigation System, complete as shown on the Drawings and/or as specified herein.

2. The principal items of work included in this section, but not exclusively, are:

a. Complete fully automatic landscape irrigation system including trenching and backfilling for mains, laterals, and risers, valves, fittings, sprinkler heads, quick couplers, controllers, low voltage electric wiring, and all necessary specialties and accessories.
b. Cut, cap, and rework existing irrigation within and adjoining the project site in order to maintain uninterrupted irrigation coverage in adjacent areas.
c. Sleeves beneath walkways, roads, and driveways where required whether shown on the drawings or not.
d. Reclaimed water warnings.
e. Clearing, testing, and adjusting of the system.
f. Guarantees.

B. Related work includes:

1. Demolition and Earthwork: Refer to civil plans.
2. Section 329000 – Landscape Work.

1.2 QUALITY ASSURANCE

A. Permits & Fees: Obtain and pay for all permits and inspections required by outside agencies.

B. Manufacturer's Directions: Manufacturer’s directions and detailed drawings shall be followed in all cases where the manufacturers used in this contract furnish directions covering points not shown in the drawings and specifications.

C. Ordinances and Regulations: All local, municipal, and state laws, and rules and regulations governing or relating to any portion of this work are hereby incorporated into and made part of these specifications, and their provisions shall be carried out by the Contractor. Anything contained in the specifications shall not be construed to conflict with any of these rules and regulations or requirements of the same. However, when the specifications and drawings call for or describe materials, workmanship, or construction of a better quality, higher standard, or larger size than is required by these rules and regulations, the provisions of the specifications and drawings shall take precedence.

D. Explanation of Drawings:

1. Due to the scale of drawings, it is not possible to indicate all offsets, fittings, sleeves, etc.,

which may be required. Carefully investigate the structural and finished conditions affecting all of this work and plan this work accordingly, furnishing such fittings, etc., as may be required to meet such conditions. Drawings are generally diagrammatic and indicative of the work to be installed. The work shall be installed in such a manner as to avoid conflicts between irrigation systems, planting, and architectural features.

2. Work called for on the drawings by notes or details shall be furnished and installed whether or not specifically mentioned in the specifications.

E. Work of this Section which is allied with work of other trades shall be coordinated as necessary.

1. Coordinate work of this Section with all existing and new underground utilities and trades responsible for their installation.

F. Underwriters Laboratories: Electrical wiring, controls, motors, and devices shall be U.L. listed, and so labeled.

G. Installer Qualifications (for solvent and rubber gasket joints): Each person shall be trained by the manufacturer's representative in techniques for making correct joints prior to performing work on the site.

1.3 SUBMITTALS

A. Submittal procedures and quantities are specified in Division 1. Provide a minimum of four copies unless otherwise directed.

B. Provide the following submittals for review and approval:

1. Irrigation Materials Lists (see paragraph 1.4 below)
2. Record Drawings (see paragraph 1.6 below)
3. Controller Charts (see paragraph 1.7 below)
4. Operating & Maintenance Manuals (see paragraph 1.8)
5. Guarantee (see paragraph 1.10 below)
6. Maintenance Tools (see paragraph 2.14 below)

1.4 IRRIGATION MATERIALS LISTS

A. Prior to installation of any work, prepare a detailed list of each material proposed for use in the project and submit to Architect for approval. Prepare typewritten material list using the following format. Double space between each item.

ITEM NO.	DESCRIPTION	MANUFACTURER	MODEL NO.
1.	Pressure supply lines	Pac. Western	Schd. 40 PVC
2.	Spray Head	Rain Bird	1804-8
3.	Etc.	Etc.	Etc.

B. If equipment is as specified, no manufacturer descriptive catalogs are necessary in submittal.

1.5 SUBSTITUTIONS

A. Substitutions of any product, material, or equipment without the prior written approval of the Architect will not be permitted.

B. Approval of any item as a substitution or alternate is for design only, based on information or samples provided by the Contractor.

C. Provide descriptive catalog literature, performance and flow charts for each item proposed to be substituted.

1.6 RECORD DRAWINGS (AS-BUILTS)

A. Maintain up to date complete "as-built" record set of drawings which shall show every change from the original drawings and exact as-built locations, sizes, and kinds of equipment.

1. Maintain information daily. Keep drawings at the site at all times and available for review by the Architect.
2. Record all required information on a set of prints of the Drawings. Do not use these prints for any other purpose.
3. Record all changes which are made from the Contract Drawings, including changes in the pressure and non-pressure lines.
4. Record information neatly and legibly so that the drawings are intelligible to persons not actually performing the installation.

B. These drawings shall also serve as work progress sheets and shall be the basis for measurement and payment for work completed.

C. Record dimensioned locations and depths for each of the following:

1. Point of Connection to existing water line(s).
2. Point of Connection to existing electrical power.
3. Main Line Routing (Provide dimensions for each 100 lineal feet (maximum) along each routing, and for each change in direction.)
4. Gate Valves
5. Master Valves
6. Flow Sensors
7. Control Valves
8. Quick Coupling Valves
9. Control Wire Routing
10. Sleeves under paving.
11. Other Related Items as directed by the Architect.

D. Locate all dimensions from two permanent points (buildings, monuments, sidewalks, curbs or pavements).

E. When record drawings have been approved by the Architect, transfer all information to a set of reproducible drawings following requirements set forth in Division one.

1. Make dimensions accurately at the same scale used on original drawings, or larger. If photo reduction is required to facilitate controller chart housing, notes or dimensions must be a minimum 1/4 inch in size.

F. Submit "as-built" drawing to the Architect for approval. Make corrections as directed by the Architect prior to making controller charts (see paragraph 1.7).

G. Deliver corrected and completed reproducibles to the Architect on or before the date of the Final Landscape Inspection.

1.7 CONTROLLER CHARTS

A. Do not prepare charts until record drawings have been approved by the Architect.

B. Provide one controller chart for each automatic controller installed. Controller shall be sized to fit within controller door, unless otherwise directed.

1. Chart may be a reproduction of the Record Drawing, if the scale permits fitting the controller door. If photo reduction prints are required, keep reduction to maximum size possible to retain full legibility.

2. Chart shall be blackline print of the actual as built system, showing the area covered by that controller.

C. Identify the area of coverage of each remote control valve, using a distinctly different pastel color, drawn over the entire area of coverage.

D. Following approval of charts by Architect they shall be hermetically sealed between two layers of 20 mil thick plastic sheet.

E. Charts must be completed and approved prior to final review of irrigation system.

1.8 OPERATING AND MAINTENANCE MANUALS

A. Provide individually bound manuals detailing operation and maintenance requirements for the irrigation system.

B. Provide three copies of each manual.

C. Provide the following in each manual:

1. Index sheet, stating Irrigation Contractor's name, address, telephone number and name of person to contact.
2. Duration of the guarantee period.
3. Equipment list providing the following for each item:
    a. Manufacturer's name.
    b. Make and model number.
    c. Name and address of local manufacturer's representative.
    d. Spare parts list in detail.
    e. Detailed operating and maintenance instructions for major equipment.

1.9 SITE OBSERVATION SCHEDULE

A. The Contractor shall be responsible for notifying the Architect in advance for the following observation meetings:

1. Pressure supply line installation and testing.
2. Automatic controller location & installation.
3. Lateral line & sprinkler head layout.
4. Coverage tests prior to planting.
5. Final inspection (minimum 7 day on notice required).

B. Provide up-to-date as built drawings at each review. No site observations will commence without as-built drawings.

C. When observations have been conducted by other than the Architect, show evidence in writing of when and by whom these observations were made.

1.10 GUARANTEE

A. Guarantee the irrigation system to provide service as designed and installed for a period of one year from date of Final Acceptance.

1. Final acceptance of the irrigation system shall be defined to be the same date as final acceptance of the landscape work as specified in Section 329000.

B. Submit guarantee as specified in Division 1, Warranties.

C. Correct all problems which develop in the system due to faulty materials or workmanship during the guarantee period.

1. Repair or replace such work as directed by the Architect.
2. Make repairs and replacements promptly when notified.
3. The Owner reserves the right to make temporary repairs during the guarantee period as necessary to keep systems in operating condition without voiding the Contractor's guarantee, nor relieving the Contractor of his responsibilities.
4. All repairs and replacements shall match original installation in every way.

D. Provide a written guarantee for each segment of the project, using the following format to be retyped on the Contractor's letterhead:

"GUARANTEE FOR SPRINKLER IRRIGATION SYSTEM

We hereby guarantee that the sprinkler irrigation system we have furnished and installed is free from defects in materials and workmanship, and the work has been completed in accordance with the drawings and specifications, ordinary wear and tear and unusual abuse or neglect excepted. We agree to repair or replace any defects in material or workmanship which may develop during the period of one year from the date of acceptance and also to repair or replace any damage resulting from the repairing or replacing of such defects at no cost to the Owner. We shall make such repairs or replacements within a reasonable time, as determined by the Owner, after receipt of written notice. In the event of our failure to make such repairs or replacements within a reasonable time after receipt of written notice from the Owner, we authorize the Owner to proceed to have said repairs or replacements made at our expense and we will pay the costs and charges therefore upon demand.

PROJECT:_____

CONTRACTOR:_____ PHONE NO:_____

ADDRESS:_____

BY:_____TITLE:_____

DATE OF ACCEPTANCE:_____ BY:_____"

1.12 PRODUCT HANDLING

A. Storage: Store materials in an orderly manner at a location as directed by the Owner's Representative. Avoid interference with other construction activities.

B. Protection: Protect all materials to prevent intrusion of dirt and moisture. Do not store PVC material in direct sunlight. Protect the installed work and materials of other trades.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Use only new materials of the brands and types noted on the drawings, specified herein, or approved equals.

2.2 PIPE & FITTINGS SCHEDULE

A. All piping and fittings including sleeves shall be “Purple” Reclaimed Water type.

B. Pressure Main Line Piping & Fittings downstream of water meter:

1. 3 inch and larger: class 200 PVC solvent weld type.
2. 2-1/2 inches and smaller: schedule 40 PVC solvent weld type.

C. Non-pressure lateral line below grade: schedule 40 PVC solvent weld type.

D. Sleeves for piping under paving and slabs: Schedule 40 PVC.

E. Sleeves for Direct Burial Conductors: PVC 1220-160 psi plastic pipe.

2.3 PLASTIC PIPE

A. Identification Markings: Identify all pipe with the following indelible markings:

1. Manufacturer's name
2. Nominal pipe size
3. Schedule or class
4. Pressure rating p.s.i.
5. NSF seal of approval
6. Date of extrusion

B. Pipe (solvent weld type) manufacture from virgin poly-vinyl chloride in accordance with ASTM D-1784 or ASTM D-2241, cell classification 12454B; hydrostatic design stress rating not less than 2000 p.s.i.

C. Fittings: Standard weight, Schedule 40 injection molded PVC. Comply with ASTM D-1784, cell classification 13454B.

1. Threads (where required): Injection molded type.
2. Tees and Ells: side gated.
3. Threaded Nipples: Standard weight, Schedule 80 with molded threads.

Fittings (2" and larger) slip type may be used, but must be similar in all respects to those manufactured by Cal Am Manufacturing Company and installed in accordance with their recommendations.

2.4 WARNING TAPE

A. Detectable underground utility marking tape, minimum 4.85 mil overall thickness, by Christy Type III, Magnatec, or equal.

2.5 JOINT CEMENT AND PRIMER

A. All PVC pipe including both non-pressure plastic pipe and fittings (lateral lines) and pressure plastic pipe and fittings (main line) shall be coated with a primer and then with a 100% active solvent cement, blue in color.

2.6 ELECTRICAL WIRING AND SERVICE

A. High Voltage: All high voltage electrical service required for automatic controller and other equipment noted on drawing for irrigation shall be provided as part of this work.

B. Low Voltage:

1. Connections between controller and remote control valves shall be made with direct burial AWG-UF, 600 volt wire, insulation thickness 3/64 inch, utilizing low density, high molecular weight polyethylene insulation.
2. Splices, where permitted, shall be waterproofed using 3M DBR-6 Connectors, and housed in a plastic box.
3. Wire sizing shall be according to Manufacturer's recommendations, in no case less than no. 14.
4. Ground (common) wire shall be white in color, all others a different color.

2.7 AUTOMATIC CONTROLLER ASSEMBLY

A. General:

1. Controllers shall be UL approved.
2. Controllers shall operate on 110 volts, single phase current, shall be completely automatic, and shall function with clock. Controllers output shall be at least 2 Amps and minimum 24 volts.
3. Controllers shall fully perform without soil moisture sensors, or mandatory telephone wires, repeaters or CAT5/Ethernet wiring.
4. Controllers shall have a Master Valve output circuit.

5. Controllers shall be capable of operating normally open or normally closed master valves.
6. After installation all ET weather based irrigation controllers shall be capable of being monitored and programmed from a single central location away from individual school sites.
7. Controllers shall have a built in flow metering circuit.
8. Controllers shall be capable of receiving Evapotranspiration (ET) data to automatically adjust or terminate existing programmed watering schedules.
9. Weather based controllers shall be provided with appropriate antenna for wireless transceiver.
10. Weather based controllers with more than six stations shall be furnished with at least 3 extra stations for future use.
11. Weather based controllers shall be capable of fully operating without the need of excavating to conceal wiring infrastructure.
12. Provide with stainless steel pedestal enclosure.
13. Controllers shall be capable of watering using (ET) Data without the need of a central monitoring station.
    a. Rainmaster Eagle-I with I-Central.
    b. Approved Equal.

B. Communications Capabilities:

1. System shall be capable of wireless 2-way communications.
2. Communication from the controller to the server shall be provided by a third party without any additional cost to the Owner for one year from the installation of controller.
3. Controllers shall be capable of sending e-mails to any e-mail capable device as a method of managing multiple school sites from a single central location.

C. Programming Capabilities:

1. Controllers shall allow programming changes to be performed at the controller and from a central irrigation management center away from individual school campuses.
2. Each controller shall be capable of being automatically updated with daily ET weather data.
3. System shall be capable of providing ET data from more than one source.
4. Controllers shall be able to pause or suspend irrigation automatically in real time.
5. Controllers shall be able to automatically read flow sensing equipment without adding on flow meter circuits.
6. Flow metering circuit shall provide high flow shutoff protection to individual remote control valves or circuits.
7. Controllers shall be capable of programming appropriate pipe size for accurate water consumption reports.
8. System shall be able to fully function using a hand held remote transmitter without additional set up requirements.
9. Controllers shall be password protected.
10. Controller management system shall not impose a security, infrastructure or product support impact on Owner’s ITD department.
11. Controllers shall be capable of producing water savings efficiency data reports required by

state agencies. (AB 1881).

D. Antenna:

1. Provide appropriate antenna type to allow complete operation of system.

2. After installation, antenna must communicate with server to produce two way communications in order to manage the central irrigation system on site and from a central irrigation management center designated by Owner.

E. Weather Based ET Data:

1. Provide with each controller a one year subscription of weather based ET data for each irrigation controller requiring a subscription.

2.8 GATE VALVES

A. 2-1/2 inches and smaller: True Union PVC ball valve or equal.

B. 3 inches and larger: ASTM A126 Class B iron body, 150 pound O.W.G., with flanged joints, non-rising stem, bolted bonnet, and double disc, equipped with operating nut, or as otherwise approved.

2.9 QUICK COUPLING VALVES

A. Two piece type brass body, 150 pound class, with 3/4 inch female threads opening at base, permitting operation with a special connecting device (coupler).

1. Coupler Threads: Lug type.
2. Hinge Cover: Provide with purple thermoplastic cover.
3. Cover shall be permanently marked with “DO NOT DRINK!” warnings in English and Spanish.

2.10 REMOTE CONTROL VALVES

A. Valve type: Spring-loaded, packless diaphragm activated, normally closed type with plastic body, equipped with flow control.

1. Provide bleeder valve to permit manual operation without controller power.
2. Provide Schrader valve capable of pressure regulation between pressures of 15 to 200 p.s.i.
3. All valves shall have purple reclaimed water flow control handles.

B. Valve Solenoid: 24 volt a.c., 4.5 watt maximum, 500 milliamp maximum surge, corrosion-proof, stainless steel construction, epoxy encapsulated to form a single unit.

2.11 VALVE BOXES

A. Provide type and size for all valves as noted on the drawings. Boxes shall be fabricated from a durable plastic resistant to weather, sunlight, and chemical action of soils, Carson or approved equal.

1. Gate valve boxes shall be round. Heat stencil “GV” on lid.
2. Remote control valve boxes shall be rectangular. Heat stencil “RCV” and correct control station number (as connected to controller) on lid.
3. Quick coupler valve boxes shall be round. Heat stencil “QCV” on lid.

B. Boxes shall have non-locking covers.

2.12 VALVE IDENTIFICATION TAGS

A. Provide separate station identification tags on each control valve.

1. Tags shall be permanently marked with the correct control station number (as connected to controller).
2. All tags shall be permanent, non-corrosive, plastic, as manufactured by Christy's or approved equal.
3. Provide at all remote control valves inside valve boxes & attach to valve.

2.13 OPERATING AND MAINTENANCE TOOLS

A. Deliver the following items to the Owner when work is completed and prior to final acceptance of work:

1. Six wrenches for disassembly and adjustment of each type of sprinkler head.
2. Two keys for each automatic controller.
3. Four couplers and matching hose swivels with globe valves.
4. Six keys for opening valve boxes.
5. One 48 inch steel tee wrench for gate valves with square nut.

PART 3 - EXECUTION

3.1 SITE REVIEW

A. Examine site for conditions that will adversely affect execution, permanence, and quality of work.

1. Verify that grading has been completed and the work of this section can properly proceed.
2. Exercise extreme care in excavating and working near existing structures, utilities, underground piping and conduits, and over waterproofing membrane. Contractor is responsible for damages that are caused by his operations or neglect. Check existing utility drawings for locations.
3. Determine locations of points of connections to all piping installed by others, and determine that pressure supply is available for work of this Section.

B. All scaled dimensions are approximate. The Contractor shall check and verify all size dimensions prior to proceeding with work under this Section.

C. Notify the Architect of any unacceptable conditions preventing the start of work.

D. Do not proceed with work until unacceptable site conditions are corrected or existing utilities are located.

3.2 EXISTING IRRIGATION MAINLINES

A. The scope of work includes cutting and capping of existing irrigation lines. At the commencement of the project the Contractor shall set up a meeting with the Landscape Architect and the Owner's Representative to discuss the exact locations for cutting and capping existing lines.

B. The Contractor shall ensure that all adjacent landscaped areas receive irrigation water throughout the entire construction period. The Contractor shall install temporary irrigation lines as required to ensure there is no interruption in water delivery to adjacent planted areas.

3.3 POINT OF CONNECTION

A. Connect to water supply points of connection at locations shown on the drawing and make any minor changes in location necessary due to actual site conditions as a part of this contract.

3.4 LAYOUT

A. All piping or equipment shown diagrammatically on the drawing outside of planting areas shall be installed inside planting areas whenever possible.

B. Lay out each sprinkler head and make any minor adjustments required due to differences between actual site conditions and the Drawings. Minor adjustments shall be maintained within the original design intent.

C. Lay out each system using staking method as approved by Architect. Maintain and protect approved staking layout.

3.5 TRENCHING

A. Excavate trenches to required depths. Follow approved layout for each system.

B. Trench bottom shall be flat to insure piping is supported continuously on an even grade.

C. Where lines occur under paved areas, consider dimension to be below the subgrade.

D. Provide minimum coverage as follows:

1. Main Lines 3 inch and larger: 24 inches.
2. Main Lines 2-1/2 inch and smaller: 18 inches.
3. Lateral Lines: 12 inches.
4. Control Wires: 18 inches.

3.6 LINE CLEARANCES

A. Provide not less than 4 inches clearance (horizontal and vertical) between each line and not less than 6 inches clearance between lines of other trades, unless otherwise noted.

B. Do not install parallel lines directly over any other line.

3.7 BACKFILLING

A. Buried pipe in trenches shall be center loaded only until all required tests are performed.

B. Trenches shall be carefully backfilled with excavated materials approved for backfilling; consisting of earth, loam, sandy clay, sand or other approved materials, free from large clods or stones.

Clean site soil free of stones larger than 1/2 inch diameter and containing no construction debris may be used for trench backfill..

C. Compact trench backfill to a dry density equal to adjacent undisturbed soil. Restore to adjacent grade, free of dips, depressions, humps or other irregularities.

1. Where acceptable soils exist, the Landscape Architect may authorize flooding in lieu of tamping.
2. Compaction by truck or other vehicle is not permitted.

3.8 EXISTING PAVEMENTS

A. Piping under existing pavements may be installed by jacking, boring, or by hydraulic driving, except as otherwise specified or directed.

B. Secure Owner's permission prior to cutting or breaking existing pavements.

C. Make completely clean cuts using power saws, at approved locations only.

D. Replace and restore all surfaces to original condition, including grade and landscaping. Restoration work shall match the original work in every respect, including type, strength, texture and finish.

3.9 NEW PAVED AREAS

A. Install all main line under paving and slabs in PVC sleeves sized large enough to permit easy extraction without the use of power equipment.

1. Provide a separate parallel sleeve for control wire.

B. If the only piping installed is over 20 feet long, pressure testing is required for that section at the time of installation. Upon completion of piping installation, the entire system must be tested.

C. If wires under paved areas cannot be continuous, all splices must be enclosed in an approved box.

3.10 INSTALLATION

A. All plastic pipe and fittings shall be installed in complete accord with manufacturer instructions.

B. Routing of main lines as indicated on the Drawings is diagrammatic. Install lines and assemblies to conform to details on the plan.

C. Installation of Piping:

1. Provide concrete thrust blocks at each change in direction and at all terminal points for all rubber gasket piping and/or all piping larger than 3 inches. Block in accordance with pipe manufacturer's instructions and as detailed on the drawings.
2. Plastic Pipe with Threaded Fittings: Assemble using teflon tape applied to male threads only.
3. All PVC pipe and fitting shall be thoroughly cleaned of dirt, dust and moisture prior to installation. Installation and solvent welding methods shall be as recommended by the pipe

& fitting manufacturer.
4. Tape all open ends of pipe to prevent entry of any foreign matter into the system.
5. On PVC to metal connections, the Contractor shall work the metal connections first. Use teflon tape on all threaded PVC to metal joints.

D. Install all specified assemblies in accordance with the Drawings. In absence of detail drawings or specifications pertaining to specific items required to complete the work, perform such work in accordance with best standard practice, as approved by the Architect.

E. All major equipment shall be verified for exact location with the Architect before installation.

1. Quick Coupling Valves: Unless otherwise indicated, locate valves within 12 inches of a walkway.
2. Remote Control Valves: Locate valves in shrub areas wherever possible. Unless otherwise approved, locate valves within 2 feet of a walkway.
3. Install backflow assemblies in shrub or planter areas at minimum height permitted by local code.
4. Automatic Controller: Verify exact location with the Architect.

F. Landscape Dripline:

1. Install following methods recommended by the manufacturer.
2. Shrubs and trees shall be planted prior to installation of drip line.
3. All lines shall be thoroughly flushed prior to installation of terminal fittings.
4. Drip line shall be buried in mulch. Where drip line from differing valve zones overlap, install drip line from one zone below grade as shown on the drawings.
5. Secure dripline to grade with tie-down stakes every 4 feet on straight runs; and every foot when following a curve of 4 foot radius or less. Use double stakes at all change of direction fittings as recommended by the manufacturer. Stakes are not required if the dripline is installed directly in the ground with mechanical equipment.

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G. Automatic Controller: Install as per manufacturers instructions. Remote control valves shall be connected to the controller in the sequence as shown on the drawings.

3.11 VALVE BOXES

A. Provide at all locations indicated.

B. Fill area under box with minimum of 2 cubic feet of pea gravel before box is installed.

C. Identification: Attach identification tag showing valve number on each solenoid pigtail.

1. Tags shall be manufactured of polyurethane Behr Desopaid, yellow in color, with black letters, 2-3/4 by 2-1/4 inches square.
2. Tags shall be as manufactured by Christy's or equal.

D. Attach reclaimed water warning tags securely to valve.

3.12 LOW VOLTAGE WIRING

A. Place wiring in the same trench and along the same routing as the main lines unless otherwise approved.

1. Install wiring prior to main line whenever possible.
2. When more than one wire is placed in a trench, tape wires together at maximum intervals of 12 feet.

B. Provide a 12 inch expansion loop at each connection and at each change in direction.

C. Use a continuous wire between controller and remote control valves.

1. Except as otherwise approved, do not splice wire at any point.
2. All approved splices shall be enclosed in an acceptable box.

D. Each controller shall be provided with separate ground (common) wire.

3.13 SYSTEM ADJUSTMENT

A. Valves: Adjust flow control for proper operation.

B. Heads: Adjust for alignment and coverage for optimum performance and to prevent as much as possible any overspray onto walks and roadways. No spray is permitted on buildings.

C. If it is determined that adjustments in the irrigation equipment will provide proper and more adequate coverage, make such changes prior to any planting. Adjustments may include changes in nozzles sizes, trajectory of spray or degrees of arc, as required.

D. All sprinkler heads shall be set perpendicular to finish grades unless otherwise indicated on the plans and at height and distance from walks, buildings, etc. as noted.

3.14 PRESSURE TESTS

A. Provide all equipment necessary to test systems, including force pump.

B. Perform all hydrostatic tests in presence of the Owner's Representative.

C. Test all main lines under hydrostatic pressure of 150 p.s.i. for a period of 2 hours, unless otherwise required and approved. Pressure drop over test period shall be zero p.s.i.

D. Do not backfill over any line more than is necessary for testing, until it has been inspected, tested and approved.

E. Do not install remote control valves, quick couplers or any other valve assembly until testing is completed and approved.

3.15 COVERAGE TESTS

A. Perform coverage tests after sprinkler system is completed, but prior to any planting, in the presence of the Landscape Architect.

B. Test system to assure that all planting areas are watered completely and uniformly.

C. Make all necessary adjustments, including realignment and relocation of heads, to provide required coverage as directed by the Architect.

3.16 OPERATING INSTRUCTIONS

A. Train the Owner's maintenance personnel in proper operation of all major equipment. Arrange for training by manufacturer's representatives for controllers.

B. Provide this training at the Owner's convenience.

C. Submit written evidence that training has been successfully completed.

3.17 CLEANUP

A. Upon completion of the work, restore ground to required elevations and remove excess materials, debris, and equipment from the site to the satisfaction of the Owner's Representative.

END SECTION

SECTION 32 90 00 - LANDSCAPE WORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Supply all work and materials, appliances, tools, equipment, facilities, transportation, and services necessary for and incidental to performing all operations in connection with furnishing, delivery, and installation of Landscape Work, complete as shown on the Drawings and/or as specified herein.

2. The principal items of work included in this section, but not exclusively, are:

a. Soil preparation.
b. Finish grading.
c. Mowstrip headers.
d. Plant materials including trees, shrubs, and flatted ground covers.
e. Staking and guying of trees.
f. Protection, maintenance and guarantees.
g. Miscellaneous work for completion.

B. Related work specified elsewhere:

1. Section 32 84 00 ”Landscape Irrigation System”.

1.3 QUALITY ASSURANCE AND PROJECT REQUIREMENTS

A. Applicable Standards:
1. American Association of Nurserymen Grades and Standards.
2. American Joint Committee on Horticultural Nomenclature: 1942, edition of Standardized Plant Names.

B. Project Requirements:
1. The work of this Section shall be coordinated with all underground utilities and trades responsible for their installation and with all related work in other sections.
2. Manufacturer's Directions: Manufacturer’s directions and detailed drawings shall be followed in all cases where the manufacturers used in this Contract furnish directions covering points not shown in the drawings and specifications.
3. Work called for on the drawings by notes or details shall be furnished and installed whether or not specifically mentioned in the specifications.
4. Do not deviate from the specified arrangements, showing types, locations, sizes and quantities of materials as set out in the Drawings and/or described in the Specifications, unless the Drawings and/or Specifications are previously modified by the Architect.

1.4 SUBMITTALS

A. Submittal procedures and quantities are specified in Division 1 Submittals. Provide a minimum of four copies unless otherwise directed.

B. Provide the following submittals for review and approval:
   1. Provide source, manufacturer's data sheets, and samples where indicated for, at a minimum, each of the following:
      a. Organic amendment.
      b. Fertilizers.
      c. Soil conditioners.
      d. Mulch including sample.
      e. Plant materials (see Section 2.3).
      f. Tree guards and tree ties.
   2. In addition to other certificates specified, furnish a certificate with each delivery of bulk material, including topsoil if proposed, stating the source, quantity and type of material; and shall verify that the material conforms to the requirements of the Specifications. A similar certificate shall be submitted for each delivery of material in containers, including soil conditioners and fertilizers, prior to the start of the installation.
   3. Submit soils test results and soils test location plan as described in Section 3.1.B.

1.5 SITE OBSERVATION SCHEDULE

A. Notify the Architect in advance for the following observation meetings:
   1. At completion of finish grading.
   2. When trees and shrubs are spaced for planting, but before holes are excavated.
   3. At the start of the maintenance period.
   4. At the end of the maintenance period.

1.6 MAINTENANCE

A. Maintenance Period:

   1. Upon completion of the construction and written approval of the project as evidenced by the Pre-maintenance Inspection approval, the Contractor shall be responsible for maintaining the project for a period of 90 days.
   2. During the maintenance period, all plants and planted areas shall be kept well watered at all times. Weeds and wild Bermuda grass shall be removed and disposed of; the lawns shall be edged wherever necessary and mowed. Planting basins shall be maintained, cultivated and kept well formed around trees and shrubs. The irrigation system shall be maintained and repaired and the entire project shall be so cared for that a neat and clean condition will exist to the satisfaction of the Owner at all times.
   3. Weeding shall consist of digging out all foreign plant material other than the desired shrubs and ground cover at least once every two weeks. Weeding may be handled by herbicide spraying at the Contractor's expense if it is acceptable to the Owner. Cultivating shall consist of scarifying the top two inches of bed so that lumps of soil are all less than 2" in diameter, and all weeds are removed. Do not harm plant roots while cultivating.
   4. Thirty (30) days after planting, an application of 16-6-8 complete fertilizer, or other fertilizer as recommended by the soils testing laboratory, shall be applied at a rate of 6 pounds per 1,000 square feet to all landscape areas. Repeat applications at the same rate at thirty-day intervals thereafter until Final Acceptance.

C. Final Acceptance: Acceptance for all landscape work shall be given after final inspection by the Owner.

1.6 JOB CONDITIONS

A. Establish all lines and levels necessary for the location and installation of the landscape construction and for all excavation, filling and grading. Take measurements of the site, verify the same with the Drawings, and be responsible for the proper fit of the completed work

B. Provide and maintain substantial and adequate protection as may be required to protect new and existing work and all items of equipment and furnishings for the entire duration of the work.

1.7 GUARANTEE

A. For general warranty requirements refer to Division 1, Warranties.

B. Plants 15 gallon and larger shall be guaranteed for a twelve (12) month period after final acceptance and trees smaller than 15 gallon, shrubs, ground covers and lawns shall be guaranteed for ninety (90) days after final acceptance unless otherwise noted. All materials not in a vigorous, thriving condition shall be replaced as soon as weather permits. Plants, including trees, which have partially died so that shape, size, or symmetry has been damaged, shall be considered subject to replacement.

1. Plants used for replacement shall be of the same kind and size as those originally specified. All work, including materials, labor, and equipment used in replacements, shall be at no additional cost. Replacement plants shall carry the same guarantee as original. Any damage, including ruts in planting bed, incurred while making replacements shall be immediately repaired.
2. When plant replacements are made, plants, plant soil mix, fertilizer, mulch, etc., are to be replaced as originally specified, and inspected for full compliance with the Contract requirements.

PART 2 - PRODUCTS

2.1 APPROVAL AND REJECTION OF MATERIALS

A. The selection of all materials and execution of all operations required under the Drawings and Specifications are subject to the approval of the Architect.

2.2 SUBSTITUTIONS OF MATERIALS

A. Comply with requirements of Section 01631, Substitutions.

B. Before submitting a bid, locate all necessary materials called for and assure their availability for use on the job. The contract bids shall be based upon providing the specified materials, processes, products, etc., identified in this Specification and/or indicated on the Drawings.

2.3 CONTRACTOR'S RESPONSIBILITY TO SUPPLY PLANT MATERIALS

A. Upon award of the Contract, the Contractor shall immediately locate all trees 15 gallon and larger for use on the project, including palm tress, unless otherwise approved by the Architect. Notify the Architect the location and/or nursery that is growing the trees. The Contractor is responsible to supply all trees at the heights, spreads and calipers specified on the Drawings.

2.4 SOIL AMENDMENTS AND CONDITIONERS

A. Organic amendment: Nitrolized redwood sawdust (0.5% actual nitrogen), or nitrolized-mineralized fir sawdust (0.8% nitrogen), or nitrolized fir bark (1% actual nitrogen). It shall be fine textured, having a minimum of 90% passing #4 mesh screen, and a minimum of 80% passing #8 mesh screen.

B. Fertilizer: Commercial, granulated type, 16-16-16 and ammonium sulfate 21-0-0. It shall be uniform in composition, dry and free flowing, to be delivered to the site, in unopened containers, each bearing the manufacturer's guaranteed chemical analysis and weight.

C. Gypsum: Agricultural or landscape grade testing 65-95% calcium sulfate (CaSO4).

D. Soil Sulfur: Agricultural or landscape grade granular or powdered material uniform if composition, dry and free flowing, testing 95% pure elemental sulfur, to be delivered to the site, in unopened containers, each bearing the manufacturer's guaranteed chemical analysis and weight.

E. Iron Sulfate: Iron (expressed as metallic) derived from ferric and ferrous sulfate, 20%; sulfur (expressed as elemental), 10%; uniform in composition, dry and free flowing, to be delivered to the site, in unopened containers, each bearing the manufacturer's guaranteed chemical analysis and weight.

G. Organic mulch in landscape areas: Composted and nitrolized medium grade shredded bark free of pine needles, construction debris and paint, plastic bag scraps, and other foreign debris.

2.5 PLANT MATERIALS

A. Plant materials shall be furnished in the quantities required to completed work as indicated on the Drawings, and shall be as specified.

B. Plant names listed on the Drawings conform to the Joint Committee on Horticultural Nomenclature, except that for names not covered therein, the established custom of the nursery trade is followed. Multi-trunk defines a plant having three or more trunks of nearly equal diameter developed from the single crown of a rootball; 'Make-up' multi-trunk trees will not be accepted.

C. Plants shall be nursery grown under climatic conditions similar to those at the site. Plants shall meet the standards of the American Association of Nurserymen in all ways.

D. Ornamental Trees and Shrubs:
   1. Plants shall be symmetrical, typical for variety and species; sound, healthy, vigorous and free from plant disease, insects and their eggs, and shall have healthy, full root systems, filling their containers, but not root bound.
   2. Plants shall not be pruned prior to delivery except as authorized by the Architect.
   3. Plants shall be protected in transit and after delivery. Plants in broken containers will not be accepted. Plants with broken branches or injured trunks will not be accepted.
   4. Container stock shall have been grown for at least six (6) months in the containers in which they are to be delivered, but shall not be root bound.
   5. Container plants with cracked or broken balls of earth when taken from the containers may be planted only with specific approval of the Architect.

E. Ornamental Ground covers:
   1. Ground covers shall be as designated on the plan and on the planting legend. Ground covers shall be sound, healthy, vigorous, free from plant disease and insects or their eggs; and unless otherwise indicated shall be rooted plants or cuttings growing in flats.
   2. Ground covers shall be protected in transit and after delivery.

2.6 MISCELLANEOUS LANDSCAPE MATERIALS

A. Concrete and Concrete Reinforcement for headers: See Division 2 Section 02510 “Portland Cement Concrete Paving”.

B. Lumber:
   1. All lumber shall be new.
   2. Wood stakes for tree staking shall be lodgepole pine pressure treated with copper napthanate, a minimum of 2" in diameter, length as required to provide adequate support for tree.

C. Hardware:
   1. All hardware shall be new and galvanized commercial quality material. Miscellaneous hardware includes turnbuckles, nails, bolts, nuts, etc.
   2. Guy wire shall be single No. 10 gauge galvanized steel wire.
   3. Eyebolts shall have eye welded close.

D. Tree Guard: Expandable, polyethylene tree guard for tree trunk base protection in lawn areas; `Arbor-guard' or approved equal.

E. Tree Ties: Flexible vinyl or rubber ties, "Cinch-Tie" or approved equal. Length as required by details.

PART 3 - EXECUTION

3.1 PREPARATORY WORK

A. Remove from the site and dispose of all soil that contains any deleterious substances such as oil, plaster, concrete, gasoline, paint, solvents, lime, etc., removing the soil to a minimum depth of six inches or to the level of dryness in the affected areas. The affected soil shall be replaced with topsoil as specified herein.

B. Provide as part of the work of this section, two (2) composite soil tests and corresponding soil amendment and fertilization recommendations per every 20,000 square feet of site area – 2 minimum – from widely separated areas of the site. Tests shall be agricultural suitability and fertility tests utilizing the Owner of California method, and shall be performed by a certified soil-testing laboratory approved by the Architect. The Soils Laboratory shall be informed of the type of landscaping proposed for each soil area. The first test shall consist of composite soil samples from a depth of 8" - 12", and the other test shall consist of composite soil samples from a depth of 24" - 30". The Contractor shall notify the Architect before samples are taken, so that the Architect may direct the location of sampling when necessary

C. Also provide as part of the work of this section, a minimum of ten water percolation tests as follow: Ten holes a minimum of 3' by 3' by 2' deep shall be dug at widely separate locations on the site, locations as directed by the Architect. Tree planting pits may be used for these tests. Each hole shall be filled with water and allowed to completely drain. Refill each hole and measure the rate the water level drops over a minimum of four hours. Any rate less than 1 inch drop per hour shall be immediately reported to the Architect and no further work shall be done until direction to proceed has been issued by the Landscape Architect.

3.2 PRELIMINARY SITE PREPARATION

A. Deep rip all planting areas to a depth of eight inches. Remove all stones greater than 3/4" diameter within the top eight inches of all planting areas. Use balloon tire mounted equipment only in landscaped areas.

B. Water settle all backfilled areas, thoroughly saturating the fill from bottom to top in a manner to drive out all air and voids. Add new topsoil if necessary to bring settled areas to finish grades. In most cases this would apply to areas adjacent to retaining walls, planter boxes and building walls. The intent of this paragraph is that the landscape contractor is responsible to settle all areas backfilled under this contract, as well as settling in areas of landscaping backfilled by others.

C. Finish Grading: When preliminary grading, including clearing and weeding has been completed and the soil may be readily worked, all planting areas shall be graded to a smooth, even and uniform plane with no abrupt change in surface. Soil areas shall slope away from buildings, and surface drainage shall be directed as indicated on the Drawings. Grade to within 1" of the top of curbs and paving. Remove all stones greater than one inch in diameter from the surface soil. Notify the Architect 48 hours in advance for approval of finish grades.

3.3 WEED CONTROL

A. After irrigation is installed and after finish grade is established, all planting areas shall undergo the following weed control treatment:
   1. Apply approved contact weed killer herbicide to all planting areas. After killing, remove all dead weeds and grasses.
   2. Apply 4 pounds per 1000 square feet ammonium sulfate 21-0-0 fertilizer to all planted areas.
   3. Irrigate at normal rates for 14 days.
   4. After 14 days again apply approved contact weed killer to all planting areas. After killing, remove all dead weeds and grasses.
   5. Pre-emergent herbicide shall be applied to all shrub and ground cover areas.

3.4 SOIL PREPARATION

A. In all planting areas shown on the Drawings add the following amendments per 1,000 square feet to a depth of six inches:
   1. 4 cubic yards organic amendment
   2. 50 pounds gypsum
   3. 2 pounds soil sulfur
   4. 12 pounds 16-16-16 fertilizer

B. Backfill for plant pits shall be:
   1. 6 parts by volume site soil
   2. 4 parts by volume organic amendment
   3. 1 pound iron sulfate per cu. yd. of mix
   4. 2 pounds 16-6-8 per cu. yd. of mix

   These materials should be thoroughly blended prior to use for backfill purposes. Contractor shall ensure that iron sulfate does not contact cement surfaces since severe staining may occur.

C. The soil amendments in the soil preparation and backfill mixture in the above paragraphs shall be installed as specified unless otherwise recommended by the soil testing laboratory. The soil laboratory recommendations shall have precedence over the above specifications.

3.5 INSTALLATION OF PLANT MATERIALS

A. Trees, Shrubs, and Rooted Ground Covers:

1. Maintenance of plant materials shall begin immediately after each plant is delivered to the site.

2. All shipments of nursery materials shall be thoroughly protected from the sun and from drying winds during transit. All plants that cannot be immediately planted upon delivery to the site shall be protected against drying by wind and sun. All plants remain the property and responsibility of the Contractor until final acceptance.

3. Plants shall not be allowed to dry out before or while being planted. Keep exposed roots moist by means of wet sawdust, peat moss or burlap at all times during planting operations; do not expose to the air or sunlight except while being placed in the ground. Wilted plants, whether in place or not, will not be accepted and shall be replaced at the Contractor's expense.

4. Position trees and shrubs or stake their intended locations as shown on the Drawings. Notify the Architect for inspection and approval 48 hours in advance of all positioning of plant materials prior to planting.

5. Excavate plant pits to the depths and widths indicated on the planting details. Tree pits shall be of such depth that, when planted and settled, the crown of the plant shall bear the same relation to finish grade that it did to soil in its container prior to planting. To allow for settlement, plant trees and shrubs 2” higher than finished grade for shrubs and small trees, and 4” higher than finished grade for larger boxed trees. Provide temporary water basin dams to facilitate deep watering.

6. Set plants vertically and backfill with soil mix to half the depth of rootball, and then tamp and thoroughly water. The remainder of the pit shall then be filled with soil mix, tamped and thoroughly watered, all within the same day of planting. Watering means thorough saturation of all backfill in plant pits, applied only by open ended hose at low pressure.

7. All tree, shrub and ground cover areas shall be mulched to a minimum settled thickness of one inch (2") over the entire area of bed then raked to an even surface. All mulch shall be applied within four (4) days after planting. After leveling, water the full depth of mulch.

8. Stake all trees within 48 hours of planting. Install tree guards around base of all trees in lawn areas.

9. Ground covers shall be planted so that after settling, the crown of the plant is even with the finished grade. After planting, smooth the soil around the plants and water thoroughly with a light spray until the soil is saturated and all air pockets are eliminated.

10. All shrub and groundcover areas shall be mulched with shredded bark to a minimum depth of 2 inches.

3.6 CLEANUP

A. During the work, the premises are to be kept neat and orderly at all times. Storage areas for plant and other material shall be neat and orderly. All trash, including debris resulting from removing weeds and rock from planting areas, preparing beds, or planting plants shall be removed from the site daily as the work progresses. All walks and drives shall be kept clean by sweeping and/or hosing; excavated soil may be distributed on the site if permitted by the Architect. Remove all tags, labels, nursery stakes and ties from all plants.

END OF SECTION

DIVISION 33
UTILITIES

SECTION 33 10 00 - WATER DISTRIBUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes piping and specialties for combined potable and fire protection water service outside the building.

B. Related Sections include the following:
1. Section 31 20 00 - Earthwork for trench excavation and backfill.
2. Drawings for potable and fire protection piping inside the building.

1.3 SYSTEM PERFORMANCE REQUIREMENTS

A. Minimum Working Pressures: The following are minimum pressure requirements for piping and specialties, unless otherwise indicated:
1. Combined Potable Water and Fire Protection Water Service: 200 psig (1380 kPa).

1.4 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.

B. Product Data: For the following:
1. Pipe, joint restraints and fittings.
2. Valves and covers
3. Backflow preventer
4. Fire Department Connection

C. Purging and Disinfecting Reports: As specified in "Cleaning" Article in Part 3.

1.5 QUALITY ASSURANCE

A. Comply with NFPA 24, "Installation of Private Fire Service Mains and Their Appurtenances," for materials, installations, tests, flushing, and valve and hydrant supervision.

B. Comply with NSF Standard 61, “Drinking Water System Components”, for material, installation, and testing requirements.

C. Comply with City of Compton requirements for tapping of water mains.

D. Comply with City of Compton standards for potable water-service piping for testing and disinfections.

E. Comply with the local Fire Department installation and testing requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Preparation for Transport: Prepare valves according to the following:
   1. Ensure that valves are dry and internally protected against rust and corrosion.
   2. Protect valves against damage to threaded ends and flange faces.
   3. Set valves in best position for handling. Set valves closed to prevent rattling.

B. During Storage: Use precautions for valves according to the following:
   1. Do not remove end protectors, unless necessary for inspection; then reinstall for storage.
   2. Protect from weather. Store indoors and maintain temperature higher than ambient dew-point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.

C. Handling: Use sling to handle valves whose size requires handling by crane or lift. Rig valves to avoid damage to exposed valve parts. Do not use handwheels or stems as lifting or rigging points.

D. Deliver piping with factory-applied end-caps. Maintain end-caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.

E. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.

F. Protect flanges, fittings, and specialties from moisture and dirt.

1.7 PROJECT CONDITIONS

A. Verify existing utility locations and meters. Contact utility locating service.

B. Verify that it is possible to install water service piping to comply with original design and referenced standards.

C. Site Information: Reports on subsurface condition investigations made during design of Project are available for informational purposes only; data in reports are not intended as representations or warranties of accuracy or continuity of conditions between soil borings. Owner assumes no responsibility for interpretations or conclusions drawn from this information.

D. Obtain necessary connection permits with local water company as required.

E. Obtain necessary street excavation and encroachment permits from the City of Los Angeles Dept. of Public Works.

1.8 SEQUENCING AND SCHEDULING

A. Coordinate piping materials, sizes, entry locations, and pressure requirements with building water distribution piping.

B. Coordinate piping materials, sizes, entry locations, and pressure requirements with building fire-protection water piping.

C. Coordinate with other site utility work.

PART 2 - PRODUCTS

2.1 PIPES AND TUBES

A. General: Applications of the following pipe and tube materials are indicated in Part 3 "Piping Applications" Article.

B. PVC Plastic, Socket Fittings: ASTM D 2466, Schedule 40.

C. PVC Plastic, Fire Service Pipe: UL 1285 and AWWA C900, Class 200 or 150 as noted on plans. Include elastomeric seal according to ASTM F 477.

D. Pipe sizes up to 2 inches shall be copper water tubing, Type K hard, ANSI H23.1, ASTM B 88, IAPMO IS. Muller Brass, Cambridge-Lee Halstead, or equal. An approved protective wrap shall be used to completely isolate and protect all underground copper tubing and extend past the surface a minimum 12 inches. The excess wrapping shall be trimmed down and taped to copper tubing with 10 mill PVC pipe tape at grade level of concrete or asphalt.

B. Ductile-Iron, Push-on-Joint Pipe: AWWA C151, with cement-mortar lining and seal coat according to AWWA C104. Include rubber compression gasket according to AWWA C111.

2.2 PIPE AND TUBE FITTINGS

A. General: Applications of the following pipe and tube fitting materials are indicated in Part 3 "Piping Applications" Article.

B. Copper Fittings: ASME B16.22; wrought-copper, solder-joint pressure type.

C. PVC Plastic, Socked Fittings: ASTM D2466, Schedule 40.

D. Ductile-Iron, Push-on-Joint Fittings: AWWA C110, ductile-iron or cast-iron; or AWWA C153, ductile-iron, compact type. Include cement-mortar lining and seal coat according to AWWA C104 and rubber compression gaskets according to AWWA C111.

2.3 JOINING MATERIALS

A. General: Applications of the following piping joining materials are indicated in Part 3 "Piping Applications" Article.

B. Solder Filler Metal: ASTM B 32, Alloy Sn95, Alloy Sn94, or Alloy E, with 0.10 percent maximum lead content.

C. Primers for PVC Piping Solvent-Cement Joints: ASTM F 656.

D. Solvent Cement for PVC Piping Solvent-Cement Joints: ASTM D 2564.

2.4 PIPING SPECIALTIES

A. Dielectric Fittings: Assembly or fitting with insulating material isolating joined dissimilar metals to prevent galvanic action and corrosion.
   1. Description: Combination of copper alloy and ferrous; threaded, solder, plain, and weld-neck end types and matching piping system materials.
   2. Dielectric Unions: Factory-fabricated union assembly, designed for 250-psig (1725-kPa) minimum working pressure at 180 deg F (82 deg C). Include insulating material isolating dissimilar metals and ends with inside threads according to ASME B1.20.1.

3. Dielectric Flanges: Factory-fabricated companion-flange assembly, for 150- or 300-psig (1035- or 2070-kPa) minimum pressure to suit system pressures.
4. Dielectric-Flange Insulation Kits: Field-assembled companion-flange assembly, full-face or ring type. Components include neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
   a. Provide separate companion flanges and steel bolts and nuts for 150- or 300-psig (1035- or 2070-kPa) minimum working pressure to suit system pressures.
5. Dielectric Couplings: Galvanized-steel couplings with inert and non-corrosive thermoplastic lining, with threaded ends and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).
6. Dielectric Nipples: Electroplated steel nipples with inert and non-corrosive thermoplastic lining, with combination of plain, threaded, or grooved end types and 300-psig (2070-kPa) working pressure at 225 deg F (107 deg C).

2.5 POLYETHYLENE ENCASEMENT

A. Polyethylene Encasement for Ductile-Iron Piping: ASTM A 674 or AWWA C105, PE film, 0.008-inch (0.20-mm) minimum thickness, tube or sheet.

2.6 VALVES

A. All Gate Valves, 4-Inch NPS (DN80) and Larger in size shall conform to AWWA Standard Specifications C500. All valves, including those over 12”, shall be rated to a minimum working pressure of 200 psi. All valves shall be iron body, bronze mounted, double-disk, parallel scat gate valves. All valves shall open by turning the stem counterclockwise. Buried valves shall be non-rising type with O-ring seal equipped with 2 inch square operating nut, and shall be bituminous coated. End connections shall be flanged, or mechanical joint as required for the type of pipe used. Buried valves shall have stem extensions to place operating nut within 6” of top of valve box.

B. Valve Boxes shall be precast concrete with cast iron traffic rated cover with lettering "WATER”, bottom section with base of size to fit over valve and barrel approximately 5 inches (125 mm) in diameter, and adjustable cast-iron extension of length required for depth of bury of valve.
   1. Provide steel tee-handle operating wrench with each valve box. Include tee handle with one pointed end, stem of length to operate valve, and socket-fitting valve-operating nut. After installation of valve box cover and after installation of adjacent paving, if any, covers shall be sandblasted or wire-brushed as necessary and painted with bituminous black paint, unless another color is required by the Architect.

C. Indicator Posts: UL 789, FM-approved, vertical-type, cast-iron body with operating wrench, extension rod, and adjustable cast-iron barrel of length required for depth of bury of valve. Posts above and including connection to riser shall be sandblasted, if necessary, after installation and painted red, unless another color is required by the Architect.

D. Tapping Sleeve and Tapping Valve: Complete assembly, including tapping sleeve, tapping valve, and bolts and nuts. Use sleeve and valve compatible with tapping machine.
   1. Tapping Sleeve: Cast- or ductile-iron, 2-piece bolted sleeve with flanged outlet for new branch connection. Sleeve may have mechanical-joint ends with rubber gaskets or sealing rings in sleeve body. Include sleeve matching size and type of pipe material being tapped and of outlet flange required for branch connection.

E. No ball valves shall be used for underground installation.

2.7 BACKFLOW PREVENTERS

A. General: Manufactured backflow preventers, of size indicated for maximum flow rate and maximum pressure loss indicated.

B. Working Pressure: 200 psig (1380 kPa) minimum, unless otherwise indicated.

C. 2-Inch NPS (DN50) and Smaller: Bronze body with threaded ends.

D. Interior Lining: AWWA C550, epoxy coating for backflow preventers with cast-iron or steel body.

E. Interior Components: Corrosion-resistant materials.

F. Strainer on inlet if strainer is indicated.

G. Hose-Connection Vacuum Breakers: ASSE 1011, nickel plated, with nonremovable and manual drain features, and ASME B1.20.7, 3/4-11.5NH threads for garden hose on outlet. Units attached to rough-bronze-finish hose connections may be rough bronze.

H. Reduced-Pressure-Principle Backflow Preventer: ASSE 1013, with OS&Y gate valves on inlet and outlet, and strainer on inlet. Include test cocks and pressure-differential relief valve with ASME A112.1.2 air-gap fitting located between 2 positive-seating check valves for continuous-pressure application.
1. Pressure Loss: 12 psig (83 kPa) maximum through middle third of flow range.
2. Double Detector Check Assembly: 15 psi (103.75 kPa) entry loss.

I. Exterior Finish: Red or yellow (as directed by Water Purveyor or local Fire Department) alkyd-gloss enamel paint. Entire device above and including connection to riser shall be sandblasted, if necessary, after installation and re-painted.

Manufacturer	Model	Size
Cia-Val	RP-LEX	2",2 1/2",3",4",6",8",10"
Cia-Val	RP-2	3/4",1",1-1/4",1-1/2"
Cia-Val	RP4	6 "
Febco	825YD2	2-1/2",3",4",6",8",10"
Febco	825Y	3/4",1",1-1/4",1-1/2",2"
Febco	825YA	3/4",1",1-1/2",2"
Febco	845	3/4",1"
Mueller	H-9506	4",6",8",10"
Orion	80-0069	1-1/2"
Orion	BRP	3/4,1”,3",4"
Orion	9-2929	2 "
Rain Bird	RPA-075-R	3/4"
Rain Bird	RPA-100-R	1”
Rain Bird	RPA-125-R	1-1/4"
Rain Bird	RPA-150-R	1-1/2"
Rain Bird	RPA-200-R	2"
Rain Bird	RPA-250-R	2-1/2"
Rain Bird	RPA-400-R	4 "
Rain Bird	RPA-600-R	6"
Rain Bird	RPA-800-R	8"
Rain Bird	RPA-1000-R	10"

Watts	909 PCQT	3/4"-2"
Watts	909HWQT	3/4",1",1-1/4",1-1/2",2"
Watts	909 PCRW	2-1/2"-10"
Watts	909 RW Bronze	2-1/2",3"
Watts	009QT	3/4",1",1-1/4",1-1/2",2"
Watts	009SSQT	3/4",1",1-1/4",1-1/2",2"
Wilkins	975XL	3/4",1",1-1/4",1-1/2",2"
Wilkins	375(SM)	1/2", 3/4",1",1-1/4",1-1/2",2"
Wilkins	375A	2 1/2", 3", 4", 6", 8", 10"
Wilkins	375ADA	2 1/2", 3", 4", 6", 8", 10"
Wilkins	450DA	4", 6", 8", 10"

2.7 FIRE DEPARTMENT CONNECTIONS

A. Exposed Fire Department Connections: UL 405, cast-brass body, with thread inlets according to NFPA 1963 and matching local fire department hose threads, and threaded bottom outlet. Include lugged caps, gaskets, and chains; lugged swivel connection and drop clapper for each hose-connection inlet; 18-inch- (460-mm-) high brass sleeve; and round escutcheon plate.
1. Connections: Two 2-1/2-inch NPS (DN65) inlets and 6-inch NPS (DN150) outlet.
2. Inlet Alignment: Inline, horizontal.
3. Finish Including Sleeve: Polished chrome-plated.
4. Escutcheon Plate Marking: "AUTO SPKR."

2.8 ANCHORAGES

A. Concrete Reaction Backing: Portland cement concrete mix, 2000 psig (13.8 MPa).
1. Cement: ASTM C 150, Type I.
2. Fine Aggregate: ASTM C 33, sand.
3. Coarse Aggregate: ASTM C 33, crushed gravel.
4. Water: Potable.

2.9 IDENTIFICATION

A. Refer to Division 2 Section "Earthwork" for underground warning tape materials.

B. Arrange for detectable warning tapes made of solid blue film with metallic core and continuously printed black-letter caption "CAUTION--WATER LINE BURIED BELOW."

C. Nonmetallic Piping Label: Engraved, plastic-laminate label at least 1 by 3 inches (25 by 75 mm), with caption "CAUTION--THIS STRUCTURE HAS NONMETALLIC WATER-SERVICE PIPING," for installation on main electrical meter panel.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Refer to Section 31 20 00 "Earthwork" for excavation, trenching, and backfilling.

B. Refer to Section 32 12 16 "Asphalt Concrete Paving" for cutting and patching of existing asphalt paving.

C. Refer to Section 32 13 13 "Concrete Paving" for cutting and patching of existing concrete paving.

3.2 PIPING APPLICATIONS

A. General: Use pipe, fittings, and joining methods for piping systems according to the following applications.

B. Transition couplings and special fittings with pressure ratings at least equal to piping pressure rating may be used, unless otherwise indicated.

C. Do not use flanges or unions for underground piping.

D. Flanges, unions, grooved-end-pipe couplings, and special fittings may be used, instead of joints indicated, on aboveground piping and piping in vaults.

E. Underground water-service piping NPS 2 to NPS 16 shall be the following:

1. Soft copper tube, ASTM B 88, Type K and B 251; wrought-copper, solder-joint fittings; and brazed joints.
2. Ductile-iron, push-on-joint pipe; ductile-iron, push-on-joint fittings; and gasketed, or mechanical-joint pipe; ductile-iron, mechanical-joint fittings; and mechanical joints.

F. Underground water-service piping NPS 30 shall be the following:
1. Ductile-iron, push-on-joint pipe; ductile-iron, push-on-joint fittings; and gasketed, or mechanical-joint pipe; ductile-iron, mechanical-joint fittings; and mechanical joints

3.3 VALVE APPLICATIONS

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
1. Underground Valves, 3-Inch NPS (DN80) and Larger: AWWA, gate valves, non-rising stem, with valve box.
2. Underground Valves, 4-Inch NPS (DN100) and Larger: UL/FM, gate valves, non-rising stem, with indicator post.

3.4 JOINT CONSTRUCTION

A. Ductile-Iron Piping, Gasketed Joints for Fire-Service Piping: According to UL 194 and AWWA C600.

B. Dissimilar Materials Piping Joints: Use adapters compatible with both piping materials, OD, and system working pressure. Refer to "Piping Systems - Common Requirements" Article below for joining piping of dissimilar metals.

3.5 PIPING SYSTEMS - COMMON REQUIREMENTS

A. General Locations and Arrangements: Drawings indicate general location and arrangement of piping systems. Install piping as indicated, unless deviations to layout are approved in advance by the Architect or USC.

B. Install components with pressure rating equal to or greater than system operating pressure.

C. Install piping free of sags and bends.

D. Install fittings for changes in direction and branch connections.

G. Piping Connections: Unless otherwise indicated, make piping connections as specified below:

1. Install dielectric fittings to connect piping of dissimilar metals.

3.6 SERVICE ENTRANCE PIPING

A. Extend water-service piping and connect to water-supply source and building water piping systems at outside face of building wall in locations and pipe sizes indicated.

1. Terminate water-service piping at building wall until building water piping systems are installed. Terminate piping with caps, plugs, or flanges as required for piping material. Make connections to building water piping systems when those systems are installed.

B. Sleeves and mechanical sleeve seals are specified in Drawings.

C. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, and other supports.

3.7 PIPING INSTALLATION

A. Make connections larger than 2-inch NPS (DN50) with tapping machine according to the following:

1. Install tapping sleeve and tapping valve according to manufacturer's written instructions.
2. Install tapping sleeve on pipe to be tapped. Position flanged outlet for gate valve.
3. Install gate valve onto tapping sleeve. Comply with AWWA C600. Install valve with stem pointing up and with cast-iron valve box.
4. Use tapping machine compatible with valve and tapping sleeve; cut hole in main. Remove tapping machine and connect water-service piping.

B. If hot tap is not possible, install cut-in tee with C-110 fittings.

C. Comply with NFPA 24 for fire-protection water-service piping materials and installation.

D. Install ductile-iron piping according to AWWA C600.

1. Encase piping with PE film according to ASTM A 674 or AWWA C105.

2. Install encasement per manufacturer's written instructions. Close seams and overlaps in the polyethylene tubes with polyethylene compatible adhesive tape. The tape shall be approximately two inches wide and shall have the ability to bond securely to a metal surface and the polyethylene material. Repair all rips, tears and other damage with suitable adhesive tape.

E. Bury piping with depth of cover over top at least 30 inches (750 mm) and according to the following:

1. Under Driveways: With at least 36 inches (900 mm) cover over top.

2. If trenching before rough grading is completed would result in a lesser depth of cover than specified above, then trenching for water piping installation shall not be done until the specified minimum cover depth can be achieved. If construction traffic will be allowed to pass over completed water piping installations prior to finish paving, then a protective pavement blanket at least equivalent to the final pavement and base thickness shall be constructed within the vehicle access area for a minimum distance of three feet on either side of the pipe. As an alternative to the temporary pavement blanket, the water pipe shall be installed at a minimum of two (2) feet deeper than specified within construction traffic areas.

3.8 ANCHORAGE INSTALLATION

A. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches. Include anchorages for the following piping systems:
1. Gasketed-Joint, Ductile-Iron, Potable-Water Piping: According to AWWA C600.
2. Fire-Service Piping: According to NFPA 24.

B. Apply full coat of asphalt or other acceptable corrosion-retarding material to surfaces of installed ferrous anchorage devices.

3.9 VALVE INSTALLATION

A. General Application: Use mechanical-joint-end valves for 3-inch NPS (DN80) and larger underground installation. Use non-rising-stem UL/FM gate valves for installation with indicator posts.

B. AWWA-Type Gate Valves: Comply with AWWA C600. Install underground valves with stem pointing up and with cast-iron valve box.

C. UL/FM-Type Gate Valves: Comply with NFPA 24. Install underground valves and valves in pits with stem pointing up and with vertical cast-iron indicator post.

3.10 FIRE DEPARTMENT CONNECTION INSTALLATION

A. Install fire department connection of type and features indicated.

3.11 IDENTIFICATION INSTALLATION

A. Install continuous plastic underground warning tape during back-filling of trench for underground water-service piping. Locate 6 to 8 inches (150 to 200 mm) below finished grade, directly over piping.

3.12 FIELD QUALITY CONTROL

A. Piping Tests: Conduct piping tests before joints are covered and after thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.

B. Hydrostatic Tests: Test at not less than 1-1/2 times working pressure for 2 hours.
1. Increase pressure in 50-psig (350-kPa) increments and inspect each joint between increments. Hold at test pressure for one hour; decrease to 0 psig (0 kPa). Slowly increase again to test pressure and hold for one more hour. Maximum allowable leakage is 2 quarts (1.89 L) per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within above limits.

C. Prepare reports for testing activities.

3.13 CLEANING

A. Clean and disinfect water distribution piping as follows:
   1. Purge new water distribution piping systems and parts of existing systems that have been altered, extended, or repaired before use.
   2. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities, use procedure described in AWWA C651 or as described below:
      a. Comply with NFPA 24 for flushing of piping. Flush piping system with clean, potable water until dirty water does not appear at points of outlet.
         1) Fill system or part of system with water/chlorine solution containing at least 50 ppm of chlorine. Isolate system or part thereof and allow to stand for 24 hours.
         2) Drain system or part of system of previous solution and refill with water/chlorine solution containing at least 200 ppm of chlorine; isolate and allow to stand for 3 hours.
         3) Following allowed standing time, flush system with clean, potable water until chlorine does not remain in water coming from system.
         4) Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination shows evidence of contamination.

B. Prepare reports for purging and disinfecting activities.

END OF SECTION

SECTION 33 31 00 - SANITARY SEWER

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Sanitary drainage piping, fittings and accessories.

B. Connection of building sanitary sewer drainage system to site sewer systems

C. Cleanout access.

1.2 REFERENCES

A. ASTM D2751 - Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings.

B. ASTM D3034 - polyvinyl chloride (PVC), SDR 35, for solvent-cemented or gasketed joints.

C. ASTM C700 - Standard Specification for Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated

D. SSPWC - Standard Specifications for Public Works Construction, latest Edition.

1.3 REGULATORY REQUIREMENTS

A. Conform to Section 306, Standard Specifications for Public Works Construction, for materials and installation of Work of this Section.

1.4 SUBMITTALS

A. Shop drawings indicating dimensions, locations and elevations of manholes, cleanouts and sub-surface structures.

B. Product data for pipe and pipe accessories.

C. Inspection and test reports specified

1.5 PROJECT RECORD DOCUMENTS

A. Accurately record location of existing and proposed pipe runs, connections, manholes, cleanouts and invert elevations.

B. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

PART 2 - PRODUCTS

2.1 SEWER PIPE MATERIALS

A. Gravity-Flow, Non-pressure Plastic Pipe: Polyvinyl Chloride (PVC) Sewer Pipe and Fittings: ASTM D 3034, SDR 35, for gasketed joints. Gaskets: ASTM F 477, elastomeric seal.

B. PVC pipe is for outside conditions.

C. Vitrified Clay Pipe (VCP) - pipe shall be “extra strength VCP” and shall comply with Section 207-8 of the Standard Specifications for Public Works Construction. Pipe shall be manufactured in accordance with ASTM C-700 and installed in accordance with ASTM C-12. Joints for Vitrified Clay Pipe shall comply with Section 208-2.3 of SSPWC and manufactured in accordance with ASTM C-425. All VCP pipe, fittings and couplings shall be clearly marked at an interval not to exceed 5 feet as follows:
   1) Nominal pipe diameter.
   2) VCP classification.
   3) Company, plant, shift ASTM, and date designation.
   4) Service designation or legend.

D. Reinforced Concrete Pipe and Fittings: ASTM C76 (ASTM C76M), Class III, Wall B, for gasketed joints.

   1) Gaskets: ASTM C443 (ASTM C443M), rubber.

E. Hub and Spigot, Cast-Iron Soil Pipe and Fittings: ASTM A74, Service class, gray cast iron for gasketed joints. Include ASTM C564, rubber compression-type gaskets.

F. Backwater Valves: Gray iron.

G. Cleanouts: PVC.

H. Corrosion-Protection Piping Encasement: LLDPE film.

I. Manholes: Standard precast concrete.
   1. Resilient pipe connectors.
   2. Reinforced-concrete grade rings.
   3. Protective coating.
   4. Manhole frames and covers, with protective coating.
   5. Manhole cover inserts.

2.2 PIPE ACCESSORIES

A. Pipe Joints: Mechanical clamp ring type, stainless steel expanding and contracting sleeve, neoprene ribbed gasket for positive seal.

B. Fittings: Same material as pipe, molded or formed to suit pipe size and end design, in required "T", bends, elbows, cleanouts, reducers, traps and other configurations required.

C. PVC Sewer Pipe and Fittings, NPS 15 and Smaller: ASTM D3034, SDR 35, for solvent-cemented or gasketed joints.

1. Gaskets: ASTM F477, Elastomeric seals.
2. Primer: ASTM F 656.
3. Solvent Cement: ASTM D 2564

2.3 CLEANOUTS

A. Lid and Frame: Cast iron construction, removable lid, closed checkerboard grill lid design; nominal lid and frame diameter as required for pipe sizes. [SPPWC 204-2]

B. Manholes: SPPWC Standard Drawing 200-3.

2.4 FILL MATERIAL

A. Bedding and Fill: As specified in Section 31 20 00 “Earthwork”

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that trench cut, or excavation base is ready to receive work, excavations, dimensions and elevations are as indicated on drawings.

B. Beginning of installation means acceptance of existing conditions.

C. Verify that existing invert elevations on site will allow proper tie in to new work with proper positive slope. Ascertain accuracy prior to trenching and installation of sanitary sewer system.

3.2 PREPARATION

A. Hand trim excavations to required elevations. Correct over excavation with approved fill material.

B. Remove large stones or other hard matter that could damage sewer pipe or impede consistent backfilling or compaction.

3.3 INSTALLATION - PIPE

A. Prior to commencing Work, Contractor shall pothole existing utilities at points of connection and verify the joining invert shown on plan. Notify Architect in event of discrepancies.

B. Install pipe, fittings and accessories in accordance with Section 306, SSPWC and manufacturer's instructions. Seal joints watertight.

C. Concrete Pipe and Fittings: Install according to ACPA “Concrete Pipe Handbook”. Provide the following seals:

1. Round Pipe and Fittings: ASTM C443 (ASTM C443M), rubber gaskets.
2. Elliptical Pipe: ASTM C877 (ASTM C877M), Type I, sealing bands.
3. Arch Pipe: ASTM C877 (ASTM C877M), Type I, sealing bands.

D. All below grade piping consisting of ferrous metals shall be given a high-quality protective coating, such as 18-mil plastic tape, extruded polyethylene, coal-tar enamel, or Portland cement mortar. Below-grade metals should be electrically insulated (isolated) from above-grade metals by means of dielectric fittings in ferrous utilities and/or exposed metal structures breaking grade.

E. Place pipe on bedding as specified in Section 31 20 00.

F. Lay pipe to slope gradient noted on Drawings with maximum variation from true slope of 1/8 inch in 10 feet.

G. Do not displace or damage pipe when compacting.

H. Connect to site sewer outlet system through installed sleeves.

I. Do not cover joints until lines have been tested and approved.

3.4 INSTALLATION - CLEANOUTS

A. Form bottom of excavation clean and smooth to correct elevation.

B. Establish elevations and pipe inverts.

C. Mount lid and frame level in grout secured to top cone section to elevation indicated.

3.5 PROTECTION

A. Protect pipe cover from damage or displacement until backfilling operation is in progress.

3.6 TESTING

A. After installation, test each sanitary drain and/or sewer and each section between successive manholes for either infiltration or exfiltration. Test shall be conducted in accordance with Section 306 - Underground Conduit Construction of the Standard Specifications for Public Works Construction.

B. Where excessive ground water is encountered test the pipeline for infiltration.

C. When infiltration or exfiltration exceeds allowable amounts as set forth in the Section 306 formula, perform repairs or replacements as necessary to comply with the required limits.

END OF SECTION

SECTION 33 41 00 - STORM DRAINAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including the General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Reference Specification: Perform all work in accordance with applicable provisions of "Standard Specifications for Public Works Construction", 2018 Edition. Unless otherwise noted, mention herein of section numbers refers to sections of the Reference Specification. Where Reference Specification refers to "Agency", substitute the word "Owner". Where Reference Specification refers to "Engineer", substitute the word "Architect". Where Reference Specification is in conflict with these Specifications, these Specifications shall govern.

1.2 SUMMARY

A. This Section includes gravity-flow, non-pressure storm drainage pipe and drainage structures outside the building.

1.3 PERFORMANCE REQUIREMENTS

A. Gravity-Flow, Non-pressure, Drainage-Piping Pressure Rating: At least equal to system test pressure

1.4 SUBMITTALS

A. Product Data for the following:

1. Pipe and fittings
2. Storm water quality devices: catch basin insert filters
3. Drains inlets

B. Shop drawings for pre-cast concrete structures. Include frames, covers, and grates.

C. Shop drawings for infiltration swale. Include filter media, piping, overflows, planter soil materials and layering.

D. Shop drawings for cast-in-place concrete or field-erected masonry structures. Include frames, covers, and grates.

E. Reports and calculations for design mixes for each class of cast-in-place concrete.

F. Coordination drawings showing structures, pipe sizes, locations, and elevations. Include details of underground structures and connections. Show other piping in same trench. Indicate interface and spatial relationship between piping and proximate structures.

G. Inspection and test reports specified in the "Field Quality Control" Article.

1.5 QUALITY ASSURANCE

A. Environmental Agency Compliance: Comply with regulations pertaining storm drainage systems.

B. Utility Compliance: Comply with regulations pertaining to storm drainage systems. Include standards of water and other utilities where appropriate.

C. Product Options: Drawings indicate sizes, profiles, connections, and dimensional requirements of system components and are based on specific manufacturer types indicated. Other manufacturers' products with equal performance characteristics may be considered. Refer to Section "Product Requirements."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not store plastic structures in direct sunlight.

B. Do not store plastic pipe or fittings in direct sunlight.

C. Protect pipe, pipe fittings, and seals from dirt and damage.

D. Handle precast concrete manholes and other structures according to manufacturer's rigging instructions.

1.7 PROJECT CONDITIONS

A. Site Information: Perform site survey, research public utility records, and verify existing utility locations. Notify architect of potential utility conflicts prior to installation of pipe system.

B. Locate existing structures and piping to be closed and abandoned.

C. Prior to commencing construction in public right-of-way and connecting to any public storm drain systems, contractor shall contact the agency of authority and obtain necessary permits.

C. Existing Utilities: Do not interrupt existing utilities serving facilities occupied by the Owner or others except when permitted under the following conditions and then only after arranging to provide acceptable temporary utility services.

1. Notify Architect not less than 48 hours in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without receiving Architect's written permission.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 PVC PIPE AND FITTINGS

A. PVC Sewer Pipe and Fittings, NPS 15 and Smaller: ASTM D 3034, SDR 35, with bell-and-spigot ends for gasketed joints with ASTM F 477, elastomeric seals.

B. PVC Sewer Pipe and Fittings, NPS 18 and Larger: ASTM F 679, T-1 wall thickness, with bell-and-spigot ends for gasketed joints with ASTM F 477, elastomeric seals.

C. PVC Sewer Pipe and Fittings: Schedule 40 ASTM D 1785 and D 2665 with solvent cement joints conforming to ASTM D 2564.

2.3 REINFORCED CONCRETE PIPE AND FITTINGS

A. Reinforced Concrete Pipe: Comply with Section 207-2 of the Standard Specifications for Public Works Construction.

B Tongue and Groove Piping: ASTM C76 (ASTM C76M), Class III, Wall B, for gasketed joints.

C. Gaskets: ASTM C443 (ASTM C443M), rubber.

2.4 NONPRESSURE-TYPE PIPE COUPLINGS

A. Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground non-pressure piping. Include ends of same sizes as piping to be joined and corrosion-resistant-metal tension band and tightening mechanism on each end.

B. Sleeve Materials:
   1. For Cast-Iron Soil Pipes: ASTM C 564, rubber.
   2. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
   3. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

C. Unshielded Flexible Couplings: Elastomeric sleeve with corrosion-resistant-metal tension band and tightening mechanism on each end.
   1. Manufacturers:
      a. Dallas Specialty & Mfg. Co.
      b. Fernco Inc.
      c. Logan Clay Products Company (The).

d. Mission Rubber Company; a division of MCP Industries, Inc.
e. NDS Inc.
f. Plastic Oddities, Inc.

D. Shielded Flexible Couplings: ASTM C 1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
1. Manufacturers:
a. Cascade Waterworks Mfg.
b. Dallas Specialty & Mfg. Co.
c. Mission Rubber Company; a division of MCP Industries, Inc.
d. Any equivalent manufacturer.

E. Ring-Type Flexible Couplings: Elastomeric compression seal with dimensions to fit inside bell of larger pipe and for spigot of smaller pipe to fit inside ring.
1. Manufacturers:
a. Fernco Inc.
b. Logan Clay Products Company (The).
c. Mission Rubber Company; a division of MCP Industries, Inc.
d. Any equivalent manufacturer.

2.5 SUB-DRAINAGE MATERIALS

A. Filter Fabric: Supplied by prefabricated drainage structure manufacturer, 4.5 oz/sq. yd. min.

B. Waterproof Sheeting: Polyvinylchloride sheeting, minimum 20 mils thick, with waterproof adhesive supplied or recommended by sheeting manufacturer.

C. Perforated Subdrain Plastic Pipe:

1. Acrylonitrile-Butadiene-Styrene (ABS) Pipe: ASTM D 2751, with a maximum SDR of 35.
2. Polyvinyl Chloride (PVC) Pipe: ASTM D 3034, with maximum SDR of 35 and with flexible elastomeric seal joint.
3. Perforations: Perforations in ABS and PVC pipe shall be circular, no more than 5/16" or less than 3/16" in diameter, and arranged in rows parallel to the longitudinal axis of the pipe. Perforations shall be approximately 3 inches center-to-center, along rows. The rows shall be approximately 1-1/2" inches apart and arranged in a staggered pattern so that all perforations lie at the mid-point between perforations in adjacent rows. The rows shall be spaced over not more than 90 degrees of circumference. The spigot or tongue end of the pipe shall not be perforated for a length equal to the depth of the socket and perforations shall continue at uniform spacing over the entire width of the pipe. Manufacturer's standard ABS or PVC pipe essentially meets these requirements and may be substituted upon approval. Wall thickness as required for earth loads and as approved by Soils Engineer, 4" diameter, SDR35 minimum.
4. Acrylonitrile-butadiene-styrene (ABS) pipe shall be joined using solvent cement or elastomeric joints and shall be in accordance with ASTM D 2751.
5. Polyvinyl Chloride (PVC) pipe joints shall be in accordance with ASTM D 3212.
6. Furnish subsoil drainage pipe prewrapped or wrap pipe with Mirafi 140N Filter Fabric, or Bidim C22 or C28 fabric manufactured by Monsanto; or equal.

2.6 MANHOLES

A. Standard Precast Concrete Manholes: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.
   1. Diameter: 48 inches minimum, unless otherwise indicated.
   2. Ballast: Increase thickness of precast concrete sections or add concrete to base section, as required to prevent flotation.
   3. Base Section: 6-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section and having separate base slab or base section with integral floor.
   4. Riser Sections: 4-inch minimum thickness, and of length to provide depth indicated.
   5. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated. Top of cone of size that matches grade rings.
   6. Joint Sealant: ASTM C 990 bitumen or butyl rubber.
   7. Resilient Pipe Connectors: ASTM C 923, cast or fitted into manhole walls, for each pipe connection.
   8. Steps: Individual FRP steps, FRP ladder, or ASTM A 615/A 615M, deformed, 1/2-inch steel reinforcing rods encased in ASTM D 4101, PP wide enough to allow worker to place both feet on 1 step and designed to prevent lateral slippage off of step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Omit steps if total depth from floor of manhole to finished grade is less than 60 inches.
   9. Adjusting Rings: Interlocking rings with level or sloped edge in thickness and diameter matching manhole frame and cover. Include sealant recommended by ring manufacturer.
   10. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, to match diameter of manhole frame and cover.
   11. Manhole Frames and Covers: Ferrous; 24-inch ID by 7- to 9-inch riser with 4-inch- minimum width flange and 26-inch- diameter cover. Include indented top design with lettering cast into cover, using wording "STORM DRAIN."
      a. Material: ASTM A 536, Grade 60-40-18 ductile iron or ASTM A 48, Class 35 gray iron, unless otherwise indicated.

2.7 CONCRETE

B. General: Cast-in-place concrete according to ACI 318/318R, ACI 350R, and the following:
   1. Cement: ASTM C 150, Type II.
   2. Fine Aggregate: ASTM C 33, sand.
   3. Coarse Aggregate: ASTM C 33, crushed gravel.
   4. Water: Potable.

C. Ballast and Pipe Supports: Portland cement design mix, 3200 psi minimum, with 0.5 maximum water-cement ratio.
   1. Reinforcement Fabric: ASTM A 185, steel, welded wire fabric, plain.
   2. Reinforcement Bars: ASTM A 615/A 615M, Grade 60, deformed steel.

2.9 CATCH BASINS

A. Standard Precast Concrete Catch Basins: ASTM C 913, precast, reinforced concrete, of depth indicated, with provision for sealant joints. Precast units shall meet H-20 traffic loading condtions.

1. Base Section: 6-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section, and having separate base slab or base section with integral floor.
2. Top Section: Eccentric-cone type unless flat-slab-top type is indicated.
3. Joint Sealant: ASTM C 990, bitumen or butyl rubber.

B. Frames and Grates: ASTM A 536, Grade 60-40-18, ductile iron designed for A-16 (heavy traffic) structural loading unless otherwise indicated. Include 24-inch ID by 7-to 9-inch riser with 4-inch minimum width flange, and 26-inch- diameter flat grate with small square or short-slotted drainage openings, unless otherwise indicated.
1. Grate Free Area: Approximately 50 percent, unless otherwise indicated.

C. Triton Catch Basin Insert filters by Contech Stormwater Solutions Inc.

2.10 CLEANOUTS

A. Cleanout Covers: Alhambra Foundry Company, Inc. Model No. A-1240 or A1242, heavy duty lamphole frame and cover, or approved equal.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavating, trenching, and backfilling are specified in Section "Earthwork."

3.2 IDENTIFICATION

A. Materials and their installation are specified in Section "Earthwork." Arrange for installation of green warning tapes directly over piping and at outside edges of underground structures.
1. Use warning tapes or detectable warning tape over ferrous piping.
2. Use detectable warning tape over nonferrous piping and over edges of underground structures.

3.3 PIPING APPLICATIONS

A. General: Include Silt tight joints, except where water tight and soil tight joints are indicated.

B. Pipe Couplings: Use where indicated and where required to join piping and no other appropriate method is specified. Do not use instead of specified joining methods. Pipe couplings and fittings with pressure ratings at least equal to piping rating may be used in applications below, unless otherwise indicated.
1. Use non-pressure-type flexible couplings where required to join gravity-flow, non-pressure storm drain piping, unless otherwise indicated.
a. Shielded flexible couplings for same or minor difference OD pipes.
b. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.

3.4 PIPING INSTALLATION

A. General Locations and Arrangements: Drawings (plans and details) indicate the general location and arrangement of underground sewerage and drainage systems piping. Location and arrangement of piping layout take into account many design considerations. Install piping as indicated, to extent practical.

B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements. Maintain swab or drag in line and pull past each joint as it is completed. Verify existing elevations prior to extensive excavating and notify Architect of any discrepancies. Contractor shall be liable for any premature construction which must be modified due to unforeseen existing conditions.

C. Install gravity-flow-systems piping at constant slope between points and elevations indicated. Install straight piping runs at constant slope, not less than that specified, where slope is not indicated.

D. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

E. Install manholes for changes in direction if shown on plan, otherwise use fittings. Use fittings for branch connections unless direct tap into existing storm drain is indicated.

F. Extend drainage piping and connect to building's storm drains, of sizes and in locations indicated. Terminate piping as indicated.

G. Install gravity-flow, non-pressure drainage piping according to the following:
   1. Install piping pitched down in direction of flow, at minimum slope of 1 percent, unless otherwise indicated.
   2. Install hub-and-spigot, cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook."
   3. Install PVC sewer piping according to ASTM D 2321 and ASTM F 1668.
   4. Install Concrete Pipe and Fittings according to ACPA “Concrete Pipe Handbook” with the following seals. Concrete round pipe and fittings per ASTM C443 (ASTM C443M), rubber gaskets. Elliptical and Arch pipe: ASTM C877 (ATM C877M), Type I, sealing bands.

H. Clear interior of piping and manholes of dirt and superfluous material as work progresses.

3.5 PIPE JOINT CONSTRUCTION

A. General: Join and install pipe and fittings according to the following.

B. Install with top surfaces of components, except piping, flush with final finished surface.

C. Polyvinyl Chloride (PVC) Plastic Pipe and Fittings: As follows:
   1. Join solvent-cement-joint pipe and fittings with solvent cement according to ASTM D 2855 and ASTM F 402.
   2. Join pipe and gasketed fittings with elastomeric seals according to ASTM D 2321.

3. Join profile pipe and ribbed drain pipe and gasketed fittings with elastomeric seals according to ASTM D 2321 and manufacturer's written instruction.
4. Install according to ASTM D 2321.

D. System Piping Joints: Make joints using system manufacturer's couplings, except where otherwise specified.

E. Join piping made of different materials or dimensions with couplings made for this application. Use couplings that are compatible with and fit both systems' materials and dimensions.

3.6 TRENCH DRAINAGE SYSTEM INSTALLATION

A. Assemble and install components according to manufacturer's written instructions and as indicated.

B. Assemble and install components according to manufacturer's written instructions, ASME A112.3.1, and as indicated.

C. Install with top surfaces of components, except piping, flush with final finished surface.

D. Assemble channel sections to form slope down toward drain outlets. Use sealants, adhesives, fasteners, and other materials recommended by system manufacturer.

E. Embed channel sections and appurtenances in a 4-inch (100-mm) minimum depth of concrete around bottom and sides.

F. Fasten grates to channel sections if indicated.

G. Assemble trench sections with flanged joints.

H. Embed trench sections and appurtenances in a 4-inch (100-mm) minimum depth of concrete around bottom and sides.

I. Make piping connections and install stainless-steel piping with gasketed joints between system components.

3.7 MANHOLE INSTALLATION

A. General: Install manholes, complete with appurtenances and accessories indicated.

B. Install precast concrete manhole sections with sealants according to ASTM C 891.

C. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 3 inches above finished surface elsewhere, unless otherwise indicated.

3.8 CATCH BASIN INSTALLATION

A. Set frames and grates to elevations indicated. Ensure catch basin walls are properly sealed at the drain pipe penetrations.

B. Use extension rings if needed to achieve the necessary invert elevations.

C. Do not allow sump condition at the bottom of catch basin, unless specifically shown on the plans and details. If invert elevation of the outlet pipe is higher than the catch basin bottom, fill the bottom with concrete to the level of the outlet pipe invert. Slope the surface of concrete infill towards the outlet pipe.

3.9 CONNECTIONS

A. Connect non-pressure, gravity-flow drainage piping to building's storm drains specified in Division 15 Section "Storm Drainage Piping."

B. Make connections to existing piping and underground manholes.
   1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye fitting, plus 6-inch overlap, with not less than 6 inches of concrete with 28-day compressive strength of 3200 psi.

3.10 FIELD QUALITY CONTROL

A. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.
   1. Do not enclose, cover, or put into service before inspection and approval.
   2. Test completed piping systems according to requirements of authorities having jurisdiction.
   3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
   4. Submit separate report for each test.
   5. Hydrostatic Tests: Test storm drain according to requirements of authorities having jurisdiction and the following:
      a. Allowable leakage is maximum of 50 gal./inch of nominal pipe size per mile of pipe, during 24-hour period.
      b. Close openings in system and fill with water.
      c. Purge air and refill with water.
      d. Disconnect water supply.
      e. Test and inspect joints for leaks.
   6. Option: Test ductile-iron piping according to AWWA C600, "Hydrostatic Testing" Section. Use test pressure of at least 10 psig.
   7. Air Tests: Test storm drainage according to requirements of authorities having jurisdiction, UNI-B-6, and the following:
      a. Option: Test plastic gravity sewer piping according to ASTM F 1417.

B. Leaks and loss in test pressure constitute defects that must be repaired.

C. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

END OF SECTION

SECTION 33 51 00 – NATURAL GAS DISTRIBUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following for natural gas distribution outside the building:
   1. Piping.
   2. Valves.

1.3 DEFINITIONS

A. Gas Main: Utility's natural gas piping.

B. Gas Distribution: Piping from gas main to individual service-meter assemblies.

C. Point of Delivery: Piping outlet from service-meter assembly.

D. Natural Gas Piping: Piping that conveys natural gas from point of delivery to natural gas utilization devices inside the building.

E. PE: Polyethylene plastic.

1.4 PERFORMANCE REQUIREMENTS

A. Minimum Working-Pressure Ratings:
   1. Piping and Valves: 100 psig (690 kPa) minimum, unless otherwise indicated.

1.5 SUBMITTALS

A. Product Data: For the following:
   1. PE pipe and fittings.
   2. Valves.
   3. Meters.

B. Shop Drawings: For natural gas service piping and service meter assembly. Include plans, elevations, sections, details, and attachments to other work.

C. Field quality-control test reports.

1.6 QUALITY ASSURANCE

A. Product Options: Drawings indicate size, profiles, and dimensional requirements of valves and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."

B. Comply with requirements of utility supplying natural gas and with college authorities having jurisdiction for natural gas systems.

C. Comply with NFPA 54 for materials, installation, testing, inspection, and purging.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Handling Flammable Liquids: Remove and legally dispose of liquids from drips in existing gas piping. Handle liquids to avoid spillage and ignition. Notify gas supplier. Do not leave flammable liquids on premises overnight.

B. Preparation for Transport: Prepare valves for shipping as follows:
1. Ensure that valves are dry and internally protected against rust and corrosion.
2. Protect valves against damage to threaded ends, flange faces, and weld ends.
3. Set valves in the best position for handling. Set valves closed to prevent rattling.

C. Storage: Use the following precautions for valves during storage:
1. Do not remove end protectors, unless necessary for inspection; then reinstall for storage.
2. Protect valves from weather. Store valves indoors and maintain a temperature higher than ambient dew point temperature. Support valves off the ground or pavement in watertight enclosures when outdoor storage is necessary.

D. Handling: Use a sling to handle valves whose size requires handling by crane or lift. Rig valves to avoid damage to exposed valve parts. Do not use handwheels or stems as lifting or rigging points.

E. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent damage and entrance of dirt, debris, and moisture.

F. Protect stored pipes and tubes from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when stored inside.

G. Protect flanges, fittings, and piping specialties from moisture and dirt.

H. Store PE pipes and valves protected from direct sunlight. Support pipes to prevent sagging and bending.

1.8 PROJECT CONDITIONS

A. Perform site survey, research public utility records, and verify existing utility locations. Contact utility-locating service for area where Project is located.

B. Verify that natural gas distribution systems piping may be installed in compliance with original design and referenced standards.

C. Site Information: Subsurface conditions were investigated during design of Project. Reports of these investigations are available for informational purposes only; data in reports are not intended as representations or warranties of accuracy continuity of conditions (between soil borings). Owner assumes no responsibility of interpretations or conclusions drawn from this information.

1.9 SEQUENCING AND SCHEDULING

A. Coordinate connection to gas main with utility company and Campus Facility Manager.

B. Coordinate with pipe materials, sizes, entry locations, and pressure requirements of building natural gas piping systems.

C. Coordinate with other utility work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal:

1. Gas Valves, 2 Inches (50 mm) and Smaller:
   a. Homestead by Olson Technologies, Inc.
   b. Lancaster by National Meter Parts, Inc.
   c. Lunkenheimer Co.
   d. A.Y. McDonald Mfg. Co.
   e. Milliken Valve Co., Inc.
   f. Mueller Co., Grinnell Co.
   g. Mueller Steam Specialty Div., Core Industries, Inc.
   h. Nordstrum Valves, Inc.
   i. Resun by J.M. Huber Corp., Equipment Div.
   j. Rockford-Eclipse Div., Eclipse, Inc.

2. Plastic Gas Valves:
   a. Kerotest Manufacturing Corp.
   b. Perfection Corp., Gas Products Div.

2.2 PIPES AND FITTINGS

A. Refer to Part 3 "Piping Applications" Article for applications of pipe, fitting, and joining materials.

B. PE Pipe: ASTM D 2513, SDR 11.
   1. PE Fittings: ASTM D 2683, socket type or ASTM D 3261, butt type with dimensions matching ASTM D 2513, SDR 11, PE pipe.
   2. Transition Fittings: Type, material, and with end connections matching piping being joined.

2.3 JOINING MATERIALS

A. Refer to Part 3 "Piping Applications" Article for joining materials required for each system.

B. Threaded-Joint Compound and Tape: Suitable for natural gas.

C. Plastic-Pipe, Fusion-Joint Procedure: According to plastic pipe and valve manufacturers' written instructions.

D. Plastic-Pipe, Flanged-Joint Gasket Material, Bolts, and Nuts: Type and material recommended by piping system manufacturer for natural gas service, except where other type or material is indicated.

2.4 GAS VALVES

A. Manual Valves: Conform to standards listed, or where appropriate, valves according to ANSI Z21.15 and ANSI Z21.15a are acceptable.

B. Gas Valves, 2 Inches (50 mm) and Bigger: 125 psig (1035 kPa) WOG minimum, equivalent to ASME B16.33, lubricated, straightaway pattern, cast-iron or ductile-iron body. Include tapered plug, O-ring seals, square or flat head, and threaded ends.
   1. Option: Include locking (tamperproof) device feature.

C. Plastic Gas Valves: ASME B16.40, polyethylene (PE), SDR 11.

D. Valves for connection to existing gas mains include fittings that are compatible to the existing main and new branches. Pressure rating is 125 psig (860 kPa) minimum.

E. Valve Boxes: Cast-iron 2-section box. Top section includes cover with "GAS" lettering. Bottom section includes base of size to fit over valve and barrel approximately 5 inches (125 mm) in diameter. Valve box includes adjustable cast-iron extension of length required for depth to bury valve.
   1. Furnish 1 steel operating wrench with each valve box. Include tee-handle with 1 pointed end, stem of length required to operate valve, and socket fitting valve-operating nut.

2.5 IDENTIFICATION

A. Equipment Nameplates: Metal nameplate with operational data engraved or stamped and permanently fastened to equipment.
   1. Data: Manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and similar essential data.
   2. Location: Accessible and visible.

B. Engraved Plastic-Laminate Signs: ASTM D 709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white (letter color) melamine subcore, except when other colors are indicated.
   1. Fabricate in sizes required for message.
   2. Engraved with engraver's standard letter style in sizes and with wording to match equipment identification.
   3. Punch for mechanical fastening.
   4. Thickness: 1/16 inch (1.6 mm), for units up to 20 square inches (0.25 sq. m) or 8 inches (200 mm) long; 1/8 inch (3.2 mm) for larger units.
   5. Fasteners: Self-tapping stainless-steel screws or contact-type permanent adhesive.

C. Metallic-Lined Plastic Underground Warning Tapes: Polyethylene plastic tape with metallic core, 6 inches (150 mm) wide by 4 mils (.01 mm) thick, solid yellow color with continuously printed caption in black letters "CAUTION - GAS LINE BURIED BELOW."

PART 3 - EXECUTION

3.1 EARTHWORK

A. Refer to Section 31 20 00 "Earthwork" for excavating, trenching, and backfilling.

3.2 PREPARATION

A. Close equipment shutoff valves before turning off gas to premises or piping section.

B. Inspect natural gas piping according to fuel gas code to determine that natural gas utilization devices are turned off in piping section affected.

C. Comply with fuel gas code requirements for prevention of accidental ignition.

3.3 PIPING APPLICATIONS

A. Flanges, unions, and transition and special fittings with pressure ratings same as or higher than system pressure rating may be used, unless otherwise indicated.

B. Underground Piping: PE pipe, PE fittings, and heat-fusion joints.

C. Protective Conduit for Underground Piping: Steel pipe and threaded- or welding-type fittings.

D. PE-to-Steel Piping Connections: Transition fitting.

3.4 VALVE APPLICATIONS

A. Use gas valves of sizes indicated for gas service piping, meters, mains, and where indicated.

B. Use plastic gas valves on plastic gas distribution piping. Install on buried piping with valve box.

C. Use valve and fitting assemblies made for tapping gas mains for connections to existing gas mains.

3.5 JOINT CONSTRUCTION

A. Use materials suitable for natural gas service.

B. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full inside diameter. Join pipe fittings and valves as follows:
   1. Note the internal length of threads in fittings or valve ends and proximity of internal seat or wall to determine how far pipe should be threaded into joint.
   2. Apply tape or thread compound to external pipe threads.
   3. Align threads at point of assembly.
   4. Tighten joint with wrench. Apply wrench to valve end into which pipe is being threaded.
   5. Damaged Threads: Do not use pipe or pipe fittings having threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

C. Flanged Joints: Align flange surfaces parallel. Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly using torque wrench.

D. Plastic Pipe and Fitting Heat-Fusion Joints: Prepare pipe and fittings and join with heat-fusion equipment according to pipe manufacturer's printed instructions.
1. Plain-End Pipe and Fittings: Butt joining.
2. Plain-End Pipe and Socket-Type Fittings: Socket joining.

E. Piping Connections: Except as otherwise indicated, make piping connections as specified below.
1. Install unions, in piping 2 inches (50 mm) and smaller, adjacent to each valve and at final connection to each piece of equipment having a 2-inch (50 mm) or smaller threaded pipe connection.
2. Install flanges, in piping 2-1/2 inches (65 mm) and larger, adjacent to flanged valves and at final connection to each piece of equipment having flanged pipe connection.

3.6 PIPING INSTALLATION

A. Install underground, natural gas distribution piping buried at least 24 inches (600 mm) below finished grade.

B. Install underground, PE, natural gas distribution piping according to ASTM D 2774.

C. Install underground, PE, natural gas distribution piping at entrance to and under part of building in steel piping protective conduit that is vented to outside.

D. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where readily accessible to permit cleaning and emptying. Do not install where condensate would be subject to freezing.
1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches (75 mm) long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.

3.7 VALVE INSTALLATION

A. Install PE shutoff valves on branch connections to existing underground, natural gas distribution piping. Install valves with valve boxes.

3.8 CONNECTIONS

A. Extend and connect natural gas distribution piping from location specified on plan to building. The building's natural gas systems are specified in Division 15 Section "Natural Gas Piping Systems."
1. Terminate gas distribution system piping at building wall until building's natural gas piping systems are installed. Terminate piping with caps, plugs, or flanges, as required for piping material. Make connections to building's gas systems when those systems are installed.

3.9 ELECTRICAL BONDING AND GROUNDING

A. Install aboveground portions of natural gas piping systems that are upstream from equipment shutoff valves, electrically continuous, and bonded to grounding electrode according to NFPA 70.

B. Do not use gas piping as a grounding electrode.

3.10 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplates and signs on or near each service regulator, service meter, and earthquake valve.
   1. Text: In addition to identifying unit, distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.

B. Warning Tapes: Arrange for installation of continuous, underground, detectable warning tape over natural gas distribution piping during backfilling of trenches for piping.

C. Refer to Section 31 20 00 "Earthwork" for warning tapes.

3.11 PAINTING

A. Refer to Division 9 Section "Painting" for field-applied finishes.

B. Paint exposed metal piping, valves, service regulators, service meters and meter bars, and piping specialties except units with factory-applied paint or protective coating.

C. Damage and Touchup: Repair marred and damaged factory-applied finishes with materials and by procedures to match original factory finish.

3.12 FIELD QUALITY CONTROL

A. Test, inspect, and purge natural gas distribution according to requirements of fuel gas code and utility.

B. Repair leaks and defective valves and specialties and retest system until no leaks exist.

C. Report results in writing.

D. Verify correct pressure settings for service regulators.

END OF SECTION

APPENDICES

APPENDIX A

SPECIFICATION

VIBRO STONE COLUMN - AGGREGATE PIER GROUND IMPROVEMENT

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Include all design, material, construction, and testing requirements for the Vibro Stone Column (VSC) Aggregate Pier ground improvement to meet the performance criteria defined in this specification and on the Drawings for the proposed school expansion.

B. A Specialty VSC Contractor to provide all equipment, material, labor, and supervision to design and install VSC to meet the performance criteria defined in these specifications and on the plans. The design shall rely upon information presented in the contract documents, geotechnical report, and plans.

1.02 REFERENCES AND RELATED DOCUMENTS

A. ASTM D3441 - Standard Test Method for Mechanical Cone Penetration Testing of Soils.

B. Geotechnical Reports and addenda for the site.

C. State of California Department of Transportation (Caltrans) Standard Specification and Test Methods (Latest Edition).

D. California Building Code, Title 24 Part 2, Volume 1 and 2, Adopted Edition.

1.03 DEFINITIONS

A. VSC: a compacted rock column in the ground that reinforces the soil and increases the density of the adjacent soil thereby reducing liquefaction potential and related soil settlement. VSC is constructed with dry, bottom-feed vibratory methods.

B. Specialty VSC Contractor: The specialist subcontractor responsible for the design, construction, and performance of VSC ground improvement outlined in these specifications.

C. The Engineer shall be the Geotechnical Engineer of Record.

1.04 SUBMITTALS

A. The Specialty VSC Contractor to submit the following for review and approval by the Engineer at least 2 weeks prior to VSC mobilization:

1. Description of VSC ground improvement process providing all details of both the type and quantity of all equipment, the sequence and duration of construction activities, the type, and frequency of quality assurance procedures, and sources of all materials.

2. Test data on the stone to be used for the construction of the VSC. Test data shall demonstrate that the stone conforms to these specifications and be repeated if the stone's source changes.

3. VSC test section program as required in these specifications for approval by the Engineer.

4. Shop drawings showing the spacing and depth of the VSC to achieve the Performance Criteria outlined in these Specifications. The drawings to show dimensioned locations of the VSC with respect to existing facilities. Drawings shall be prepared, signed, and stamped by a registered professional engineer licensed in California.

5. Detailed calculations that are the basis for the proposed VSC plan. The calculations shall use analytical techniques that are based on widely-accepted industry practice such as that provided in, but not limited to, the Standards and Reference section of this Specification. The Engineer shall review all calculations prepared by the Specialty VSC Contractor.

B. The Specialty VSC Contractor to furnish a written, daily record with the information required in these specifications of VSC installation to the General Contractor and the Engineer within 48 hours of each VSC installed.

1.05 QUALIFICATIONS OF THE VSC CONTRACTOR TO BE SUBMITTED WITH BID

A. General: The Stone Column Contractor shall submit a Qualifications Package that demonstrates VSC experience. One (1) Contractor, the VSC Contractor, shall perform all parts of the VSC installation. The VSC Contractor shall be experienced in all aspects of VSC design and construction and shall furnish all necessary plant, materials, skilled labor, and supervision to complete the Contract. The VSC Contractor may be the Contractor bidding the job or a subcontractor.

B. Staff Experience: The VSC Contractor shall submit qualifications of the Project Superintendent, VSC Design Engineer, VSC Rig Operator(s) to be utilized on the project. The Project Superintendent shall be authorized to act on behalf of the VSC Contractor. The Project Superintendent shall have at least five (5) years of on-site experience managing VSC field operations of similar size and scope and shall have supervised at least two (2) projects

within the past five (5) years employing the VSC technique proposed for this project. The Project Superintendent shall have experience and knowledge of all aspects of VSC as required for the project and shall be present at the worksite at all times during VSC operations. The VSC Design Engineer shall have at least five (5) years of experience in the design/QC of VSC systems. The VSC Design Engineer shall be a Civil, Structural, or Geotechnical Engineer currently registered by the State of California. The VSC Design Engineer shall supervise review QC records and as-built drawings to confirm that the VSC work meets the design intent. The VSC Rig Operator(s) shall have at least three years of experience using the equipment selected for this project. VSC Contractor shall submit evidence of previous staff experience in the Qualifications Package Submittal. Personnel named in this package shall not be substituted without the express written consent of the Engineer.

C. Project Experience. The VSC Contractor shall submit evidence of experience and competence to design and construct the VSC. This evidence shall document that the VSC Contractor has at least five years of VSC experience; and has completed at least five (5) projects of similar scope to this project. The VSC Contractor shall submit information on prior projects in the Qualifications Package Submittal to document their qualifications. The projects must have the following characteristics to qualify as acceptable projects. Failure of the Qualification Package to meet these requirements may result in the rejection of the VSC Contractor.

1. Satisfactorily completed at least five (5) school projects with DSA/CGS involvement for liquefaction mitigation using VSCs, during the last three years.
2. At least five (5) projects show the independent and successful design and installation of structural VSC of similar or greater depth and length.
3. At least five (5) projects where the VSC Contractor implemented QA/QC programs during VSC treatment.
4. An ongoing project may be used to satisfy the experience requirements.
5. Qualifications Package Submittal: The Qualifications Package shall include project and staff experience. For project experience, the VSC Contractor shall submit detailed information on previous projects in the format listed below. The architect may contact any of the listed references to verify the accuracy of the information. Failure to provide accurate and complete information may result in the invalidation of the listed project.
    a. Name of person in charge of the project for the Contractor.
    b. Name of the project.
    c. Location of the project.
    d. Name of client/owner.

e. Name and telephone number of the person in charge of the project for the client. The contractor shall verify that all listed references and telephone numbers are current and complete.

f. A description of the project, including a detailed discussion of the work elements included in the construction.

1.06 PERFORMANCE CRITERIA

A. Specialty VSC Contractor is completely responsibility for the execution and performance of the soil improvement.

1. Geotechnical Engineer to review and approve that all treated ground has attained the required performance criteria in these specifications and required by field conditions.

B. Construct VSC beneath the buildings and in the areas shown on the contract documents and Drawings to meet the minimum requirements listed below:

1. The diameter of VSC should be 36 inches (nominal).

2. The maximum spacing between VSCs should be 8 feet.

3. The minimum depth of VSCs should be as shown on the drawings.

4. Minimum lateral limit of VSCs as shown on drawings.

5. Add additional row(s) of VSCs as shown on drawings where stone columns cannot extend out becauser of utilities or structures.

C. The average post-treatment differential settlement is not to exceed 2.88” over 40’ (0.006*L)

D. Following VSC improvement, complete one post CPT sounding per 4,000 square feet of the treatment area as located by and under the supervision of the Engineer.

1. Complete no less than two post CPTs per building.

2. Locate CPTs at the center of the grid of 4 or 3 columns.

3. Terminate each CPT at no less than 50 feet below the ground.

4. Complete the CPTs no earlier than 10 calendar days following VSC installation.

E. Submit calculations by the Specialty VSC Contractor to show the requirements of all the Performance Criteria specified herein have been satisfactorily achieved.

1. Analytical techniques used in the calculations are to be based on widely-accepted industry practices such as that provided in, but not limited to, the Standards and Reference section of this Specification.

2. The Engineer to review all calculations prepared by the Specialty VSC Contractor.

F. Specialty VSC Contractor to employ the specialty subcontractor to perform the CPT in accordance with ASTM D3441.

G. If any CPT probe does not meet the acceptance criteria specified in this Section, provide an additional two (2) CPT probes by the Specialty VSC Contractor in the vicinity of the failed test; as approved by the Engineer.

H. If the Performance Criteria are not met, the Specialty VSC Contractor is to install additional VSC and perform additional CPT verification testing in order to meet the Performance Criteria at no additional cost to the Owner.

1.07 QUALITY ASSURANCE

A. Required areas of treatment with VSC ground improvement are shown on the contract Drawings.

B. The Field Quality Control Representative (FQCR) shall be an independent approved engineering testing firm to provide Quality Assurance services. The FQCR may be the Geotechnical Engineer of Record provided they are DSA approved.

C. The FQCR:

1. Monitor the installation of VSC to verify that the production VSC installation methods are the same or similar to those used during the installation of the VSC test sections.

2. Monitor Pre and Post Cone Penetration Testing of the VSC ground improvement.

3. Report any installation or material discrepancies to the Engineer, Specialty VSC Contractor, and General Contractor.

1.08 EXISTING UTILITIES

A. The General Contractor shall field locate and verify the locations of all utilities prior to starting work. The General Contractor shall notify the VSC Contractor, Engineer, and Owner's Project Manager of any utility locations that may be impacted and may require relocation.

PART 2 PRODUCTS

2.01 STONE BACKFILL

A. Stone backfill (aka gravel, aggregate, or crushed rock) to be used in the VSC shall consist of hard, durable, clean, crushed rock or crushed concrete, free of vegetable matter, steel, and other deleterious substances.

1. Stone gradation to conform to the following requirements:

Sieve Size	Percent Passing
2 inch	100
1 inch	90-100
1/2 inch	5-80
No. 4	0-5

PART 3 EXECUTION

3.01 EXISTING PROPERTY CONDITION SURVEY

A. Inspect adjacent buildings, structures, and utilities within 15 feet of the VSC improvement area for pre-construction conditions. This work shall include a photo survey, elevation survey, and crack/damage survey.

B. If VSC vibrations cause any damage or movement of the adjacent buildings, structures, and utilities within 15 feet of the work, the following actions are to be taken:

1. Notify Engineer immediately, and;

2. Stop the work in the area, and;

3. Specialty VSC Contractor to propose remedial measures to conclude the work in the area, which require approval by the Engineer prior to continuing the work in the affected area.

3.02 SITE AND BUILDING PAD PREPARATION

A. Site Contractor to prepare the building pad to a stable condition to support a 150-ton crane or vibro rig and heavy rubber-tired loader equipment.

B. Perform VSC ground improvement following clearing and grubbing of the project site or building pad.

C. Re-grade the building pad to its condition prior to VSC treatment.

D. Grading, compaction, and certification of the building pad to be performed by the Contractor in accordance with the project manual and geotechnical requirements.

3.03 VSC CONSTRUCTION

A. The Specialty VSC Contractor to determine the method of VSC treatment and construction procedures, the specific equipment to be used, and the size and spacing of the VSC elements to achieve the Performance Criteria outlined in this Specification Section with the minimum requirements stated above. Such procedures and related information are subject to review by the Geotechnical Engineer during the submittal phase.

B. Utilize offset rows, generally forming an equilateral triangular array of VSC for layout.

C. Tolerance: Locate all VSC within 6 inches of the plan positions shown on the approved shop drawings.

D. Construct VSC in maximum stone lift thickness of 24 inches. Redrive each lift through with the vibrator/mandrel to achieve the increased density in the soil.

E. Where an unforeseen obstruction is encountered below the ground, inform the Engineer immediately. Should any obstruction be encountered during installation of VSC work, the General Contractor is responsible for removing such obstruction; alternatively, relocate or abandon the VSC, as approved by the Engineer.

3.04 TEST SECTIONS

A. Prior to VSC production work, the Specialty VSC Contractor to install one (1) VSC test sections within production areas approved by the Engineer with at least sixteen (16) VSC elements.

B. The Specialty VSC Contractor to propose a test program for the Engineer's approval.

C. The method of installation is to be monitored and recorded by the FQCR and includes the bottom depth of the vibrator, the average volume of rock placed into VSC, and total VSC installation time.

D. Test VSC test section for increased density by CPT no less than 10 calendar days after test section installation to confirm the performance criteria outlined in these specifications.

E. The Specialty VSC Contractor to employ the specialty testing subcontractor to perform the CPT in accordance with ASTM D3441.

F. Specialty VSC Contractor can go into production at its risk after performing the test section. All additional work required because of failing test section shall be responsible by VSC Contractor.

3.05 QUALITY CONTROL

A. VSC Inspections

1. Perform all VSC operations under the inspection of the FQCR.
2. Specialty VSC Contractor and the FQCR are to provide the monitoring and logging of VSC operations for production work.
3. The FQCR will provide site inspection to evaluate the performance of the VSC work.
    a. Inspection may include: Recording of pre-drill hole depth, observance of the Specialty VSC Contractor's procedures, and recording of compaction energy information.
4. Specialty VSC Contractor to provide access to the FQCR to observe the work, and to take samples, measurements, and tests as necessary for quality control purposes.

B. Construction Records: Specialty Geotechnical Contractor to keep written, daily records of the VSC treatment completed and shall submit signed copies of the records to the General Contractor and Engineer within two working days. The records shall show:

1. VSC identification number and date of installation for each VSC.
2. Elevation of the top and bottom of each VSC.
3. The average volume of stone in cubic feet placed in each VSC.
4. Average time of driving and raising of vibrator/mandrel per lift of stone.
5. Vibrator power consumption during penetration and compaction per 24 inches of VSC.
6. Total time to install each VSC.
7. Detailed documentation of obstruction, delays, and any unusual ground conditions.

END OF SECTION

APPENDIX B

SPECIFICATION

Deep Soil Mixing (DSM)

PART 1 - GENERAL

1.01 SCOPE

A. In accordance with the specifications contained in this Section and as shown on the Contract Drawings, the DSM Contractor shall furnish all plant, equipment, labor, and materials required to plan, develop mix design, and construct the Deep Soil Mixing (DSM) test section and production DSM at the locations and elevations indicated on the Contract Drawings and these specifications, and associated testing, monitoring, sampling, and recording to meet the performance requirements outlined in these Contract Documents.

B. The purpose of the DSM is to mitigate the liquefaction potential and limit differential settlement under the building area.

C. The scope of work shall include, but not limited to, the following:

1. Design for DSM.

2. Construction of the DSM.

1.02 RELATED DOCUMENTS

1.02.1. The DSM Contractor shall acknowledge that the following references have been received, read, and understood at the time of the bid.

1.03 DEFINITIONS

1. DSM: A soil-cement constructed by treating soils in situ by deep soil–cement mixing technology. The DSM shall consist of overlapping DSM columns in a single row or overlapping multiple columns.

2. Element: This is an inclusive term that refers to a DSM element produced by a single stroke of the mixing tools at a single equipment location. An element produced by a single-axis machine or a set of overlapping elements produced by a single stroke of a multiple shaft mixing tool is each considered an element. An element consisting of overlapping elements produced by a single stroke of a multiple-shaft mixing tool is sometimes referred to as a "panel".

3. Cement factor in place, cement dosage: Ratio of weight of dry cement to the volume of soil to be treated and the grout volume.

4. Grout: A stable mixture of water, Portland cement, and admixtures. The purpose of the grout is to assist in loosening the soils for penetration and optimum mixing, and upon

setting, to strengthen the in situ soil.

5. Grout–soil ratio: A volumetric ratio of grout to in situ soil to be mixed.

6. Volume ratio: Ratio of the volume of slurry injected to the volume of soil mixing column.

7. Spoil Return: All materials including, but not limited to liquids, semi-solids, and solids that are discharged above the ground surface during, or as a result of the DSM process.

8. Obstruction: Man-made or man-placed objects or materials occurring at or below the ground surface which unavoidably stops the progress of work for more than one (1) hour despite the DSM Contractor's diligent efforts.

1.04 SUBMITTALS

A. Complete fabrication, assembly, and installation drawings, together with details and data governing materials used, and other accessories furnished, shall be submitted for acceptance in accordance with the procedures outlined in Section 1A, "General." Data submitted shall include, but not be limited to the following:

1. Qualifications Package.

2. Grout Mix: Proposed mix designs including all materials and quantities.

3. Cement: Mill certificates

4. Manufacture information for each admixture

5. Field Test Program.

6. Deep Mixing Work Plan.

7. Workplan for the Quality Control Program.

8. Sample Daily Quality Control Report.

9. Daily Quality Control Reports shall be submitted at the end of the next working day.

10. Calibrations: Submit all metering equipment calibration test results including mixing systems, delivery systems, alignment systems, and mixing tool rotational and vertical speed.

11. DSM Test Results: Submit all QC test results.

12. Record Drawings: Submit record drawings indicating the location of the DSM in terms of project coordinates.

1.05 QUALIFICATIONS OF THE DSM CONTRACTOR TO BE SUBMITTED WITH BID

A. General: The DSM Contractor shall submit a Qualifications Package that demonstrates DSM experience. One (1) Contractor, the DSM Contractor, shall perform all parts of the DSM installation. The DSM Contractor shall be experienced in all aspects of DSM design and construction, and shall furnish all necessary plant, materials, skilled labor, and supervision to complete the Contract. The DSM Contractor may be the Contractor bidding the job or a subcontractor.

B. Staff Experience: The DSM Contractor shall submit qualifications of the Project Superintendent, DSM Design Engineer, DSM Rig Operator(s), and DSM Mixing Plant Operator(s) to be utilized on the project. The Project Superintendent shall be authorized to act on behalf of the DSM Contractor. The Project Superintendent shall have at least five (5) years on-site experience managing DSM field operations of similar size and scope and shall have supervised at least two (2) projects within the past five (5) years employing the DSM technique proposed for this project. The Project Superintendent shall have experience and knowledge of all aspects of DSM as required for the project and shall be present at the worksite at all times during DSM operations. The DSM Design Engineer shall have at least five (5) years of experience in the design/QC of DSM systems. The DSM Design Engineer shall be a Civil and Structural or Geotechnical Engineer currently registered by the State of California. The DSM Design Engineer shall supervise review QC records and as-built drawings to confirm that the DSM work meets the design intent. The DSM Rig and Mixing Plant Operator(s) shall have at least three years of experience using the equipment selected for this project. DSM Contractor shall submit evidence of previous staff experience in the Qualifications Package Submittal. Personnel named in this package shall not be substituted without the express written consent of the Engineer.

C. Project Experience. The DSM Contractor shall submit evidence of experience and competence to design and construct the DSM. This evidence shall document that the DSM Contractor has at least five years of experience over the last ten years; and has completed at least five (5) projects of similar scope to this project. The DSM Contractor shall submit information on prior projects in the Qualifications Package Submittal to document their qualifications. The projects must have the following characteristics to qualify as acceptable projects. Failure of the Qualification Package to meet these requirements may result in the rejection of the DSM Contractor.

1. Satisfactorily completed at least five (5) school projects with DSA/CGS involvement for liquefaction mitigation using DSMs, during the last three years.

2. At least five (5) projects showing the independent and successful design and installation of structural DSM of similar or greater depth and length.

3. At least five (5) projects where the DSM Contractor implemented QA/QC programs during DSM treatment and used computerized data acquisition systems; and

4. An ongoing project may be used to satisfy the experience requirements provided the qualifying work has been completed and accepted by the owner.

5. Qualifications Package Submittal: The Qualifications Package shall include project and staff experience. For project experience, the DSM Contractor shall submit detailed

information on previous projects in the format listed below. The architect may contact any of the listed references to verify the accuracy of the information. Failure to provide accurate and complete information may result in the invalidation of the listed project.

a. Name of person in charge of the project for the Contractor.

b. Name of the project.

c. Location of the project.

d. Name of client/owner.

e. Name and telephone number of the person in charge of the project for the client. The contractor shall verify that all listed references and telephone numbers are current and complete.

f. A description of the project, including a detailed discussion of the work elements included in the construction.

D. For staff experience, the DSM Contractor shall submit the names and resumes of the Project Superintendent, DSM Design Engineer, DSM Rig Operator(s), and DSM Mixing Plant Operator(s) to be utilized on the project.

1.06 PERFORMANCE CRITERIA

A. Perform appropriate Ground Improvement beneath areas of structures listed above as stated under the scope of work to provide the following criteria upon successful completion of each.

1. Post Construction Liquefaction induced differential settlement shall be less than:

a. ≤ 2.40 inches over 40 feet for the Mechanical Building

b. ≤ 0.50 inches over 154 feet for the Swimming Pool

2. DSM should be constructed to a depth sufficient to satisfy the criteria above, as confirmed by the testing specified herein.

3. The minimum area replacement ratio is defined as: area of GI/ the tributary area for a GI shall be 30%.

1.07 BENCH-SCALE TEST PROGRAM

A. The DSM Contractor shall submit a field demonstration test program plan that contains descriptions of the construction procedures, equipment, and ancillary equipment to be used for mixing and grout proportioning and injection; mix design(s)/cement dosage(s) and associated soil strata to be evaluated; operational and material parameters to be monitored during the field demonstration test program; layout of the DSM test elements to be constructed; a summary of QC/QA samples to be collected and tested for the test program; and examples of the forms that will be used to document the work.

B. Laboratory testing shall be used to identify initial mix designs for the bench-scale test program. Bulk soil samples from the site shall be obtained by the contractor.

C. Based on the results of the lab bench scale test results, the DSM Contractor shall submit a deep mixing work plan for review and acceptance by the Engineer.

D. It is important to recognize the bench-scale testing result and field obtain strength data can vary. The type of drill the DSM contractor uses, the number of blades, and its rotation, penetration rate, and pump rate all play a key role in determining the strength result.

1.08 DEEP MIXING WORK PLAN

A. Based on the results of the field demonstration test program, the DSM Contractor shall submit a deep mixing work plan for review and acceptance by the Engineer. This plan shall include the following items:

1. Detailed descriptions of a sequence of construction, all construction procedures, equipments (catalog cut sheets), batching and storage equipment layout, ancillary equipment to be used to penetrate the ground, proportion, mix binders and inject and mix the site soils.

2. Proposed mix design(s), including cement, water, and admixtures, and their relative proportions, the required mixing time, water-to-cement ratio of the grout, cement factor in place, and volume ratio for a deep mixed element. The mix design shall be stamped and signed by a Civil or Geotechnical Engineer who is currently registered by the State of California.

3. Proposed injection and mixing parameters, including mixing slurry rates, slurry pumping rates, air injection pressure, and volume flow rates, mixing tool rotational speeds, and penetration and withdrawal rates.

4. Methods for controlling and recording the verticality and the top and bottom elevation of each element.

5. Methods for monitoring the quality control parameters outlined in the quality control program and collecting samples for laboratory confirmation testing.

6. Methods for locating the DSM in the field and confirming that the DSM is plumb.

7. The anticipated cement dosages to achieve the acceptance criteria.

8. A proposed element numbering scheme.

9. Working drawings for the DSM elements showing the site location of the DSM project as well as the dimensions, layout, and locations of all DSM elements. Drawings shall indicate the identification number of every element if a multi-shaft mixing tool is used and every element if a single-auger mixing tool is used.

10. Sample Daily Quality Control Reports.

11. The GEOR or his representative shall perform the QC testing.

1.09 EXISTING UTILITIES

A. The General Contractor shall field locate and verify the locations of all utilities prior to starting work. The General Contractor shall notify the DSM Contractor, Engineer, and Owner's Project Manager of any utility locations that may be impacted and may require relocation.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Grout: The material added to the blended in situ soils shall be a Portland cement grout. The purposes of the grout are to assist in loosening the soils for penetration and optimum mixing, and upon setting, to strengthen the in-situ soils. The grout shall be premixed in a mixing plant that combines dry materials and water in predetermined proportions. Ratios of the grout components shall be proposed by the DSM Contractor, confirmed during the field test program, and reviewed and accepted by the Architect. Once accepted, the grout composition shall not change unless requested in writing from the DSM Contractor and accepted in writing by the Engineer.

B. Cement: The cement used in preparing the grout shall conform to ASTM C 150 Type II/V PCC. The cement shall be adequately protected from moisture and contamination while in transit to and in storage at the job site. Reclaimed cement or cement containing lumps or deleterious matter shall not be used.

C. Water: Water used in mixing cement grout shall conform to ASTM C 1602.

D. Admixtures: Admixtures of softening agents, dispersions, retarders, or plugging or bridging agents may be added to the water or the grout to permit efficient use of materials and proper workability of the grout provided the DSM Contractor submits documentation demonstrating the effects of the admixture. Admixtures shall be accepted by the Engineer before use.

2.02 EQUIPMENT

A. Deep mixing equipment shall be of sufficient size, capacity, and torque to perform the required deep mixing to the desired depths. Characteristics of deep mixing equipment are as follows:

B. Drilling Equipment: The equipment shall be capable of advancing through previously installed elements to achieve designed overlapping or remixing as needed and be sufficient to maintain the necessary revolutions per minute and penetration rate at the maximum depth to achieve thorough mixing.

1. The mixing and injection equipment shall be sufficient to adequately blend and distribute the binder with the in-situ soils to provide the required strength. The mixing

shafts shall have mixing augers and blades (paddles) configured in such a manner so that they are capable of thoroughly blending the in-situ soils andgrout.

2. The power source for driving the mixing shafts shall be sufficient to maintain the required revolutions per minute (RPM) and penetration rate from a stopped position at the maximum depth required.

C. Equipment Instrumentation: All equipment shall have monitoring equipment to permit accurate and continuous monitoring, recording, and controlling of mixing tool depth, location, binder volume flow rates, and density, binder injection pressures and quantities, tool rotational speeds, tool advancement, and withdrawal rates.

1. The output from these sensors, the cement factor in place, and the number of mixing cuts per unit depth shall be visible in real-time to the operator and QC Inspector during penetration and withdrawal.

2. The proposed display and monitoring systems shall be submitted and accepted by QC Inspector prior to use.

3. Calibration of this equipment shall be performed at the beginning of the project and the calibration data shall be submitted to QC Inspector. The calibration shall be repeated at intervals not to exceed two (2) months.

D. In the event that equipment instrumentation becomes partially or fully inoperable, the DSM Contractor shall repair the instrumentation system and bring it to a fully operational state. DSM construction is not allowed without instrumentation unless there is a safety hazard by not continuing the work. The DSM rig shall be equipped with electronic sensors built into the leads to determine vertical alignment in two (2) directions.

1. The sensors shall be calibrated at the beginning of the project and the calibration data shall be submitted to QC Inspector. The calibration shall be repeated at intervals not to exceed two (2) months.

2. The output from the sensors shall be routed to a console that is visible to the operator and QC Inspector during penetration. The console shall be capable of indicating the alignment angle in each plane.

E. Grout Mixing: Grout shall be premixed in a mixing plant, using a batch process, which combines dry materials and water in predetermined proportions. The mixing plant shall consist of a grout mixer, grout agitator, grout pump, and a computer control/measurement unit.

1. Dry materials shall be stored in silos. The dry materials shall be transported to the project site and blown into the on-site storage tanks using a pneumatic system.

2. The air evacuated from the storage tanks during the loading process shall be filtered before being discharged to the atmosphere.

3. Automatic batch scales or calibrated auger shall be used to accurately determine mix proportions for water and cement during grout preparation.

4. The dry admixtures, if used for mixing with water and cement, may be delivered to the mixing plant by a calibrated auger. However, the DSM Contractor shall demonstrate that the calibrated auger can deliver the quantity of dry admixture with accuracy equivalent to that measured and delivered by weight.

5. The grout density shall be measured by a mud balance or a mass flow meter before it is sent to the mixing rig.

6. Calibration of mixing components shall be done at the beginning of the project and repeated at intervals not to exceed two (2) months thereafter.

7. The cement shall be adequately protected from moisture and contamination while in transit to and in storage at the job site. Reclaimed cement or cement containing lumps or deleterious matter shall not be used.

8. Positive displacement pumps shall be used to transfer the grout from the mixing plant to the DSM equipment. The grout shall be delivered to each slurry–injection point by an individual positive displacement pump.

PART 3 - EXECUTION

3.01 FIELD TEST PROGRAM

A. Prior to production work, the DSM Contractor shall construct a test section to verify that the DSM Contractor's proposed equipment, procedures, and mix design can uniformly mix the onsite soils to the target depth(s) and achieve the product requirements outlined in the acceptance criteria. The field test program shall be used to optimize the various components of the DSM process, such as type of mixing equipment (e.g. single, double, or triple-axis), grout mix composition, rotational speed, penetration, and retraction rates, and confirm that results create soil-cement properties that meet required design criteria. The DSM Contractor shall construct more than one (1) test section if multiple mix designs/cement dosages are proposed.

B. The DSM Contractor can begin production work before test program results are available at its sole risk.

C. The DSM Contractor shall submit a plan drawing showing the location of the test section elements.

D. One (1) test section shall be constructed for each initial DSM mix design/cement dosage the DSM Contractor proposes to evaluate in the field demonstration test program and possibly use for the production DSM. A test section is defined as a continuous secant-type DSM section at least 15 linear feet long and of the depth and arrangement shown on the contract drawings. The cement dosage used for the accepted test section shall be required for use in the production DSM construction.

E. Equipment, procedures, accepted mix design, and element layout used on the test section shall be identical to those proposed for the production DSM construction.

F. The DSM Contractor shall perform full-depth core sampling and the related laboratory UCS testing for each test section in accordance with the Quality Control Program.

G. The DSM Contractor shall submit to the Engineer results of the test program and recommend grout mix, procedure, and equipment parameters based on those results. The DSM Contractor, at their expense, may be required to repeat construction of a test section if recommended parameters fall outside test requirements. The test program shall confirm that the resultant test section geometry and soil-cement properties meet the required design criteria before production work commences.

3.02 PRODUCTION DSM

A. The DSM Contractor shall proceed with construction of the production DSM after results of the field test program have been accepted by the Engineer. The DSM Contractor shall take all the risks, if he proceeds with the production prior to the approval of the field test program by the Engineer.

B. The DSM Contractor is responsible for the survey and site layout of each column to within 3

inches of the design coordinates. Due to the construction procedure of the Deep Soil Mixing operation, a daily re-layout of target locations is required. The layout can also be done by the DSM Contractor's QA/QC representative with oversight by a licensed professional engineer. The General Contractor is responsible for grading a suitable working platform at the site capable of supporting the weight of the drill and other equipment and allowing movement from location to location without difficulty.

C. The DSM shall have essentially vertical elements and shall extend through the on-site soils to the elevations required by the contract drawings.

D. The completed DSM elements shall be a homogeneous mixture of grout and in-situ soils. Mixing is to be controlled by shaft rotational speed, drilling speed, and grout injection rate.

E. The DSM Contractor shall determine the average target DSM strength, thickness, and depth(s).

F. The overlap of elements and constant center-to-center spacing between adjacent elements shall conform to the contract drawings. A vertical alignment of 1.5 percent shall be maintained during the DSM installation.

G. Monitoring of construction parameters and confirmation testing will be used to verify that the acceptance criteria have been satisfied.

1. The DSM Contractor shall establish consistent procedures to be employed during DSM construction to ensure a relatively uniformly mixed product is created.

2. These procedures are to be defined in the deep mixing work plan and subsequently modified, if necessary, based on the results of the test section(s).

3. Prior to beginning production DSM installation, the DSM Contractor shall construct test section(s) in the area shown on the Contract Drawings, and results of the test section program shall be accepted by the Engineer.

4. The purpose of the test sections is to verify that the DSM Contractor's proposed equipment, procedures, and mix design can uniformly mix the on-site soils to the target depth(s) and achieve the required DSM strength(s).

5. Based on the evaluation of completed in–place test sections, the Engineer will determine if the test sections yield acceptable results and whether the DSM Contractor may proceed with the production DSM construction.

    a. The cement factor in place, equipment, installation procedures, and sampling and testing methods established during the test sections shall be used for the production DSM construction.

6. The DSM Contractor may request that the established cement factor in place, equipment, installation procedure, or test methods be modified. The Engineer may require additional testing or a new test section, at no additional cost to the owner, to verify that acceptable results can be achieved using the modification(s).

7. The DSM Contractor shall not employ cement factor in place, equipment, installation procedures, or sampling or testing methods unless accepted by the Engineer in writing.

H. The DSM Contractor shall conduct sampling and testing of the production DSM using the same methods employed during the test sections and in accordance with the requirements listed in the Quality Control Program.

1. For the production DSM construction, the following minimum frequency shall be instituted: Collect full–depth continuous core of the DSM for a minimum of 2% of the DSM locations.

2. Perform UCS tests on wet (grab) specimens in accordance with the requirements of the Quality Control Program.

3.03 MATERIAL ACCEPTANCE CRITERIA

A. The in-place grout mix together with the soils shall achieve:

1. A minimum unconfined compressive strength (UCS) at 28 days of 150 psi and shall be determined by ASTM D 1633 "Standard Test Method for Compressive Strength of Molded Soil-Cement Cylinders"

2. No more than ten (10) percent of the wet samples or ten (10) percent of the core samples tested for each building shall exhibit a UCS of less than 75 psi at 28 days.

3. A pattern of low-strength samples, such as at a constant depth will not be accepted.

4. Uniformity of soil-cement shall meet the requirement as outlined in Section 3.05.

3.04 GEOMETRIC ACCEPTANCE CRITERIA

A. The DSM Contractor shall accurately stake the location of the proposed DSM shown on the Contract Drawings before beginning installation.

B. The DSM shall be installed within the following geometric tolerances:

1. The horizontal alignment of the DSM shall be within three (3) inches of the planned location at the top of DSM.

2. The vertical inclination of the DSM shall be inclined no more than 1.5 percent from vertical.

3. The element overlaps and constant center-to-center spacing between adjacent elements shall conform to the contract plan and the vertical alignment of 1.5 percent shall be maintained during the DSM installation.

C. The DSM Contractor shall provide an adequate method to allow QC Inspector to verify the as-built location of the DSM during construction.

1. The DSM Contractor shall not be compensated for DSM sections that are located outside of the specified tolerances.

D. The equipment operator shall control the vertical alignment of the DSM element. Two (2) measures of the drill rig mast verticality shall be monitored, longitudinal and transverse to the DSM alignment. The DSM elements shall be installed at an inclination deviating no more than 1.5 percent from vertical at any point.

E. DSM depths shall be determined by the DSM Contractor.

1. The equipment shall be adequately marked to allow QC Inspector to confirm the penetration depth during construction. The total depth of penetration shall be measured either by observing the length of the mixing shaft inserted below a reference point on the mast, or by subtraction of the exposed length of the shaft above the reference point from the total shaft length, or by electronic depth encoder.

2. The final depth of the stroke shall be noted and recorded on the Daily Quality Control Report by the DSM Contractor.

3. If rigs with varying mixing shaft lengths are used, the shortest shafts shall extend to the minimum District-accepted DSM depth(s) provided by the DSM Contractor.

3.05 UNIFORMITY OF MIXING ACCEPTANCE CRITERIA

A. Uniformity of mixing shall be evaluated by QC Inspector based on the full–depth core samples recovered by the DSM Contractor from the DSM.

1. To evaluate uniformity using core samples, all lengths of the unrecovered core shall be assumed to be unimproved soil.

2. Uniformity shall be determined by QC Inspector through inspection of core samples. A full-depth core is defined as a full–length continuous coring operation at a single location that extends from the top to the bottom of the DSM element.

3. Recovery shall be at least 85 percent for each full-depth core. In addition, continuous core recovery shall be at least 85 percent over any 5-foot core run. If 85% cannot be confirmed by coring in sandy or gravelly soils, the DSM Contractor at no extra cost may propose optical viewer logs to confirm uniformity.

4. Within a full-depth core, the sum length of unmixed or poorly mixed soil regions or lumps that extend entirely across the diameter of the core sample (2.5 inches) shall not exceed 10 percent of the entire recovered core length of a DSM element. In addition, lumps of unimproved soil shall not be more than 15 percent of the total volume of any 5-foot section interval of the full-depth core. Any individual or aggregation of lumps of unimproved soil shall not be larger than six (6) inches in the greatest dimension. If there are excessive mechanical damages to the recovered cores, the DSM Contractor is allowed to perform additional core(s) in the same or adjacent soil mixing column(s) at the DSM Contractor’s expense.

B. If any section of the DSM is found not to satisfy the above criteria, the DSM Contractor shall mitigate (while injecting grout at the design grout ratio) the failed section of the DSM at no additional cost to the owner.

1. Unless otherwise determined by the Engineer, the extent of the failed section shall be considered to include all DSM sections constructed during all rig shifts that occurred between the times of construction when passing tests were achieved, i.e., within the wet sampling interval. The DSM Contractor may conduct additional sampling and testing to better define the limits of the failed area at no additional cost to the owner.

2. The DSM Contractor shall submit a proposed remixing/repair plan of failed section(s) for review and acceptance by the Engineer.

3.06 OBSTRUCTIONS

A. The DSM Contractor shall be responsible to penetrate and mix some dense sand layers and stiff clay layers, which may need pre-drilling at no cost to the owner. If an obstruction is encountered that prevents pre-drilling advancement, the DSM Contractor shall immediately notify the Engineer and Owner's Project Manager and investigate the location and extent of the obstruction using methods accepted by the Engineer. The DSM Contractor shall propose remedial measures to clear the obstruction for acceptance by the Engineer and Owner's Project Manager. The DSM Contractor will be compensated for removal or clearing of obstructions with prior acceptance from the Engineer. If the element cannot be installed at the design location due to obstructions, the element shall be relocated as directed by the Engineer and Owner's Project Manager.

B. While the investigation for obstruction is underway, the DSM Contractor shall continue to install elements in areas away from the obstruction location. No stand–by delay will be allowed for equipment and operations during the investigation of obstruction.

C. The DSM Contractor shall be compensated for removal or clearing of unknown obstructions with prior acceptance by the Engineer.

3.07 GROUT PREPARATION

A. Dry binders shall be stored in silos and fed to mixers for agitation and shearing. In order to accurately control the mixing ratio of grout, the addition of water and cement shall be determined by weight using the automatic batch scales in the mixing plant, or the real-time grout-specific gravity measurement.

1. The admixtures, if used, for mixing with water and cement, can be delivered to the mixing plant by a calibrated auger. However, the DSM Contractor shall prove that the calibrated auger can deliver the quantity of dry admixture with accuracy equivalent to that measured and delivered by weight.

B. A minimum mixing time of three minutes and a maximum holding time of three (3) hours shall be enforced for the grout.

1. The specific gravity of the (grout) shall be determined during the design mix program. The specific gravity of the grout shall be checked by the DSM Contractor at least two times per shift per rig using the methods outlined in ASTM D 4380. If the grout is batched by the jet valve method, the specific gravity shall be measured in real-time during production. The specific gravity of the grout measured in the field shall not deviate by more than 3 percent of the calculated specific gravity for the design cement ratio.

2. If the grout density deviates by more than 3 percent, the DSM Contractor should recalibrate monitoring equipment and perform additional testing as required at no additional cost to the owner. The DSM Contractor may also adjust cement or water quantities appropriately and retest at no additional cost to the owner.

3. The grout hold time shall be calculated from the beginning of the initial mixing.

4. The specific gravity measurements shall be indicated on the Daily Quality Control Report.

3.08 SOIL–GROUT MIXING

A. Installation of each element shall be continuous without interruption. If an interruption of more than one (1) hour occurs, the element shall be remixed (while injecting grout at the design grout ratio) for the entire height of the element at no additional cost to the owner.

B. The completed DSM shall be a uniform mixture of cement grout and the in situ soils.

1. Soil and grout shall be mixed together in place by specially designed blades on the mixing shafts.

2. The grout shall be pumped through the mixing shafts and injected from the bottom of the mixing tool. The mixing tool shall break up the soil and blend it with cement grout.

3. The mixing action of the tool shall blend, circulate, and knead the soil over the length of the element while mixing it in place with the grout.

4. Over any five (5)–foot section of an element, the lumps of unimproved soil shall not amount to more than fifteen (15) percent of the total volume of the DSM segment and any individual lump or aggregationof lumps of unimproved soil shall be no larger than six (6) inches in greatest dimension.

3.09 SHAFT ROTATIONAL SPEED AND PENETRATION/WITHDRAWAL RATE

A. The mixing shaft rotational speed (measured in RPMs) and penetration/withdrawal rates may be adjusted to achieve adequate mixing. The required rotational speeds and penetration/withdrawal rates for the various soil layers encountered shall be determined during the test sections.

B. The shaft rotational speed shall be adequate during penetration and withdrawal to achieve

the design blade rotation number. The blade rotation number is defined as the number of the blade cut through one (1) meter of soil. The rotational speeds and penetration/withdrawal rates shall be recorded on the Daily Quality Control Report.

C. The cementing factor in place and the blade rotation number determined during the test section shall be used during the balance of the work. If these parameters are varied less than 85 percent from those determined during the test sections, the DSM section shall be remixed (while injecting grout at the design grout ratio) to a depth at least three (3) feet below the deficient zone at no additional cost to the owner.

D. The DSM Contractor may request that the established mixing parameters be modified during the production DSM installation. To verify acceptable results for the modified parameters, the Engineer may require additional testing or a new test section at no additionalcost to the owner.

3.10 GROUT INJECTION RATE

A. The grout injection rate per vertical foot of the element shall be in accordance with the requirements of the design mix.

1. The required mix design and cement factor in place shall be determined during the test sections.

2. The grout injection rate shall be constantly monitored and controlled.

3. The DSM Contractor shall record the volume of grout injected for each three (3) vertical feet of each element on the Daily Quality Control Report.

B. If the volume of grout injected per vertical foot of element is less than eighty-five (85) percent of the amount required to meet the grout–soil ratio established during the test sections, the DSM shall be remixed and additional grout injected (at the design grout– soil ratio) to a depth at least three (3) feet below the deficient zone, at no additional cost to the owner.

C. The DSM Contractor may request that the established cement factor in place be modified during the production DSM installation.

1. To verify acceptable results for the modified cement factor in place, the Engineer may require additional testing or a new test section at no additional cost to the owner.

3.11 CONTROL OF SPOILS

A. The DSM Contractor shall control and process all spoils created during the DSM construction.

1. The areas designated by the owner shall be used for containment and processing of the spoils.

2. Positive means shall be provided for containing all spoil returns, flush water, and other

waste materials within the work area.

3. All sedimentation and turbidity control measures required by applicable Federal, State, and local regulations shall be implemented. Precautions and measures shall be implemented to prevent any spoil returns or other waste material fromentering storm drain structures, drainage courses, or leaving the site via surface drainage. If spoil returns or other waste materials enter such areas, the DSM Contractor shall be responsible for immediately and completely cleaning and removing these materials to the acceptance of the owner and at no cost to the owner.

3.12 QUALITY CONTROL PROGRAM

A. General.

1. The DSM Quality Control (QC) Program shall be the responsibility of the DSM Contractor and shall include, as a minimum, the following components:

   a. Construction of at least one (1) test section by the DSM Contractor;

   b. Construction of additional test sections when the DSM Contractor proposes to evaluate multiple grout mix/cement dosages;

   c. Field monitoring by the DSM Contractor of construction parameters during DSM construction;

   d. Sample collection including full depth continuous coring, and wet sampling, along with testing performed by the DSM Contractor;

   e. Reporting of the field monitoring, sampling, and any strength testing performed by the DSM Contractor.

2. The DSM Contractor shall provide all the personnel and equipment necessary to implement the Quality Control Program.

   a. Prior to site mobilization, the DSM Contractor shall submit a detailed work plan for the Quality Control Program for review and acceptance by the Engineer.

   b. The work plan shall include, as a minimum, a description of all procedures to be implemented, parameters to be monitored, tolerances for the parameters monitored, and the names of any subcontractors used for testing.

3. Following the test sections, the DSM Contractor may revise the Quality Control Program.

   a. The established quality control procedures shall be maintained throughout the production DSM installation to ensure consistency in the DSM installation and to verify that the work complies with all requirements indicated in the Contract Plans and Specifications.

B. Sample Collection and Strength Testing

1. The acceptance of the work shall be based on demonstrating that the in-place grout mix together with the soils has achieved the strength and uniformity requirements.

2. Confirmation that the strength and uniformity requirements have been satisfied will be determined by a series of tests performed on samples collected by the DSM Contractor. Confirmation sample collection and testing shall include:

   a. Full-depth continuous coring and testing: Full–depth continuous coring performed by the DSM Contractor and QA laboratory UCS testing conducted on the core samples by the GEOR laboratory.

   b. Wet (grab) soil mix samples: Wet samples that are retrieved and cast into molds by the DSM Contractor and QC laboratory UCS testing by the GEOR laboratory.

   c. Additional confirmation testing: The DSM Contractor, at its own expense, may perform borehole imaging.

3. Full–Depth Coring, Sampling and Testing: Continuous coring shall be performed for the full depth of the DSM by the DSM Contractor.

   a. Full–depth samples obtained by the DSM Contractor shall have a diameter of at least 2.5 inches. The full–depth samples shall be obtained along an essentially vertical alignment located one–fourth of an element diameter from the element center.

   b. Full–depth samples shall be retrieved using standard continuous coring techniques after the soil–grout mixture has hardened sufficiently.

   c. For the continuous coring method, each core run shall be at least five (5) feet in length and contain at least five (5) test specimens with a length to diameter ratio of 2, or greater.

      1) A minimum recovery of 85 percent for each five (5)–foot–long core run shall be achieved. During coring, the elevation of the bottom of the holes shall be measured after each core run in the order that the core recovery for each run can be calculated. If 85% cannot be confirmed by coring in sandy or gravelly soils, the DSM Contractor at no extra cost may propose optical viewer logs to confirm uniformity.

      2) The DSM Contractor shall determine the time interval between element installation and coring except that the interval shall be no longer than required to conduct twenty-eight (28)–day strength testing.

   d. Upon retrieval, the full–depth samples shall be logged and test specimen selection.

1) Field logging will be performed to determine if the uniformity and recovery criteria have been satisfied.

2) Following logging, select four (4) to ten (10) specimens from each full–depth sample recovered for QA UCS strength testing.

3) Following logging and test specimen selection the entire full–depth sample, including the designated test specimens, shall be immediately sealed in plastic wrap to prevent drying. The designated test core specimens for QA testing will be transported to the GEOR laboratory.

4) All core holes shall be filled with cement grout that will obtain a twenty-eight (28)–day strength equal to or greater than the strength of the DSM.

e. QA strength testing shall be conducted on core samples.

1) The core samples shall be stored in a moist room in accordance with ASTM C 192 until the test date.

2) UCS tests shall be conducted on core samples at the design target cure age in accordance with ASTM D 1633.

3) The remaining portions of the full–depth samples that are not tested shall be retained by the DSM Contractor, until completion and acceptance of all DSM sections, for possible inspection and confirmation testing.

4. Wet Sample Collection and Testing: Wet (grab) samples shall be retrieved and cast into molds by the DSM Contractor from a minimum of one column per work shift per rig, at one random depth.

a. Samples shall be retrieved using an in-situ wet sampler immediately after element construction and shall consist of no fewer than six (6) specimens per sampling event. The specimens shall be in (3)-inch by six (6)-inch cylindrical molded.

b. UCS shall be conducted on wet specimens in pairs at selected ages in accordance with ASTM D 1633, including the design target cure age. Results of wet specimens tested before the design target cure age may be used to provide an early indication of DSM strength and the trend of strength increase with curing time, and to evaluate whether the work of the DSM Contractor can achieve the average target UCS criteria.

5. Daily Quality Control Report.

a. The DSM Contractor shall submit Daily Quality Control Reports to the Engineer at the end of the next working day in an electronic file or by hard copy. The Daily Quality Control Report shall document the progress of the DSM construction, present the results of the QC parameter monitoring, and clearly indicate if the

elements have met the acceptance criteria.

b. The Daily Quality Control Report shall include as a minimum the results of the following QC parameter monitoring for each element:

1) Rig number.

2) Type of mixing tool.

3) Date and time (start and finish) of element construction.

4) Element number and reference drawing number.

5) Element diameter.

6) Element top and bottom elevations.

7) Grout mix design designation.

8) Slurry-specific gravity measurements.

9) Description of obstructions, interruptions, or other difficulties during installation and how they were resolved.

c. The Daily Quality Control Reports shall also include the following parameters recorded automatically or manually for each element at intervals no greater than four (4) feet and submitted in the form of either table or figures:

1) Elevation in feet vs. real-time.

2) Shaft rotation speed in RPMs vs. real-time.

3) Penetration and withdrawal rates in feet per minute vs. real-time.

4) Grout injection rate in GPM vs. real-time.

5) Grout specific gravity vs. time.

6) The cement factor in place vs. depth.

7) The blade rotation number vs. depth.

3.13 AS-BUILT DRAWINGS

A. Following DSM construction, the DSM Contractor shall submit as-built drawings of the DSM in terms of project coordinates.

END OF SECTION