PROJECT MANUAL

FOR

STRUCTURAL UPGRADE OF REMAINING PORTIONS OF EXISTING BUILDING Y

1111 EAST ARTESIA BLVD.
COMPTON, CA 90221-5393

COMPTON COLLEGE
COMPTON COMMUNITY COLLEGE DISTRICT

DSA SUBMITTAL SPC
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PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Testing and inspection services to meet requirements of the California Building Code (CBC) and the Division of the State Architect (DSA).

B. Related Requirements:

1. Section 03 2000 – Concrete Reinforcing.
2. Section 03 3000 – Cast-in-Place Concrete.
3. Section 05 1200 – Structural Steel Framing.
4. Section 06 1000 – Rough Carpentry.

1.2 REFERENCES

A. American Concrete Institute (ACI):

1. ACI 318 – Building Code Requirements for Structural Concrete and Commentary.

B. American Institute of Steel Construction (AISC):

1. AISC 360 – Specification for Structural Steel Buildings.
2. AISC 341 – Seismic Provisions for Structural Steel Buildings.

C. ASTM International (ASTM):

1. ASTM A108 – Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished.
2. ASTM A370 – Standard Test Methods and Definitions for Mechanical Testing of Steel Products.
3. ASTM A706 – Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement.
4. ASTM C31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field.

5. ASTM C172 - Standard Practice for Sampling Freshly Mixed Concrete.

6. ASTM E164 - Standard Practice for Contact Ultrasonic Testing of Weldments.

7. ASTM E488 - Standard Test Methods for Strength of Anchors in Concrete Elements.

8. ASTM E543 - Standard Specification for Agencies Performing Nondestructive Testing.

9. ASTM F606 - Standard Test Methods for Determining the Mechanical Properties of Externally and Internally Threaded Fasteners, Washers, Direct Tension Indicators, and Rivets.

D. Association of the Wall and Ceiling Industry (AWCI):

1. AWCI Technical Manual 12-B - Standard Practice for the Testing and Inspection of Field Applied Thin Film Intumescent Fire-Resistive Materials; an Annotated Guide.

E. American Welding Society (AWS):

1. AWS D1.1 – Structural Welding Code.

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

3. AWS D1.8 – Structural Welding Code – Seismic Supplement.

F. Division of the State Architect (DSA) Interpretation Regulations (IR):

1. DSA IR 17-2 – Nondestructive Testing (N.D.T.) of Welds.

2. DSA IR 17-3 – Structural Welding Inspection.

3. DSA IR 17-8 – Sampling and Testing of High Strength Bolts, Nuts and Washers.

4. DSA IR 17-9 – High Strength Bolting Inspection.

5. DSA IR 17-10 – Sampling, Testing and Tagging of Reinforcing Bars.

6. DSA IR 17-11 – Identification, Sampling and Testing of Threaded Steel Anchor Bolts and Anchor Rods.

1.3 REGULATORY REQUIREMENTS

A. Laboratories performing testing shall have DSA's Laboratory Evaluation and Acceptance Program approval prior to providing material testing or special inspection services.

B. Tests of materials and inspections shall be in accordance to Section 4-213 through 4-219 of the California Building Standards Commission's, California Administrative Code.

C. Required material testing, inspections and special inspections are indicated on the DSA approved DSA-103, Listing of Structural Tests & Special Inspections (T&I List). OAR will provide CONTRACTOR copy of DSA-103.

1.4 TESTS

A. OWNER will contract with a DSA approved testing laboratory to perform the testing indicated on the Contract Documents, including the Tests and Special Inspections (T&I) list.

B. Selection of material to be tested shall be by the Testing Laboratory and not by CONTRACTOR.

C. Any material shipped from the source of supply prior to having satisfactorily passed such testing and inspection, or prior to the receipt of notice from Project Inspector such testing and inspection is not required, shall not be incorporated into the Work.

D. OWNER will select, and directly reimburse, the Testing Laboratory for costs of all DSA required tests and inspections; however, the Testing Laboratory may be reimbursed by CONTRACTOR for such costs as specified or noted in related sections of the Contract Documents.

E. The Testing Laboratory is not authorized to release, revoke, alter, or enlarge requirements of the Contract Documents or approve or accept any portion of the Work.

F. The Testing Laboratory shall not perform any duties of CONTRACTOR.

G. CONTRACTOR shall provide an insulated curing box with the capacity for twenty concrete cylinders and will relocate said box and cylinders as rapidly as required in order to provide for progress of the Work.

1.5 TEST REPORTS

A. Test reports shall include all tests performed, regardless of whether such tests indicate the material is satisfactory or unsatisfactory. Samples taken but not tested shall also be reported. Records of special sampling operations, when and as required, shall also be reported. Reports shall indicate the material (or materials) was sampled and tested in accordance with requirements of CBC, Title 24, Parts 1 and 2, as indicated on the Contract Documents. Test reports shall indicate specified design strength and specifically state whether or not the material (or materials) tested comply with the specified requirements.

1.6 VERIFICATION OF TEST REPORTS

A. Each Testing Laboratory shall submit to the Division of the State Architect, in duplicate, a verified report covering all tests required to be performed by that agency during the progress of the Work. Such report, covering all required tests, shall be furnished prior to Substantial Completion and/or, when construction on the Work is suspended, covering all tests up to the time of Work suspension.

1.7 INSPECTION BY OWNER

A. OWNER, and its representatives, shall have access, for purposes of inspection, at all times to all parts of the Work and to all shops wherein the Work is in preparation. CONTRACTOR shall, at all times, maintain proper facilities and provide safe access for such inspection.

B. OAR shall have the right to reject materials and/or workmanship deemed defective Work and to require correction. Defective workmanship shall be corrected in a satisfactory manner and defective materials shall be removed from the premises and legally disposed of without charge to OWNER. If CONTRACTOR does not correct such defective Work within a reasonable time, fixed by written notice and in accordance with the terms and conditions of the Contract Documents, OWNER may correct such defective Work and proceed in accordance with related Articles of the Contract Documents.

C. CONTRACTOR is responsible for compliance to all applicable local, state, and federal regulations regarding codes, regulations, ordinances, restrictions, and requirements.

1.8 PROJECT INSPECTOR

A. A Project Inspector will be employed by OWNER in accordance with requirements of Title 24 of the California Code of Regulations with their duties specifically defined therein. Additional DSA Special Inspectors may

be employed and assigned to the Work by OWNER in accordance with the requirements of the CBC and DSA.

B. Inspection of Work shall not relieve CONTRACTOR from any obligation to fulfill all terms and conditions of the Contract Documents.

C. CONTRACTOR shall be responsible for scheduling times of inspection, tests, sample taking, and similar activities of the Work.

1.9 STRUCTURAL TESTS AND SPECIAL INSPECTIONS

A. Soils:

1. General: Periodic inspection by Geotechnical Engineer for verification of the following construction activities in conformance to CBC Table 1705A.6:

   a. Site has been prepared properly prior to placement of controlled fill and/or excavations for foundations.

   b. Foundation excavations are extended to proper depth and have reached proper material.

   c. Materials below footings are adequate to achieve the design bearing capacity.

2. Compacted Fills: Testing and inspections shall be in conformance to Table 1705A.6:

   a. Geotechnical Engineer will continuously verify the use of proper materials and inspect lift thicknesses, placement, and compaction during placement of fill.

   b. Testing Laboratory under the supervision of the Geotechnical Engineer will:

      1) Perform qualification testing of fill materials.

      2) Test the compaction of fill.

B. Concrete:

1. Cast in Place Concrete: Inspection and testing in conformance to CBC Table 1705A.3:

   a. Inspection of reinforcement, including prestressing tendons and verification of placement, per ACI 318, sections 25.2, 25.2, 25.5.1 through 26.5.3.

b. Reinforcing bar welding: Inspect per AWS D1.4, ACI 318 26.5.4.

1) Verification of weldability of reinforcing bars other than ASTM A706.

2) Inspect single-pass fillet welds, maximum 5/16”.

3) Inspect all other welds.

c. Inspect anchors cast in concrete per ACI 318, section 17.8.2.

d. Inspect anchors post-installed in hardened concrete members:

1) Continuous inspection of adhesive anchors installed in horizontally or upwardly inclined orientations to resist sustained tension loads, per ACI 318, section 17.8.2.4.

2) Mechanical anchors and adhesive anchors, not defined in previous paragraph, per ACI 318, section 17.8.2.

e. Design Mix:

1) Verify use of required mix, per ACI 318, chapter 19 and sections 26.4.3 and 26.4.4.

2) Batch Plant Inspection: The quality and quantity of materials used in transit-mixed concrete and in batched aggregates shall be continuously inspected as required by CBC section 1705A.3.2. If approved by DSA, batch plant inspection may be reduced to periodic if plant complies with CBC section 1705A3.3.1, item 1, and requires first batch inspection, weightmaster, and batch tickets.

f. Prior to concrete placement, fabricate specimens for strength tests, perform slump and air content tests, and determine the temperature of the concrete, per ASTM C172, ASTM C31, ACI 318, sections 26.4.5 and 26.12.

g. Inspect concrete and shotcrete placement for proper application techniques, per ACI 318, section 26.4.5.

h. Verify maintenance of specified curing temperature and techniques per ACI 318 sections 26.4.7 through 26.4.9 and CBC section 1908.9.

i. Inspect prestressed concrete for:

1) Application of prestressing forces, per ACI 318 section 26.9.2.1

2) Grouting of bonded prestressing tendons per ACI 318 section 26.9.2.3.

j. Inspection of erection of precast concrete members per ACI 318 chapter 26.8.

k. Verify in-situ concrete strength, prior to stressing of tendons in post-tensioned concrete and prior to removal of shores and forms from beams and structural slabs per ACI 318 section 26.10.1.b.

l. Sampling and testing of reinforcing steel per ASTM A370, DSA IR 17-10 and CBC section 1910A.2. CONTRACTOR shall submit mill certificate indicating compliance with requirements for reinforcement, anchors, ties, and metal accessories.

2. Post-installed Anchors:

a. Special Inspector will inspect installation of post-installed anchors in hardened concrete members as required by CBC table 1705A.3, item 4.

1) Adhesive anchors installed in horizontally or upwardly inclined orientations to resist sustained tension loads, per ACI 318, section 17.8.2.4.

2) Mechanical anchors and adhesive anchors not defined above, per ACI 318, section 17.8.2.

b. Testing Laboratory will test post-installed anchors in conformance to CBC section 1905A and ASTM E488.

C. Structural Steel:

1. Special inspector will verify that all materials are properly marked in conformance with AISC 360, Section 3.3 and applicable ASTM standards.

a. Mill certificates indicating material properties that comply with requirements.

b. Materials, sizes, types and grades complying with requirements.

2. Testing Laboratory will test unidentified materials in conformance with ASTM A370.

3. Special inspector will examine seam welds of HSS shapes in conformance with DSA IR-17-3.

4. Special inspections and non-destructive testing of structural steel elements shall be in conformance to CBC section 1705A.2.1.

D. High Strength Bolts:

1. Special inspector will verify identification markings and manufacturer's certificates of compliance conform to ASTM standards specified in the Contract Documents, per DSA IR 17-9.

2. Testing Laboratory will test high-strength bolts, nuts and washers in conformance with ASTM F606, ASTM A370 and DSA IR 17-8.

3. Special inspector will inspect bearing-type ("snug tight") bolt connections in conformance with AISC 360, section M2.5 and DSA IR 17-9.

4. Special inspector will inspect slip-critical bolt connections in conformance with AISC 360, section M2.5.

E. Welding:

1. Verification of Materials, Equipment and Welders:

a. Special inspector will verify weld filler material identification markings per AWS designation listed on the Contract Documents and the WPS.

b. Special inspector will verify material manufacturer's certificate of compliance.

c. Special inspector will verify WPS, welder qualifications and equipment in conformance to DSA IR 17-3.

2. Shop Welding: Special inspector will inspect the following, per CBC 1705A.2.1, AISC 360 (and AISC 341, as applicable) and DSA IR 17-3:

a. Groove, multi-pass fillet welds larger than 5/16”, plug and slot welds.

b. Single-pass fillet welds equal or less than 5/16”.

c. Inspect welding of stairs and railing systems.

d. Verification of reinforcing steel weldability.

e. Welding of reinforcing steel, per AWS D1.4.

3. Field Welding: Special inspector will inspect the following, per CBC 1705A.2.1, AISC 360 (and AISC 341, as applicable) and DSA IR 17-3:

a. Groove, multi-pass fillet welds larger than 5/16”, plug and slot welds.

b. Single-pass fillet welds equal or less than 5/16”.

c. End welded studs (ASTM A108) installation, including bend test.

d. Welding of stairs and railing systems.

e. Verification of reinforcing steel weldability.

f. Inspect welding of reinforcing steel.

4. Non-Destructive Testing: Testing Laboratory will test perform ultrasonic and magnetic particle testing in conformance to AISC 360 section N5.5, AISC 341 appendix Q5.2, AWS D1.1, AWS D1.8, ASTM E543, ASTM E1444, ASTM E164 and DSA IR 17-2.

PART 2 – PRODUCTS (Not used).

PART 3 – EXECUTION (Not used).

END OF SECTION

DIVISION 02
EXISTING CONDITIONS

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SECTION 02 41 19 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Selective demolition, dismantling, cutting and alterations as indicated, specified, and necessary for the completion of the Contract.
2. Rerouting or offsetting existing utilities, such as piping, ducts, conduit and wiring.
3. Removing demolished materials not indicated to be salvaged, from the site.
4. Patching, repairing and finishing existing items to restore to the specified condition with an invisible transition, under normal lighting conditions at the site, between new and existing.
5. Preparation and cleaning of surfaces as required to install new work and finishes.
6. Protection of work to remaining.

B. Related Requirements:

1. Division 01 for special project procedures.
2. Division 01 for temporary building protection.
3. Division 31 for site demolition and clearing.
4. Divisions 22, 23 and 26 for disconnecting, cutting and capping utilities.

C. NIC work: Encapsulation, removal and disposal of asbestos and other hazardous materials.

1.2 DEFINITIONS

A. Remove: Detach items from existing construction and dispose of them off-site unless indicated to be salvaged or reinstalled.
B. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and store.
C. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage, prepare for reuse, and reinstall where indicated.
D. Existing to Remain: Leave existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.
E. Dismantle: To remove by disassembling or detaching an item from a surface, using gentle methods and equipment to prevent damage to the item and surfaces; disposing of items unless indicated to be salvaged or reinstalled.

1.3 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition waste becomes property of Contractor.
B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.

1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Scheduling and Sequencing:

B. Pre-demolition meeting:

1. Prior to start of demolition, arrange a meeting between the subcontractor that will be responsible for the work of this Section, the Contractor, the roofing manufacturer's authorized representative, and the Architect to review existing conditions, the Drawings, and the Specifications.
2. Review structural load limitations of existing structure.
3. If more than one trade is responsible for the successful performance of the work of this Section, these trades shall attend the meeting.
4. Identify areas of concern and remedial measures.
5. Take photographs of the areas of concerns, before and after remedial measures are taken.
6. Review areas where existing construction is to remain and require protection.
7. Record meeting minutes and distribute copies to all concerned, including the Architect, within 48 hours of the meeting.

1.5 SUBMITTALS

A. Qualification Data: For refrigerant recovery technician.
B. Engineering Survey: Submit engineering survey of condition of building.
C. Proposed Protection Measures: Submit report, including Drawings, that indicate the measures proposed for protecting individuals and property, for environmental protection, for dust control and, for noise control. Indicate proposed locations and construction of barriers.
D. Schedule of Selective Demolition Activities: Indicate the following:

1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's building manager's on-site operations are uninterrupted.
2. Interruption of utility services. Indicate how long utility services will be interrupted.
3. Coordination for shutoff, capping, and continuation of utility services.
4. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.

E. Predemolition Photographs or Video: Show existing conditions of adjoining construction, including finish surfaces, that might be misconstrued as damage caused by demolition operations. Comply with Division 01. Submit before Work begins.
F. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.
G. Warranties: Documentation indicating that existing warranties are still in effect after completion of selective demolition.
H. Inventory: Submit a list of items that have been removed and salvaged.

1.6 QUALITY ASSURANCE

A. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.

1.7 FIELD CONDITIONS

A. Owner will occupy buildings immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.

1. Hazardous materials will be removed by Owner before start of the Work.
2. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.

E. Storage or sale of removed items or materials on-site is not permitted.
F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

1. Maintain fire-protection facilities in service during selective demolition operations.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
B. Standards: Comply with ASSP A10.6 and NFPA 241.

2.2 MATERIALS

A. Contractor’s option, except that materials used for patching shall be identical to the existing materials.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped before starting selective demolition operations.
B. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.
C. Perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.

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

D. Verify that hazardous materials have been remediated before proceeding with building demolition operations.
E. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs or video.

1. Inventory and record the condition of items to be removed and salvaged. Provide photographs or video of conditions that might be misconstrued as damage caused by salvage operations.

3.2 PREPARATION

A. Refrigerant: Before starting demolition, remove refrigerant from mechanical equipment according to 40 CFR 82 and regulations of authorities having jurisdiction.

B. Protection:

1. Do not begin demolition until temporary partitions, barricades, warning signs and other forms of protection are installed.
2. Protect trees, plants, utilities, and existing improvements that are not to be removed from injury or damage resulting from the Contractor's operation. Replace damaged landscaping, improvements, and utilities in kind.
3. During demolition provide safeguards, including warning signs and lights, barricades, and the like, for protection of the public, Contractor's employees and existing improvements to remain.

C. Noise control: Refer to other Sections of Division 01.

1. Exercise caution and care to prevent generation of unnecessary noise.
2. Keep noise levels to the minimum possible.
3. Discontinues noise producing operations, when requested by the Owner, and reschedule at a mutually acceptable time.

D. Dust control: Control dust at all times.

1. Provide dust-tight partitions to prevent dust escaping into other parts of the building where demolition is not in progress, as specified in other Sections of Division 01.
2. Assume liability for claims related to flying dust caused by this work.

E. Water control:

1. Control the use of water to prevent damage to the existing facility and improvements to remain. Provide wet vacuum equipment where water, such as waste cooling water from concrete sawing, is used in and adjacent to existing building.
2. Provide impermeable floor coverings and suitable dams to prevent damage by water, and immediately clean-up and remove surplus water, and water spilled in non-working areas.
3. Assume liability for claims related to water seepage and leakage caused by this work.

F. Security: Coordinate security with the Owner; refer to Division 01.

1. Take necessary precautions to keep trespassers out of demolition areas.
2. Properly secure demolition areas from entry when demolition is not in progress but do not block required exitways.

G. Safety:

1. If at any time the safety of existing construction appears to be endangered, take immediate measures to support such endangered construction; cease operations and immediately notify the Architect.
2. Do not resume demolition until Architect's instructions are received.

3.3 SELECTIVE DEMOLITION

A. Existing conditions:

1. Intent of Drawings is to show existing conditions with information developed from field surveys and to generally show the extent and type of demolition required.
2. Make a detailed survey of existing conditions prior to commencing demolition, and report discrepancies or conflicts between Drawings and actual conditions in writing to the Architect for clarifications and instructions.
3. Do not proceed where such conflicts or discrepancies occur prior to receipt of Architect's instructions.

B. The Contractor shall be fully responsible for the adequacy and installation of temporary shoring and bracing systems used during demolition.
C. Demolition shall be performed by skilled and properly equipped personnel.
D. Remove existing construction only to the extent necessary for the proper installation of new construction and junction with existing materials. Cut back finished surfaces to straight, plumb or level lines as required.
E. If unanticipated conditions which conflict with intended function or design are encountered, investigate and measure both nature and extent of the conflict.

1. Submit report to Architect in written, accurate detail.
2. Pending receipt of directive from Architect, rearrange demolition schedule as necessary to continue overall job progress without delay.

F. Where openings are cut oversize or in improper location, replace to excess removed material, to the Architect's satisfaction, at no additional cost to the Owner.
G. Coordinate demolition with other trades to assure the proper sequence, limits, methods and time of performance. Schedule demolition so as to impose a minimum of hardship on the present operation of the facilities and the performance of the work of other trades.
H. Whenever possible use small hand or small power tools designed for sawing or grinding, whenever possible avoid the use of tools with a hammering and chopping motion. Cut through finished surfaces from the exposed or finished side into concealed surfaces.
I. In general remove materials as follows:

1. Portland cement concrete:

a. Locate and identify reinforcing bars in concrete prior to drilling and cutting, and protect structural integrity of existing work.
b. Use removal methods that will not crack or structurally affect adjacent concrete constructions.
c. Cut back concrete to clean, straight lines by saw cutting a minimum of 1 -inch deep; remainder of concrete may be jack-hammered.
d. Where indicated and where it will not weaken the structure, cut off reinforcing bars flush with the face of the concrete.
e. Where existing reinforcing bars are shown to be bonded into new concrete or masonry, use caution not to bend or otherwise damage them while removing concrete cover. Protect existing rebar from corrosion until new concrete is cast.
f. Where new concrete topping or cementitious setting bed will be cast on existing slabs, scarify or scab the surface to a profile of 1/4-inch to provide a mechanical bond with topping or setting bed.

2. Masonry: Cut back to joint lines and remove old mortar without damaging units to remain to allow space for repairs to backing where applicable.

3. Modular materials:

    a. Remove to a natural breaking point in whole units to a joint line with no damaged or defective unit remaining where joining new construction.
    b. After removing flooring materials, clean substrates of old cement and adhesive.

4. Gypsum board: Remove to a joint line on a support.
5. Lath/plaster:

    a. Saw cut plaster, but not lath and weather barrier (paper backing), cleanly.
    b. Leave at least 2 -inch of lath exposed to tie into new lath, where applicable.
    c. Leave sufficient undamaged weather barrier exposed to create a watertight, by proper lapping, joint with the new weather barrier or flashing.

6. Roofing and base flashing: Remove existing roof as indicated on Drawings.

    a. Coordinate removal with Section 07 54 19 to minimize the exposure time untill the new roof is installed. Protect building structure from water damage once the existing roof is removed until the new roof is installed.
    b. Obtain the manufacturer representative's approval of the work which must be watertight; conduct water test when required by the manufacturer representative.

7. Utility Services and Mechanical/Electrical Systems:

    a. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.
    b. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utility services and mechanical/electrical systems serving areas to be selectively demolished.

        1) Arrange to shut off utilities with utility companies.
        2) If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
        3) Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated on Drawings to be removed.

            a) Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
            b) Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material and leave in place.
            c) Equipment to Be Removed: Disconnect and cap services and remove equipment.
            d) Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
            e) Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
            f) Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
            g) Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material and leave in place.

J. Materials not mentioned to be removed that interfere with new construction, except where structural integrity of the assembly is at risk, shall be cut to clean cut lines to provide for proper interface with new construction, or patching and repair, as required.
K. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

3.4 SALVAGE

A. Removed and salvaged items: Comply with the following.

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to Owner.
4. Transport items to Owner's storage area on-site off-site designated by Owner indicated on Drawings.
5. Protect items from damage during transport and storage.
6. See Schedule at the end of the Section for a list of salvage materials.

B. Title to materials:

1. Except where indicated or specified otherwise, materials and equipment removed and not reused shall become the property of the Contractor and shall be removed from the site.
2. The Owner will not be responsible for the condition or loss of, or damage to, such property after notice to proceed.
3. Material and equipment shall not be viewed by prospective purchasers or sold on the site.

C. Existing items to remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.5 PATCHING

A. Patch materials to remain when damaged by demolition.
B. Finish material and appearance of the patch or repair shall match the existing contiguous materials and finishes in all respects, as approved by the Architect.

3.6 CLEAN-UP/DISPOSAL

A. Debris, waste, and removed materials, other than items to be salvaged, are Contractor's property for legal disposal off the site.
B. Continuously clean-up and remove these items and do not allow to accumulate in the building and on the site. Refer to Section 01 70 00 for additional requirements on this subject.
C. Protection of existing work:

1. Install protection before activities within existing building and on existing roof.
2. Activate each fire sprinkler alarm valve system as soon as roof is installed.
3. Other barriers (expected to remain in place less than 45 days) may be built using flame-retardant reinforced polyethylene film.
4. Restore surfaces of existing building to original condition where damaged due to work of this Contract or due to insufficient protection. Pay for repair of damage to contents.
5. Do not allow water to enter wall insulation or roof insulation to remain. Replace when insulation has been wetted.

6. Protect interior of structure from dust and weather and conserve interior heat. Protect temporary openings in exterior walls with fire-retardant treated weatherproof plywood or reinforced polyethylene barriers.

END OF SECTION

DIVISION 03
CONCRETE

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SECTION 03 10 00 – CONCRETE FORMING AND ACCESSORIES

PART 1 - GENERAL

1.1 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 20 00: Concrete Reinforcing.
3. Section 03 30 00: Cast-In-Place Concrete.

1.2 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.

1.3 SUBMITTALS

A. Submit detailed structural calculations and drawings approved and signed by a California registered Civil Engineer where the height of the falsework or vertical shoring, as measured from the top of the sills to the soffit of the superstructure exceeds 14 feet, or where individual horizontal span lengths exceed 16 feet, or where provision for vehicular traffic through falsework or shoring occurs. For all other falsework and shoring submit layout signed by California registered Civil Engineer, manufacturer's authorized representative or a licensed contractor experienced in the usage and erection of falsework and vertical shoring. A copy of the plans and calculation shall be available at the jobsite at all times.

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

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

1.4 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.

1.5 DELIVERY, STORAGE AND HANDLING

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

PART 2 - PRODUCTS

2.1 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. Tube Forms: Sonoco "Seamless Sonotubes," Ceme-Tube, Quik-Tube, or equal, of the type leaving no marks in concrete, one-piece lengths for required heights.

F. Joist Forms: Code recognized steel or molded plastic types as required.

G. Special Forms: For exposed integrally-colored concrete, plywood as above with high density overlay, plywood with integral structural hardboard facing or fibrous glass reinforced plastic facing, providing specified finish.

H. For Exposed Concrete Finish:

1. Plywood: New, waterproof, synthetic resin bonded, exterior type Douglas fir or Southern pine plywood manufactured especially for concrete formwork and conforming to NIST Voluntary Product Standard PS 1, Grade B-B grade, Class I.

2. Glass-Fiber-Fabric Reinforced Plastic Forms: Matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to structural tolerances and appearance of finished concrete surfaces.

3. Steel: Minimum 16 gage sheet, well matched, tight fitting, stiffened to support weight of concrete, without deflection detrimental to tolerances and appearances of finished concrete surfaces.

4. Plywood: "Finland Form,," "Combi Form" by North American Plywood Corporation, “Plyform” by Roy O. Martin, “ProForm” by Pacific Wood Laminates, or equal. The material shall be furnished with hard smooth birch face veneers with phenolic resin thermally fused onto panel sides. Edges shall be factory sealed.

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

J. 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.

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

L. Void Forms: Manufactured by SureVoid Products, Inc., Sonotube, Void Form International, or equal. Forms shall be "WallVoid" for temporary support of concrete walls and grade beams spanning between supports, and "SlabVoid" for creating gaps between concrete slabs or steps and underlying soils. Void forms shall be fabricated of corrugated paper with moisture resistant exterior, and shall be capable of withstanding working load of 1,500 psf. Provide accessories as required.

PART 3 - EXECUTION

3.1 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.

3.2 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

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.

3.3 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 30 00: Cast-In-Place Concrete.

3.4 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.

3.5 PROTECTION

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

3.6 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

1.1 SUMMARY

A. Section Includes:

1. Concrete steel reinforcement.

B. Related Requirements:

1. Division 01 - General Requirements.
2. Section 01 45 23: Testing and Inspection.
3. Section 03 10 00: Concrete Forming.
4. Section 03 30 00: Cast-In-Place Concrete.

1.2 REGULATORY REQUIREMENTS

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

1.3 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.

1.4 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.

1.5 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.

1.6 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

2.1 GENERAL

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

2.2 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.

2.3 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

3.1 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.

3.2 CLEAN UP

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

3.3 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

1.1 SUMMARY

A. Section Includes:

1. Cast-in-place normal weight, 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.

1.2 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 C494 - Standard Specification for Chemical Admixtures for Concrete.
17. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
18. ASTM C845 - Standard Specification for Expansive Hydraulic Cement
19. ASTM C989 - Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars.
20. ASTM C1107 - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
21. ASTM C1064 - Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete.
22. ASTM C1240 - Standard Specification for Silica Fume Used in Cementitious Mixtures.
23. ASTM C1315 – Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.
24. ASTM D1308 – Standard Test Method for Effect of Household Chemicals on Clear and Pigmented Organic Finishes.
25. ASTM C1567 - Standard Test Method for Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method).
26. ASTM D1751 - Standard Test Method for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types).
27. ASTM D7234 – Standard Test Method for Pull-Off Adhesion Strength of Coatings on Concrete Using Portable Pull-Off Adhesion Testers.
28. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.
29. ASTM E1155 - Standard Test Method for Determining F_F Floor Flatness and F_L Floor Levelness Numbers.
30. 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.
31. ASTM E1745 - Standard Specification for Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.
32. ASTM F710 – Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring.
33. ASTM F1869 – Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.
34. ASTM F2170 – Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using In Situ Probes.

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

1.3 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 1903A.5.

5. Curing materials: ASTM C171.

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

1.4 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. Continuous batch plant inspection requirement may be waived in accordance with CBC Section 1705A.3.3.1. Waiver shall be in writing, including DSA approval. When batch plant inspection is waived by DSA, the following requirements shall be met:

1. Approved inspector of the testing laboratory shall check the first batching at the start of work and furnish mix proportions to the licensed weightmaster.

2. Licensed weightmaster shall positively identify materials as to quantity and certify to each load by a ticket.

3. Tickets shall be transmitted to the Inspector by a truck driver with load identified thereon. The Inspector will not accept the load without a load ticket identifying the mix and will keep a daily record of placements, identifying each truck, its load and time of receipt and approximate location of deposit in the structure and will transmit a copy of the daily record to DSA.

4. At the end of the project, the weightmaster shall furnish an affidavit to DSA certifying that all concrete furnished conforms in every particular to proportions established by mix designs.

E. Special Inspections and Tests shall be in accordance with CBC Chapter 17A, Reinforcement and Anchor testing per CBC Section 1910A and Specification Section 01 4523.

1.5 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.

1.6 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

2.1 MATERIALS

A. Cement: ASTM C150. Portland Cement.

B. Aggregates: Conform to the following standards:

1. Normal weight concrete: ASTM C33.

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

3. 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 3.6.

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: Modify ACI 318 Sections 3.6.6 and 3.6.7 as follows:

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) 15 percent by weight of fly ash or other pozzolans shall substitute for ASTM C150 Portland cement provided the mix design is proportioned per ACI 318, Section 318 5.3.

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 2600, 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.

2.2 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 4.

D. Concrete proportioning shall be determined on the basis of field experience and/or trial mixtures shall in accordance with ACI 318, Section 5.3. 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

3.1 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.

3.2 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.

3.3 PREPARATION

A. For installation of vapor barrier refer to Section 07 2600, 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.

3.4 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 5.13.

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.

3.5 CURING

A. Length of time, temperature and moisture conditions for curing concrete shall be in accordance with ACI 318, Section 5.11.

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.

3.6 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.

3.7 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 and landings 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.

3.8 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.

3.9 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

DIVISION 04
MASONRY

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04 21 13 - BRICK VENEER MASONRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Replacement of brick veneer cavity wall that was removed to accommodate the seismic upgrade.
2. Grout, mortar, reinforcement, ties, and flashing concealed within brick masonry.

B. Work installed but furnished in other Sections: bolts, anchors and other items furnished by other trades for installation in brick masonry.

C. Related requirements: Division 07 for the following.

1. Water repellent coating.
2. All other flashings.

1.2 SUBMITTALS

A. Samples:

1. Triplicate Samples of each type, shape and size of brick. Include in each set the full range of exposed color and texture to be expected in the finish Work.
2. Full size Samples of wall anchor, weep hole vent, and 6 inches long Samples of each type concealed flashing and neoprene pad.

B. Data: Copies of manufacturer's printed specifications, installation instructions and general recommendations for all materials specified, except cementitious materials.

C. Shop drawings:

1. Building elevations where brickwork repair will be required, identifying all brick shapes and sizes. Large scale isometric Shop Drawings for all brick sizes and shapes other than "standard."
2. Large scale, dimensioned Shop Drawings for all concealed flashings identifying materials, gage(s), and showing details of fabrication, methods of lapping, joining and fastening, and other pertinent data. For conditions difficult to illustrate in 2-dimension, furnish isometric drawings.

1.3 QUALITY ASSURANCE

A. Mockup:

1. Prior to start of work, lay-up an *in-place* mockup of a brick wall where the infill is required in a designated location by the Architect for review.
2. Provide Fluid-Applied Air Barrier over concrete substrate prior to installation of brick veneer system.
3. Grout and point mockup as specified herein.
4. Rework the mockup as required to meet Architect’s approval.
5. Protect mockup from damage, dirt and stain after approval.
6. Retain mockup in a final approved condition.
7. This installation shall be the standard for all other brick infills.

B. Refer to Section 07 27 26 for criteria regarding air and water leakage of exterior wall mockup incorporating brick masonry.
C. Provide bricks, mortar, ties, etc. for the mockup specified in Section.

1.4 HANDLING

A. Storage:

1. Stack brick above ground on level platforms and in a dry location. Store mortar materials and accessories off the ground under cover in a dry place.
2. Deliver reinforcement to the site bundled, tagged and marked; handle to prevent damage to material. Use metal tags indicating size, length and other markings shown on placement drawings. Maintain tags after bundles are broken.

1.5 JOB CONDITIONS

A. Environmental conditions:

1. Do not begin work until a temperature of 50 deg. F or more can be maintained without interruption, during and for 3 days after completion of brickwork.
2. Protect masonry erected when the ambient air temperature is more than 99 deg. F in the shade, and the relative humidity is less than 50 percent, from direct exposure to wind and sun for 48 hours after installation.

B. Protection: During erection, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
C. Stain prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed. Remove immediately any grout, mortar, and soil that comes in contact with such masonry.

1. Protect base of walls from rain-splashed mud and mortar splatter with coverings spread on ground and over wall surface.
2. Protect sills, ledges, and projections from mortar droppings.
3. Protect cast stone, plaster, window and door frames, as well as similar construction with painted and integral finishes from mortar droppings.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General:

1. Match the materials used in the original installation where visible.
2. Do not change the source of materials which may affect the appearance of the finished brickwork after masonry has started.
3. Bricks shall be factory-blended to prevent unbalanced concentrations of colors in the Work.
4. Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects will be exposed in the completed Work.
5. Bricks salvaged from the existing veneer walls removal may be cleaned and reused if there are no chips, cracks or other deformations.

B. Brick: Non-efflorescence contributing bricks complying with the following requirements applicable to each form of brick required.

1. Provide special molded shapes where indicated and as follows:

a. For applications requiring brick on exposed surfaces that cannot be produced by sawing standard brick sizes.
b. For applications where stretcher units cannot accommodate special conditions including those at corners, arches, movement joints, bond beams, sashes, and lintels.

2. Provide units without cores (except for vaults and arches) or frogs, and with all exposed surfaces finished for ends of sills, caps, and similar applications where brick surfaces that otherwise would be concealed from view, are exposed.
3. Comply with ASTM C 216, Grade SW, 8000 psi compressive strength, Type FBX.

C. Provide basic size of brick to match existing brick veneer walls; Contractor's shall detail and dimension all other sizes and shapes on Shop Drawings. Provide bricks manufactured within the tolerances specified in ASTM C 216.

1. For color and texture range, match existing wall.

D. Portland cement: ASTM C 150, Type I or II, low alkali (less than 0.6 percent alkali).
E. Lime: Hydrated, ASTM C 207, Type S.
F. Grout admixture: Sika Grout Aid by Sika Corp. or equal.
G. Aggregate for mortar: ASTM C 144 except that not less than 3 percent nor more than 15 percent shall pass the No. 100 sieve.
H. Mortar coloring pigments: Chemically inert, color-fast, finely ground lime-proof pigment by LM Scofield & Co. or equal, of the color required to match Architect's control sample.
I. Water used in mortar and grout: Taken from a supply distributed for domestic purposes and clean and free of acids, alkalies, or other organic materials at time of mixing.
J. Sealant materials: As specified in Section 07 92 00.
K. Anchor bolts: ASTM A 307, galvanized.
L. Concealed flashings: Type 302/304 stainless steel, 22 gauge minimum. Fabricate in accordance with Section 07 62 00.
M. Brick cleaner: Commercially prepared brick cleaning solution with a mild citric, acetic or sulfamic acid may be used when tests Samples provided by the Contractor are satisfactory to the Architect; do not use hydrofluoric, hydrochloric (muriatic) and ammonium bifluoride based acids.

2.2 REINFORCEMENT, ANCHORS AND ACCESSORIES

A. 2 Seal Thermal Wing Nut Anchor by Hohmann & Barnard, Inc, basis of design.:

1. Screw-Attached, Adjustable Masonry Veneer Anchors:
2. Type: Thermal, polymer-coated single-screw, dual-diameter barrel anchor, with EPDM washers sealing to both the weather barrier and insulation, with steel reinforced plastic-coated wings for inserting vertical legs of wire tie.
3. Backup: Wood stud.
4. Wire Ties: 0.187-inch diameter.
5. Finish: Glavanized Steel
6. Acceptable Product:

a. Hohmann & Barnard, Inc.; 2-Seal Thermal Wing Nut: www.h-b.com. Or equal.

7. Provide Seismic Option: 2X-Hook Seismic Pintle (SH) with continuous 0.187-inch diameter joint reinforcing wire in facing wythe.

B. 2X-Hook Pintle by Hohmann & Barnard, Inc, basis of design:

1. Pintle connections having legs with flattened radiuses giving connector a structural performance capable of withstanding a 200 lbf (890 N) load in both tension and compression without deforming beyond 0.05 inch (1.3 mm) or developing play in excess of 1/16 inch (1.5 mm) at 1.25 inch (32 mm) offset. Size ties to extend at least halfway through facing wythe but with at least 5/8-inch (16-mm) cover on outside face.

C. Wire: Match existing system except that the new system must meet these requirements:

1. Horizontal reinforcement: 9-gage galvanized wire complying with ASTM A 82.
2. Tie wire: 16-gage annealed steel wire.

D. Neoprene strip filler: Rapid Soft Joint, 1/4-inch thick minimum, by Dur-O-Wal, Inc. or equal complying with ASTM D 1056, Class RE41.

E. Brick cleaner: Commercially prepared brick cleaning solution with a mild citric, acetic or sulfamic acid may be used when tests Samples provided by the Contractor are satisfactory to the Architect; do not use hydrofluoric, hydrochloric (muriatic) and ammonium bifluoride based acids.

2.3 MORTAR AND GROUT MIXES

A. Mortar: Add water as necessary or convenient for a workable mix. Do not use mortar which has begun its final set.

B. Grout: Minimum strength 2,000 psi. Design grout mixes shall be by a laboratory acceptable to the Architect and paid by the Contractor.

C. Proportioning and mixing:

1. Measure ingredients accurately. When partial batches are mixed, use care in proportioning the ingredients to maintain the same ratio.
2. Mix in a mechanically operated mortar mixer for at least 3 minutes after all ingredients are in the drum, but in no case less than required for a complete mix of the materials.
3. Use admixture in compliance with its manufacturer's printed instructions.
4. Empty the drum completely before the succeeding batch of materials is placed therein.

PART 3 - EXECUTION

3.1 EXAMINATION/PREPARATION

A. Verify conditions and measurements affecting the work of this Section at site.

B. Correct detrimental conditions before proceeding with installation.

C. Foundations:

1. Verify that the foundation is clean, rough and level. Sandblast the area under the masonry if the surface contains laitance or other foreign material, or is not sufficiently rough.
2. Verify that foundation elevation is such that the bed joint thickness will be between 1/4-inch and 3/4-inch. The foundation edge shall be true to line so that the masonry does not project over more than 1/4-inch.

3.2 SHORES AND CENTERING

A. Design, erect, support, brace and maintain shoring and centering for temporary support of masonry elements.

B. Construct true to required finished shape, size and form, well braced and made rigid in all parts and capable of supporting and sustaining the loads to which they are subjected.

C. Leave shores and centering in place until masonry can safely carry its own weight and the added loads of construction.

3.3 INSTALLATION

A. General:

1. Do not use bricks with chips, cracks, voids, discolorations and other defects which might be visible or cause staining in the finished Work.
2. Wherever possible, use full size units.

    a. Keep cutting to a minimum.
    b. Cut and fit bricks, including work required to accommodate the work of other trades, by saw cutting to produce straight, sharp edges without spalling or other defects.

3. When being laid, the brick shall have suction sufficient to hold the mortar and to absorb water from the mortar and grout. The brick shall be sufficiently damp so that the mortar will remain plastic enough to permit the brick to be leveled and plumbed immediately after being laid without destroying bond.

B. Wall ties:

1. Install brick anchor system in compliance with its manufacturer's instructions and, as approved by authorities having jurisdiction.
2. Cut anchor slots to length and bolt securely concrete walls at 16 inches o.c. maximum unless otherwise noted. As a minimum, provide 2 anchor bolts per veneer panel and/or pier.
3. Install the Tee anchors in the channel at 12 inches o.c. vertically in a full bed of mortar as the brick is laid so that each tie does not support more than 1.6 (maximum) sq.-feet of veneer.
4. Reinforce the wall with a 9-gage continuous wire, located in each joint where the anchor occurs, and engaged in the slots of the Tee anchor. Lap wire 6 inches.

C. Laying walls, pilasters, cornices and arches:

1. Layout brickwork in advance for accurate spacing of exposed bond patterns with uniform joint widths, and to properly locate openings, returns and offsets. Avoid the use of less-than-half-size units at corners, jambs and wherever possible at other locations.
2. Provide weep holes spaced not over 24 inches o.c. in the first course above the foundation and at each level of through-wall flashings.
3. Lay-up brickwork accurately, plumb and true with courses level, accurately spaced and coordinated with other work. Comply with tolerances specified herein.
4. Use line blocks whenever possible. When absolutely necessary to use a line pin, fill the hole in the joint with mortar immediately when the pin is withdrawn.
5. Tool exposed joints to match existing. Cut joints flush for masonry to be concealed. Rake out mortar where joints will receive sealant. Regardless of jointing specified, all jointing in masonry exposed to the weather shall be tooled, making solid, smooth, watertight compact joints.
6. Remove bricks disturbed after laying; clean and relay in fresh mortar. Do not pound corners at jambs to fit stretcher units which have been set in position. If adjustments are required, remove bricks, clean off mortar, and reset in fresh mortar.
7. Stop masonry work by racking back 1/2 masonry unit length in each course; do not tooth. Stop grout pour 4 inches back of rack at ends and as further specified at top of pour. Prior to resuming masonry work, remove loose units and unbonded mortar, clean exposed surfaces of set masonry and, if required to be wetted, wet units lightly.

8. Build-in items specified under this and other Sections of the Specifications as the work progresses. Fill-in solidly with masonry around built-in items. Grout space between hollow metal frames and masonry solidly.
9. Install concealed flashings where shown as masonry progresses. Extend the flashings from the outer face of the wall, through the wall, and up on its inside face 6 inches. Form a watertight dam at concealed ends of flashing above and below openings whenever the flashing is interrupted. Lap joints 4-inch minimum and seal with sealant.
10. Execute pattern work, bonds, or special details indicated on the Drawings accurately.
11. Bevel mortar for bed joints.

    a. Slope beveled bed joints toward the center of the wall so that the bed joints will be filled when the brick is finally brought to line. Do not furrow bed joints.
    b. Avoid fins of bed joint mortar that protrude into the grout space; if they occur, leave in place if not projecting more than the bed joint thickness.
    c. In no case shall they be cut off and dropped on to the grout or space below.

12. Fill head joints with mortar regardless of thickness.
13. Shove brick in stretcher (flat-wise) courses into place.
14. When grouting, use caution to prevent grout or mortar from staining the face of masonry to be left exposed. If grout or mortar does contact the face of masonry, remove immediately. Protect sills, ledges, offsets, etc. from droppings of mortar. Protect adjacent materials from damage during the masonry work.

D. Grouting: Where indicated grout space between back of brick and back-up surface leaving 1-inch (or as indicated on the Drawings) clear air space in front of concrete walls using expanded metal lath as backing. Dam grout where indicated to limit its spread.
E. Tolerances for completed brickwork: Do not exceed the following.

3.4 EXPANSION AND CONTROL JOINTS

A. Provide control joints in brickwork where indicated on the Drawings, existing in original constuction and as specified below.
B. Where brick comes in contact with the bottom of a shelf angle, install a continuous neoprene strip filler, in compliance with its manufacturer's printed instructions, to clean steel surfaces. Do not grout this joint but fill with sealant as specified below.
C. New exposed expanding and control joints shall match existing joints.
D. In other control joints, insert preformed joint filler or back-up material in joints at proper depth to allow the correct cavity depth for the sealant.

    1. Make joint widths same as mortar joints.
    2. Keep joints open and clean by stuffing with polypropylene rope or other material to prevent filling with dirt, grout or mortar.

E. After brick is grouted and completely dry, remove temporary filler material; brush joints clean and fill with the specified back-up material and sealant as specified in Section 07 92 00.

3.5 REPAIRING/POINTING

A. Remove and replace bricks which are loose, chipped, broken, stained or otherwise damaged, or if units do not match adjoining units.
B. Provide new units to match adjoining units and install in fresh mortar or grout, pointed to eliminate evidence of replacement.
C. During the tooling of joints, enlarge voids or holes and completely fill with mortar or grout.

3.6 CLEANING

A. At the conclusion of masonry clean bricks with specified cleaner using stiff bristle brushes in compliance with the cleaner manufacturer instructions.
B. Coordinate cleaning with application of clear sealer specified in Section 09 90 00A.

3.7 FIELD QUALITY CONTROL

A. Field tests on actual building:

1. Method for field check for water leakage, but not interpretation of results, shall conform to AAMA 501.2-83, except as modified herein.
2. There shall be no unacceptable water leakage as defined herein.
3. Provide powered scaffold, hose, water supply and manpower to perform at least two successful tests, plus any unsuccessful tests.
4. Water testing shall be conducted early in the construction schedule. Construction sequence shall include provisions for timely completion of test areas.
5. Remedial measures shall maintain standards of quality and durability and are subject to approval.

END OF SECTION

DIVISION 05
METALS

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SECTION 05 50 00 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes metal fabrications not classified as "structural steel", and not specified in other Sections, including the following:

1. Miscellaneous framing and supports, including signage support framings.
2. Aluminum caged roof ladders.
3. Miscellaneous steel trim.
4. Metal bollards.
5. Cane detection rail.
6. Loose bearing and leveling plates.
7. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.

B. Related requirements:

1. Division 03 for grouting and dry-packing other than required for the work of this Section.
2. Divisions 05 and 09 for light-gage metal framing (studs, channels, etc.) for support of plaster and gypsum board, and backing plates for surface-applied items fastened to these materials.
3. Division 05 for the following:

   a. Architectural metal fabrications.

4. Division 09 for finish painting metal fabrications.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Scheduling and sequencing: Schedule installation so wall attachments are made only to completed walls.

B. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible with one another.

C. Coordinate installation of metal fabrications that are anchored to or that receive other work. 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 such items to Project site in time for installation.

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.

3. Provide reaction loads for stair hangers and brackets.

C. Samples: Provide 3 minimum 6-inch square samples of finished material for ladders.
D. Welding certificates.
E. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
F. Research Reports: For post-installed anchors.

1.4 QUALITY ASSURANCE

A. Qualifications for welding work:

1. Welding Qualifications: Qualify procedures and personnel in accordance with the following welding codes:

a. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
b. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
c. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

2. Examine that welders to be employed in this work have satisfactorily passed AWS qualification tests.
3. If recertification of welders is required, retesting shall be Contractor's responsibility.
4. Submit certificates of compliance to demonstrate compliance with the above requirement.
5. Costs for fabricator tests, inspections and quality control shall be borne by the Contractor.

B. Ladder Manufacturer Qualifications: A firm experienced in producing aluminum metal ladders similar to those indicated for this Project.

1. Record of successful in-service performance.
2. Sufficient production capacity to produce required units.
3. Professional engineering competent in design and structural analysis to fabricate ladders in compliance with industry standards and local codes.
4. Installer Qualifications: Competent and experienced firm capable of selecting fasteners and installing ladders to attain designed operational and structural performance.

C. Product Qualification for ladders: Product design shall comply with OSHA 1910.27 minimum standards for ladders.
D. Special inspections:

1. Except where otherwise specified, special inspections by Owner’s testing laboratory, prescribed by Code, will not be required where work is performed on the premises of a licensed fabricator, registered and approved by authorities having jurisdiction to perform such work without special inspection.
2. Submit certificates of compliance to demonstrate compliance with the above requirement.
3. Costs for fabricator tests, inspections and quality control shall be borne by Contractor.

1.5 HANDLING

A. Store metal fabrications above ground, under cover.

1.6 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls, floor slabs, decks, and other construction contiguous with metal fabrications by field measurements before fabrication.

1.7 LADDER WARRANTY

A. Provide an extended Warranty for ladders of this Section for a period of 5 years commencing with Substantial Completion 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.

B. Manufacturer shall be notified immediately of defective products and be given a reasonable opportunity to inspect the goods prior to return. Manufacturer makes no other warranty, expressed or implied, to the merchantability, fitness for a particular purpose, design, sale, installation, or use, of the ladder; and shall not be liable for incidental or consequential damages, losses of or expenses, resulting from the use of ladder products.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General: Provide load-bearing assemblies capable of safely withstanding the dead loads of the assemblies, plus the live loads prescribed by Code without exceeding allowable design working stress of materials involved, including anchors and connections. Apply each load to produce maximum stress in each component.
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.

2.2 MATERIALS

A. Metal surfaces - general: For metal fabrications exposed to view upon completion of the Work, provide materials selected for their surface flatness, smoothness, and absence of surface blemishes. Do not use materials whose exposed surfaces exhibit pitting, seam marks, roller marks, rolled trade names, roughness, and, for steel sheet, variations in flatness exceeding those permitted by reference standards for stretcher-leveled sheet.
B. Steel plates, shapes, and bars: ASTM A 36.
C. Steel tubing:

1. Cold-formed steel tubing: ASTM A 500, Grade A or B, as required for design loading, unless otherwise indicated.
2. Hot-formed steel tubing: ASTM A 501. For exterior installations and where otherwise specified, provide tubing with hot-dip galvanized coating in compliance with ASTM A 53.

D. Steel pipe/tubing:

1. Handrails: One of the following.

a. Welded and Drawn Over Mandrel (DOM), ASTM A 513, Type S.
b. Cold Drawn Seamless (CDS), ASTM A 519.

c. Hot Finished Seamless (HFS), ASTM A 519, machined to match the finish of the DOM steel above.

2. Elsewhere: ASTM A 53; finish, type, and weight class as follows.

a. Galvanized finish for exterior installations and where specified, black finish elsewhere.
b. Type S, Grade A, standard weight (schedule 40), unless another grade or weight or both required by design loading.

E. Slotted Channel Framing: Cold-formed metal box channels (struts) complying with MFMA-4.

1. Size of Channels: As indicated.
2. Galvanized Steel: ASTM A653/A653M, commercial steel, Type B, with G90 (Z275) coating; 0.108-inch nominal thickness.
3. Cold-Rolled Steel: ASTM A1008/A1008M, commercial steel, Type B; 0.0966-inch minimum thickness;

a. Interior application: unfinished
b. Exterior application: hot-dip galvanized after fabrication.

F. Uncoated structural steel sheet: Product type (manufacturing method), quality, and grade, as follows.

1. Cold-rolled structural steel sheet: ASTM A 1008, Grade A, unless otherwise required by design loading.
2. Hot-rolled structural steel sheet: ASTM A 1011, Grade 30, unless otherwise required by design loading.

G. Uncoated steel sheet: Commercial quality, product type (method of manufacture) as follows.

1. Cold-rolled steel sheet: ASTM A 1008.
2. Rolled steel floor plate (Checkered): ASTM A 786, Pattern No. 1, 4 or 5. Use same pattern throughout the Project.
3. Hot-rolled steel sheet: ASTM A 1011.

H. Galvanized steel sheet:

1. Structural quality: ASTM A 653 SQ, Grade 33, G90 designation, unless another grade required for design loading.
2. Commercial quality: ASTM A 653 CQ, G90 coating designation.

I. Concrete inserts:

1. Threaded or wedge type galvanized ferrous castings, either malleable iron complying with ASTM A 47, or cast steel complying with ASTM A 276.
2. Provide bolts, washers, and shims as required, hot-dip galvanized in compliance with ASTM A 153.

J. Welding rods and bare electrodes: Select in accordance with AWS specifications for the metal alloy to be welded.

K. Fasteners: Provide zinc-coated fasteners for exterior use or where built into exterior walls, elsewhere fasteners may be uncoated. Select fasteners for type, grade, and class required.

1. Bolts and nuts: Regular hexagon-head bolts, ASTM A 307, Grade A, Property Class 4.6; with hex nuts, ASTM A 563; and flat washers, unless otherwise indicated.
2. Anchor bolts: ASTM F 1554, Grade 36.
3. Machine screws: ASME B18.6.3, ASME B18.6.7M.
4. Plain washers: Round, carbon steel, ASME B18.22.1.
5. Lock washers: Helical, spring type, carbon steel, ASME B18.21.1.

6. Post -Installed Anchors: Torque-controlled expansion anchors.
    a. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.
    b. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1) stainless steel bolts, ASTM F593 (ASTM F738M), and nuts, ASTM F594 (ASTM F836M).
7. Chemical anchors:
    a. Set by Simpson Strong-Tie Co., Inc., or HY-150 by Hilti, both used with machine bolts complying with FS FF-B-575, Grade S.
    b. Select drilled-in and chemical anchors to resist loads imposed thereon with a safety factor of 4 minimum for static loads, and 10 minimum for dynamic and overhead loads.
8. Lock washers: Helical spring type carbon steel, FS FF-W-84.

L. Grout: See Section 03 30 00.
M. Cement (expansive): Factory-prepared with accelerators quick-setting hydraulic cement complying with ASTM C 595.
N. Shop primer for ferrous metal:
1. Interior surfaces: Tnemec Unibond 115 or V-115 (basis of design), or equal fast-curing, lead-free, waterborne crosslinking hydrophobic acrylic primer selected for compatibility with finish paint systems specified in Section 09 90 00, and complying with performance requirements equal to or better than the basis of design.
2. Exterior surfaces: As specified in Section 09 96 00.
O. Galvanizing repair (zinc-rich) paint: “94-H20 Hydro-Zinc” by Tnemec Co., ZRC by ZRC Worldwide, Amercoat 68HS by PPG or equal.
P. Bituminous paint: Cold-applied asphalt mastic complying with SSPC Paint 12 but containing no asbestos fibers, or cold-applied asphalt emulsion complying with ASTM D 1187.
Q. Aluminum Plate and Sheet: ASTM B209 (ASTM B209M), Alloy 6061-T6.
R. Aluminum Extrusions: ASTM B221 (ASTM B221M), Alloy 6063-T6.
S. Aluminum-Alloy Rolled Tread Plate: ASTM B632/B632M, Alloy 6061-T6.
T. Aluminum Castings: ASTM B26/B26M, Alloy 443.0-F.

2.3 FASTENERS

A. General: Unless otherwise indicated, provide Type 304 stainless steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
1. Provide stainless steel fasteners for fastening aluminum and stainless steel.
B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A (ISO 898-1, Property Class 4.6); with hex nuts, ASTM A563 (ASTM A563M); and, where indicated, flat washers.
C. Stainless Steel Bolts and Nuts: Regular hexagon-head annealed stainless steel bolts, ASTM F593 (ISO 3506-1); with hex nuts, ASTM F594 (ASTM F836M); and, where indicated, flat washers; Alloy Group 1 (A1).
D. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563 (ASTM A563M); and, where indicated, flat washers.
1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.
E. Anchors, General: Capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in

concrete, as determined by testing in accordance with ASTM E488/E488M, conducted by a qualified independent testing agency.

F. Cast-in-Place Anchors in Concrete: Either threaded or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A47/A47M malleable iron or ASTM A27/A27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F2329/F2329M.

G. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.
2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1) stainless steel bolts, ASTM F593 (ISO 3506-1), and nuts, ASTM F594 (ASTM F836M).

H. Slotted-Channel Inserts: Cold-formed, hot-dip galvanized-steel box channels (struts) complying with MFMA-4, 1-5/8 by 7/8 inches (41 by 22 mm) by length indicated with anchor straps or studs not less than 3 inches (75 mm) long at not more than 8 inches (200 mm) o.c. Provide with temporary filler and tee-head bolts, complete with washers and nuts, all zinc-plated to comply with ASTM B633, Class Fe/Zn 5, as needed for fastening to inserts.

2.4 MISCELLANEOUS MATERIALS

A. Interior metal shop primers: Provide primers that comply with Section 09 90 00 - Painting.
B. Exterior non-galvanized steel: Use rich-zinc primer compatible with topcoat..
C. High Performance Coatings: Water-Based Primer: Emulsion type, anticorrosive primer for mildly corrosive environments that is resistant to flash rusting when applied to cleaned steel, and compatible with topcoat. Coordinate with Section 09 96 00.
D. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.
E. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
F. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.
G. Shrinkage-Resistant Grout: Factory-packaged, nonmetallic, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.
H. Concrete: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained concrete with a minimum 28-day compressive strength of 3000 psi.

2.5 PREFABRICATED UNITS

A. Metal Bollards

1. Fabricate metal bollards from Schedule 40 steel pipe.
2. Cap bollards with 1/4-inch- thick steel plate.
3. Where bollards are indicated to receive controls for door operators, provide cutouts for controls and holes for wire.
4. Where bollards are indicated to receive light fixtures, provide cutouts for fixtures and holes for wire.
5. Fabricate bollards with 3/8-inch- thick steel baseplates for bolting to concrete slab. Drill baseplates at all four corners for 3/4-inch anchor bolts.
6. Where bollards are to be anchored to sloping concrete slabs, angle baseplates for plumb alignment of bollards.
7. Fabricate sleeves for bollard anchorage from steel pipe or tubing with 1/4-inch- thick steel plate welded to bottom of sleeve. Make sleeves not less than 8 inches deep and 3/4 inch larger than OD of bollard.
8. Prime bollards with primer specified in Section 09 96 00 High-Performance Coatings.
9. Cap bollards with 1/4-inch- thick steel plate.

10. Where bollards are indicated to receive controls for door operators, provide cutouts for controls and holes for wire.
11. Where bollards are indicated to receive light fixtures, provide cutouts for fixtures and holes for wire.

B. Slotted channel framing:

1. Multipurpose steel profiles by Unistrut, Power-Strut, Famet, or equal, complete with manufacturer's standard steel fasteners and connectors, nuts integrally self-locking or fitted with locking devices. Provide galvanized steel members where embedded in concrete or masonry, and factory-primed items elsewhere.
2. Provide hanger rods, nuts, bolts, connectors, and anchors with electro-galvanized finish.

C. Weld size shown on the design drawings are considered effective weld size and shall be increase in accordance with AWS as required by gaps or skews between components.

2.6 ALUMINUM CAGED LADDERS

A. Basis of design: O'Keeffe's, Inc.
B. Or equal.
C. Cage Ladder with High Parapet Access, Platform and No Return.

1. Model 533 as manufactured by O'Keeffe's Inc.

D. Materials:

1. Aluminum Sheet: Alloy 5005-H34 to comply with ASTM B209.
2. Aluminum Extrusions: Alloy 6063-T6 to comply with ASTM B221.

E. Finish: Paint. Urethane over chemically pretreated substrate. Color as called out on Drawings.
F. Prime exterior steel ladders, including treads, railings, brackets, and fasteners, with primer specified in Section 09 96 00 High-Performance Coatings.

2.7 FABRICATION - GENERAL

A. Comply with the reference standards and the following.
B. Engineer, fabricate and install exterior components to allow for expansion and contraction for a temperature range of 150-degree F without causing buckling, excessive opening of joints, and over-stressing of welds and fasteners.
C. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
D. Drill holes for bolts and screws. For screws exposed to view in finished surfaces use FHCS type with screw slots filled and finished flush and smooth with adjacent surfaces.
E. Form exposed work true to line and level with accurate angles and surfaces, and straight, sharp edges, so assembling can be done without filler pieces.
F. Shear and punch metals cleanly and accurately. Remove burrs.
G. Remove sharp or rough areas on exposed surfaces. Projecting edges are not permitted. Ease exposed edges to a radius of approximately 1/32-inch.
H. Weld corners and seams continuously to comply with AWS recommendations and the following:

1. Do not use stitch, spot or tack welds on exposed surfaces.
2. For work exposed to view, provide weld quality and finish equal to NOMMA Finish #1. Elsewhere provide weld quality and finish equal to NOMMA Finish #4.
3. Use materials, methods and welding sequence that minimize distortion and develop strength and corrosion resistance of base metals.
4. Obtain fusion without undercut or overlap.
5. Remove welding flux immediately.

6. 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.
7. 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.

I. Form bent metal corners to the smallest radius possible without causing grain separation or otherwise impairing the strength of the material.
J. Form exposed connections with flush, hairline joints, using concealed fasteners wherever possible. Cope intersections of rails and posts, weld joints, and grind smooth; butt weld end-to-end joints of railings or use welding connectors.
K. Bend pipe without collapsing or deforming its walls, to produce a smooth, uniform curved section and to maintain uniform sectional shape.
L. Fabricate joints that will be exposed to the weather with weep holes where water or condensation may accumulate.
M. Cut, reinforce, drill, punch, thread and tap metal work as required to receive finish hardware and similar items of work.
N. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches, with a minimum 6-inch embedment and 2-inch hook, not less than 8 inches from ends and corners of units and 24 inches o.c., unless otherwise indicated.
O. Provide supplementary parts necessary to complete each item of metal fabrication even though such parts may not be shown or specified. Provide all anchors, brackets, and sleeves for securing metal work to adjacent construction.
P. Remove blemishes by grinding before cleaning, treating, and applying specified finishes.

2.8 PIPE RAILING FABRICATION

A. General: Fabricate handrails and railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.
B. Assemble handrails and railings in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.
C. Form simple and compound curves by bending members in jigs to produce uniform curvature for each repetitive configuration required; maintain cylindrical cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of handrail and railing components.
D. Connect members by welding. Cope components at perpendicular and skew connections to provide close fit, or use fittings designed for this purpose when acceptable to the Architect. Weld connections continuously to match approved Samples.
E. Brackets, flanges, fittings, and anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to connect handrail and railing members to other work, unless otherwise indicated.

1. Provide inserts and other anchorage devices for connecting handrails and railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by handrails and railings. Coordinate anchorage devices with supporting structure.
2. For railing posts set in concrete, unless otherwise indicated, provide preset sleeves of steel not less than 6-inch long with inside dimensions not less than 1/2-inch greater than outside dimensions of post, and steel plate forming bottom closure.

F. Provide weep holes or another means to drain entrapped water in hollow sections of handrail and railing members that are exposed to exterior or to moisture from condensation or other sources.
G. Fabricate joints to be exposed to weather to be watertight.
H. Close exposed ends of handrail and railing members.
I. Provide wall returns at ends of wall-mounted handrails, unless otherwise indicated. Close ends of returns, unless clearance between end of railing and wall is 1/4-inch or less.
J. Provide fillers made from steel plate, or other suitably crush-resistant material, where needed to transfer wall bracket loads through wall finishes to structural supports. Size fillers to suit wall finish thicknesses and to produce adequate bearing area to prevent bracket rotation and overstressing of substrate.

2.9 LADDER FABRICATION

A. Rungs: Not less than 1-1/4 inches in section and 18–3/8 inches long, formed from tubular aluminum extrusions. Squared and deeply serrated on all sides.

1. Rungs shall withstand a 1,500-pound load without deformation or failure.

B. Channel Side Rails: Not less than 1/8-inch wall thickness by 3 inches wide.
C. Heavy Duty Tubular Side Rails: Assembled from two interlocking aluminum extrusions no less than 1/8-inch wall thickness by 3 inches wide. Construction shall be self-locking stainless-steel fasteners, full penetration TIG welds and clean, smooth, and burr-free surfaces.
D. Ship Ladders: Not less than 1-1/4 inches high, 4-1/8 inch deep and 2 feet wide; tread spacing shall be 1 foot on center. Handrails shall be aluminum pipe, not less than 1-1/2 inches in diameter with hemispheric end caps.
E. Walk-Through Rail and Roof Rail Extension: Not less than 3 feet 6 inches above the landing and shall be fitted with deeply serrated, square, tubular grab rails.
F. Landing Platform: 1-1/2 inches or greater diameter, tubular aluminum guardrails and decks of serrated aluminum treads.
G. Security Doors: Formed 1/8-inch-thick aluminum sheet. Security panels shall extend on both sides, perpendicular to the door face, to within 2 inches of the wall. Security door shall be furnished with continuous aluminum piano hinge and heavy duty forged steel locking hasps.
H. Safety Cages:

1. Fabricate ladder safety cages to comply with authority having jurisdiction. Assemble by welding. Spacing of primary hoops, secondary hoops and vertical bars shall not exceed that required by code.
2. Safety cage hoops and vertical bars: 3/16 inch by 2 inches aluminum bar.

2.10 WELDING

A. Weld shop and field connections continuously in compliance with AWS D1.1, Structural Welding Code - Steel, and AWS D1.3, Structural Welding Code - Sheet Steel, unless bolted connections are specifically shown.
B. Grind welds that will remain exposed, smooth and flush to match and blend with parent metal surfaces. Match approved weld Samples.

2.11 FABRICATION TOLERANCES

A. Squareness: 1/8-inch maximum difference in diagonal measurements.
B. Maximum offset between components at joints: 1/16-inch except that at welded joints no offset is allowed.
C. Maximum misalignment of adjacent members: 1/16-inch.
D. Maximum bow: 1/8-inch in 48-inches.
E. Maximum deviation from plane: 1/16-inch in 48-inches.

2.12 GALVANIZING

A. See Section 05 03 12.

2.13 SHOP PRIMING-STEEL

A. Do not shop prime galvanized surfaces.
B. Surfaces exposed in the Work comply with : SSPC SP6 followed by application of zinc-rich primer.
C. Surfaces concealed from view: SSPC SP3 followed by rust inhibitive shop primer.
D. Shop prime metal assemblies as follows, unless otherwise specified in Section 09 96 00:

1. Prepare surfaces as specified above.
2. Remove loose mill scale, rust, cutting and punching burrs, oil, grease and other deleterious materials before priming.
3. Immediately after surface preparation, apply primer in compliance with its manufacturer's instructions to provide a uniform dry film thickness of not less than 1-1/2 mils per coat for rust-inhibitive primer and 3.5 to 3.5 mils for zinc-rich primer. Use painting methods that will result in full coverage of joints, corners, edges and all exposed surfaces.
4. Apply primer to completely cover all exposed surfaces as well as surfaces concealed after assembly. Stripe paint corners, crevices, bolts, welds, and sharp edges.
5. Allow paint to dry thoroughly before handling.
6. Apply one coat of primer to surfaces exposed in the finished work, and 2 coats to surfaces that will be inaccessible after their assembly or erection.

2.14 PROTECTIVE COATINGS

A. Apply a heavy coat of bituminous paint to metal surfaces that will be in contact with cementitious materials. Do not apply on exposed surfaces.

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. Corrosion prevention: Prevent galvanic action and other forms of corrosion by isolating metals and other materials from direct contact with incompatible materials using heavy bituminous paint at least 10 DFT, hard plastic spacers, Teflon tape, or silicone or neoprene gaskets.
B. Fastening:

1. Provide anchorage devices and fasteners required for attaching metal fabrications to in-place construction, including threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws and other connectors required.
2. Dry-pack metal fabrications supported on concrete and masonry as specified in Section 03 30 00 to provide firm, level bearing surfaces.

C. Cutting, fitting and placing:

1. Perform all cutting, drilling and fitting required for installation of metal fabrications.
2. Set items accurately in their proper location, alignment and elevation, plumb, level, true and free of rack as measured from established lines and levels.
3. Provide temporary bracing or anchors for items to be built into concrete, masonry or similar construction.
4. Fit exposed connections accurately to form flush, hairline joints.

5. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Grind exposed joints smooth and flush with parent metal.

D. Field welding: Comply with AWS Code for procedures of manual shielded arc welding, appearance and quality of welds made, and methods used to correct faulty welds.

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

E. Installing metal bollards.

1. Fill metal-capped bollards solidly with concrete and allow concrete to cure seven days before installing.

   a. Do not fill removable bollards with concrete.

2. Anchor bollards to existing construction with expansion anchors. Provide four 3/4-inch bolts at each bollard unless otherwise indicated.

   a. Embed anchor bolts at least 4 inches in concrete.

3. Anchor bollards in concrete in formed or core-drilled holes not less than 8 inches deep and 3/4 inch larger than OD of bollard. Fill annular space around bollard solidly with nonshrink grout; mixed and placed to comply with grout manufacturer's written instructions. Slope grout up approximately 1/8 inch toward bollard.
4. Anchor bollards in place with concrete footings. Center and align bollards in holes 3 inches above bottom of excavation. Place concrete and vibrate or tamp for consolidation. Support and brace bollards in position until concrete has cured.

F. Metal Ships’ ladders and pipe crossovers:

1. Secure top and bottom of ships' ladders to construction to comply with manufacturer's written instructions.
2. Secure pipe crossovers to construction to comply with manufacturer's written instructions.

G. Prefabricated units: Install as specified, and in compliance with their manufacturer's instructions.
H. Gate hardware:

1. Drill and tap gate frames on the job as required for installation of hardware.
2. Attach hardware accurately fitted to gates and frames with tamper-resistant or concealed means. Install ground-set items in concrete for anchorage.
3. Adjust to operate smoothly and without sticking and binding.
4. Gates shall close uniformly against frame. When open in any position, gates shall remain stationary, without drifting.
5. Latch shall engage strike and keeper regardless of the degree of force with which gates are closed.
6. Where so required for smooth and noiseless operation, lubricate hardware in compliance with its manufacturer instructions.

I. Installation tolerances: Adjust metal fabrications for squareness, alignment, twist, levelness and plumbness to the following tolerances.

1. Squareness where applicable: Plus or minus 1/16-inch, measured on the diagonal.
2. Alignment: Plus or minus 1/16-inch where fabrications are separated by one inch or more; where components join or are separated by less than one inch, components shall be aligned; no deviations permitted.
3. Twist: Plus or minus 1/16-inch, except that deviation shall be such that joined panelized components are flush at joints; no deviations permitted.
4. Plumbness: Plus or minus 1/16-inch, except that deviation shall be such that joined panelized components are flush at joints; no deviations permitted.
5. Levelness: 1/8-inch from level, except where tighter tolerances are required for joining or alignment with adjacent work.
6. Deviation from theoretical location in plan: 1/4-inch, except where tighter tolerances are required for joining or alignment with adjacent work.

3.3 FIELD QUALITY CONTROL

A. 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.

B. Touchup:

1. General: Immediately after erection, clean field welds, bolted connections and abraded areas, and proceed as follows.
2. Damaged primer: Clean the damaged area, sand smooth, re-clean and spot-prime with the same paint as that used for shop priming applied to the same dry film thickness as the undamaged primer; minimum thickness of 2 dry mils.
3. Damaged zinc coating:

    a. Clean abraded area in accordance with SSPC-SP11, “Power Tool Cleaning” to bare metal all welds and damaged zinc coating. Extend cleaning 2 inches past damaged area.
    b. Spot prime damaged area with Tnemec “94-H20 Hydro-Zinc” applied at 2.5 to 3.5 Mils DFT.

4. Where galvanized surface will remain exposed in the Work, repair damaged areas with zinc-based solder in accordance with ASTM A 780, regardless of the width of the abrasion (not limited to 3/16-inch).

END OF SECTION

DIVISION 06
WOOD AND COMPOSITES

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SECTION 06 10 00 – ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Rough carpentry Work.
2. Installation of glued laminated members, plywood web joists or wood chord metal web joists.

B. Related Requirements:

1. Division 01 - General Requirements.
2. Section 01 45 23: Testing and Inspection.
3. Section 03 10 00: Concrete Forming and Accessories.
4. Section 03 30 00: Cast-In-Place Concrete.
5. Section 06 20 00: Finish Carpentry.
6. Section 09 29 00: Gypsum Board.

1.2 SYSTEM DESCRIPTION

A. Regulatory Requirements:

1. Work of this Section shall comply with CBC Chapter 23.

1.3 QUALITY ASSURANCE

A. Comply with the following as a minimum requirement:

1. Redwood structural and framing lumber shall be graded in accordance with Standard Specifications for Grades of California Redwood Lumber of the Redwood Inspection Service.
2. Douglas fir, larch or hemlock structural and framing lumber shall be graded in accordance with the Standard Grading Rules of the West Coast Lumber Inspection Bureau (WCLIB) or the Western Lumber Grading Rules of the Western Wood Products Association (WWPA).
3. Plywood shall conform to requirements of Product Standard PS 1, and shall be grade marked by a recognized grading agency (APA and PTL).

B. Lumber shall bear official grade mark of the association under whose rules it was graded or official grade mark of another recognized grading agency.

C. Structural and framing members 2-inch thick (nominal) and larger shall be air-dried to moisture content not to exceed 19 percent before installation.

D. Each piece of preservative treated lumber shall be identified by the Quality Mark of an approved inspection agency in accordance with CBC Chapter 23; refer to Section 01 4523: Testing and Inspection.

E. Lumber showing visible signs of mold growth:

1. Lumber showing visible signs of mold growth shall be removed from the project site or cleaned as outlined below.

2. The contractor is responsible for all costs associated with cleaning, post-cleaning testing, and reporting for lumber with mold.

   a. Lumber that shows visible signs of mold growth prior to, or after installation, shall be cleaned pursuant to the current edition of USEPA's guidance publication "Mold Remediation in Schools and Commercial Buildings (EPA 402-K-01-001).

   b. A minimum of 10 percent of the total locations cleaned must be sampled (tape lift method) post cleaning to ensure cleaning effort was successful. Cleaning will be considered acceptable when tape lift sample results evaluated by direct microscopic examination determine that the general abundance of mold is non-detect or rare (normal trapping to 1+).

   c. A report prepared by a Certified Industrial Hygienist (CIH) that details the sampling and cleaning results shall be prepared and submitted to the OAR for review and approval of the LAUSD Office of Environmental Health and Safety.

   d. Cleaned lumber shall not be installed or enclosed by finish materials until approval of test results. Cleaned lumber must meet moisture content requirements as required elsewhere in this specification prior to installation or application of finishes.

1.4 STORAGE, HANDLING AND PROTECTION

A. The materials supplied as part of the Work of this section shall be protected from exposure to inclement weather before being covered by other Work.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Lumber: Structural and framing lumber shall be of following species and grades:

	INSTALLATION	SPECIES	GRADE
1.	Subfloor, wall sheathing, roof sheathing and ceiling furring	Douglas fir and larch	Construction Board, WCLIB; WWPA
2.	Posts, (5-inch by 5-inch and larger, width not more than 2 inches greater than thickness).	Douglas fir and larch	No. 1 or better Structural Posts and Timbers, WCLIB. No. 1 or better Post and Timbers, WWPA.
3.	Beams, girders and truss members (5-inch and thicker, rectangular, width more than 2-inches greater than thickness) where exposed as finish members.	Douglas fir and larch	No. 1 or better Structural Beams and Stringers, WCLIB; WWPA.
4.	Joists, rafters, lintels, posts, mullions and members (2 to 4-inch thick, 2 to 4-inch wide)	Douglas fir and larch	No. 1 or better; Structural Light Framing, WCLIB;

5.	Other lumber (2 to 4-inch thick, 2 to 4-inch wide) not specified in subparagraph 4 above.	Douglas fir and larch	No. 2 or better; Light Framing WCLIB; WWPA
6.	Framing lumber (2 to 4-inch thick, 5-inch and wider).	Douglas fir and Larch	No. 1 or better Structural Joists and Planks, WCLIB; WWPA.
7.	Mudsills and plates in contact with earth.	Douglas fir and Larch Treated	Same as subparagraphs 5 and 6.
8.	Sills or plates installed on concrete or masonry surfaces 6 inches or less above earth or finish grade.	Douglas fir and Larch Treated	Same as subparagraphs 5 and 6.
9.	Sills, foundation plates and sleepers installed on concrete, masonry foundations, or installed on concrete slab in direct contact with earth.	Douglas fir and Larch treated	Same as subparagraphs 5 and 6.
10.	Miscellaneous nailing strips and blocks embedded in concrete or masonry.	Douglas fir and Larch treated	Same as subparagraphs 5 and 6.

B. Plywood: Plywood furnished for structural purposes, when exposed outdoors, shall be exterior type plywood. Other plywood furnished for structural purposes shall be exterior type, or Exposure 1.

C. OSB Board or Panels:

1. Oriented strand board or panels shall not be furnished as part of the Work of this section.

D. Preservative Treated Wood:

1. Wood and plywood specified; as treated wood shall be pressure treated wood in accordance with CBC requirements.

2. Seasoning: Treated lumber shall be air seasoned after treatment, for a minimum of two weeks before installation. Moisture content shall be 15 percent maximum.

3. Creosote or arsenic is not permitted for treating wood.

4. When treated wood member have been notched, dapped, drilled, or cut, such newly cut surfaces shall be painted with a heavy coat of the same preservative material originally provided for treatment of wood member.

E. Fire Retardant Protection: Wood and plywood specified as fire retardant protected wood shall be treated by approved methods and materials and shall be dried following treatment to maximum moisture content as follows:

1. Solid sawn lumber 2-inch thick or less: 19 percent.

2. Plywood: 15 percent.

F. Plywood Subflooring: Underlayment, Group 1, Exposure 1; of thickness indicated.

G. Mineral Fiber Panels: Asbestos-free, thickness as indicated.

H. Adhesive: Elastomeric adhesive – follow manufacturer's installation instructions. Product must be approved by OWNER Office of Environmental Health and Safety and conform to ASTM D 3498 or APA-AFG-01.

PART 3 - EXECUTION

3.1 FASTENINGS

A. Nails and Spikes:

1. Furnish only common wire nails or spikes whenever indicated, specified or required.
2. Whenever necessary to prevent splitting, holes shall be pre-drilled for nails and spikes.
3. Nails in plywood shall not be overdriven.
4. Machine Applied Nailing: Use of machine nailing is subject to a satisfactory Project site demonstration for each Project and approval by the Architect or structural engineer retained by the Architect as an Architect Consultant and DSA. Installation is subject to continued satisfactory performance. Machine nailing is not permitted for 5/16 inch plywood. Do not permit nail heads to penetrate outer ply. Maintain minimum allowable edge distances when installing nails.

B. Lag Screws:

1. When installing lag screws in a wood member, pre-drill hole as required by the CBC.
2. Lag screws, which bear on wood, shall be fitted with standard steel plate washers under head. Lag screws shall be screwed and not driven into place.

C. Bolts:

1. Lumber and timber to be fastened together with bolts shall be clamped together with holes for bolts bored true to line.
2. Bolts shall be fitted with steel plates or standard cut washers under heads and nuts. Bolts shall be tightened when installed and again before completion of the Work of this section.

D. Wood Screws: When installing wood screws, pre-drill holes as required by the CBC.

E. Metal Framing Devices: Framing anchors, joist hangers, ties, and other mechanical fastenings shall be galvanized or furnished with a rust inhibitive coating. Nails and fastenings shall be of the type recommended by manufacturer.

F. Powder Driven Fasteners:

1. Loads shall not exceed 75 pounds unless indicated on the Drawings or when reviewed by the Architect.
2. The operator, tool, and fastener shall perform the following as observed by the Inspector.
   a. Observe installation of first 10 fasteners.
   b. Test the first 10 fasteners by performing a pullout test. Load shall be at least twice the design load, or 150 pounds, whichever is greater.
   c. Random testing:

1) Load less than 75 pounds - approximately 1 in 10 pins.

2) Load 75 pounds or greater - 1/2 of the pins.

3. Failure of any test will result in testing of all installed pins.

4. Nail heads shall not break the outer skin of sheathing.

5. Non-compliant pins shall be replaced.

3.2 INSTALLATION

A. Stud Walls, Partitions and Furring:

1. Wood stud walls, partitions and vertical furring shall be constructed of members of size and spacing indicated. Provide single treated plate at bottom and double plate at top unless otherwise indicated. Interior, nonbearing non-shear partitions may be framed with a single top plate, installed to provide overlapping at corners and at intersections with other wall and partitions or by metal ties as detailed.

2. Walls and partitions shall be provided with horizontal staggered blocking at least 2 inch nominal thickness and same width as studs, fitted snugly, and nailed into studs. Blocking shall be installed at mid-height of partition or not more than 7 feet on center vertically. Install wood backing on top of top plate wherever necessary for nailing of lath or gypsum board.

3. Walls, partitions and furred spaces shall be provided with 2-inch nominal thickness wood firestops, same width as space to be firestopped, at ceiling line, mid-height of partition and at floor line. Firestops at floor line are not required when floor is concrete. If width of opening is such that more than one piece of lumber is necessary, provide two thicknesses of one inch nominal material installed with staggered joints.

4. Firestops shall be installed in stud walls and partitions, including furred spaces, so the maximum dimension of any concealed space is not over 10 feet.

5. Corners, and where wood stud walls and wood vertical furring meet, shall be constructed of triple studs. Openings in stud walls and partitions shall be provided with headers as indicated and a minimum of 2 studs at jambs, one stud of which may be cut to support header in bearing.

6. Where wood and masonry or concrete walls intersect, end stud shall be fastened at top, bottom and mid-height with one 1/2 inch diameter bolt through stud and embedded in masonry or concrete a minimum of 4 inches. Bolts shall be provided with washers under nuts.

7. Sills under bearing, exterior or shear walls shall be bolted to concrete with 5/8 inch diameter by 12-inch long bolts with nuts and washers, spaced not more than 4 feet on center unless noted otherwise. There shall be a bolt within 9 inches of each end of each piece of sill plate. Sills shall be installed and leveled with shims, washers, with nuts tightened to level bearing. Space between sill and concrete shall be dry packed with cement grout.

B. Floor Joists, Roof and Ceiling Framing:

1. Wood joists shall be of the size and spacing indicated, installed with crown edge up, and shall have at least 4-inch bearing at supports. Provide 2-inch solid blocking, cut in between joists, same depth as joists, at ends and bearings, unless otherwise indicated.

2. Floor joists of more than 4 inches in depth and roof joists of more than 8 inches in depth shall be provided with bridging. Floor joists shall be bridged every 8 feet

with solid blocking or metal cross bridging. Roof joists shall be bridged every 10 feet.

3. Joists under and parallel to bearing partitions shall be doubled and nailed or bolted together as detailed. Whenever a partition containing piping runs parallel to floor joists, joists underneath shall be doubled and spaced to permit passage of pipes and blocked with solid blocking spaced at not more than 4 feet intervals.

4. Trimmer and header joists shall be doubled, when span of header exceeds 4 feet. Ends of header joists more than 6 feet long shall be supported by framing anchors or joist hangers unless bearing on a beam, partition, or wall. Tail joists over 12 feet long shall be supported at header by framing anchors or on ledger strips at least 2 by 4.

5. Provide solid blocking between rafters and ceiling joists over partitions and at end supports where indicated.

C. Beams, Girders and Joists:

1. Ends of wood beams, girders and joists which are 2 feet or less above finished outside grade and which abut, but do not enter concrete or masonry walls, as well as wood blocking used in connection with ends of those members shall be treated with wood preservative.

2. Where wood beams, girders and joists enter masonry or concrete walls 2 feet or less above outside wall, metal wall boxes or equivalent moisture barriers shall be provided between wood and masonry or concrete.

D. Subflooring:

1. Floor sheathing: Plywood of thickness and nailing indicated. Install with the face grain direction across supports, end joints staggered and centered over supports. Provide solid blocking under plywood edges where indicated. In addition to nailing, sheets of plywood flooring shall be secured in place with elastomeric adhesive, installed at beams, joints, perimeter supports and panel edges.

E. Roof:

1. Plywood roof sheathing shall be Structural I, Appearance Grade C-D, Exposure 1, thickness as indicated.

2. Where exposed roof sheathing is indicated, area shall be sheathed solid with dressed and center matched, V-jointed boards of sizes indicated. Boards shall be installed perpendicular to supports.

3. Soffits of overhanging eaves, where indicated, shall be boxed-in using Group I, Exterior Type, Appearance Grade A-C, plywood, thickness as indicated.

4. Provide and install metal H-clips of required size, midway between rafters at unsupported edge joints of plywood roof sheathing where rafters are spaced at 24 inches on center. Clips shall be Plyclips, by Timber Fasteners Inc., Panel Clips by Simpson Co., USP Structural Connectors, or equal.

F. Attic Space Partitions and Attic Walkways:

1. Attic space partitions shall be constructed of 2 by 4 wood members spaced at 2 feet on center maximum with 5/8 inch gypsum board.

2. Doors in attic space partitions shall be self-closing, of the same sheathing material as partition, constructed with 2 battens and a diagonal brace across back.

3. Shear walls passing through attic space shall be sheathed with 5/8 inch gypsum board on each side.

4. Attic walkways shall be constructed of 2 by 12 planks installed one-inch apart and nailed at each support with three 16d nails.

G. Furring:

1. Rafters or ceiling joists indicated to be furred for support of materials other than acoustical tile shall be furred with 2 by 4 wood members installed at right angles to supports, spaced as indicated and nailed in place. Furring shall be aligned, and bottoms shall be leveled by installing wood shims as required, and nailed as indicated.

2. Furring for protective wall padding in gymnasium shall be 1 by 3 Douglas fir, Construction Boards, S1S1E; applied horizontally to concrete walls at top and bottom of padding panels; and at uniform intermediate spacing not more than 18 inches on center. Stripping shall be shimmed where required, aligned to a true plane, and secured to concrete walls with concrete nails at not more than 18 inches on center.

H. Furring: Where metal furring is not indicated or specified, provide wood furring at points indicated and required for concealing conduit, piping, structural framing or other unfinished materials. Wood furring shall be 2-by studs of required width. Vertical members contacting concrete or masonry shall be attached as specified for anchoring interior wood stud partitions.

I. Grounds:

1. Provide and set wood grounds at points where wood trim occurs and work is to be plastered. Grounds at 3/4 inch metal lath shall be 5/8 inch thick, net, 1 ½-inch wide Douglas Fir, S1S. Grounds shall be doubled where trim member exceeds 5-inch width, or wherever indicated. Grounds shall be applied after lath has been installed set plumb, level and true to line.

2. Apply grounds over wood framed surfaces and lath and securely nail to wood backing at each stud or bearing. Grounds applied over steel channel studs and lath shall be securely nailed at each stud or bearing to nail-blocks provided and installed in metal studs.

3. Grounds applied to concrete surfaces shall be securely nailed to woodblocks provided and built into concrete.

J. Nailing Strips and Plates:

1. Provide wood nailing strips, plates and blocking indicated or required. Nailing strips in connection with metal work shall be bolted to metal. Wood nailing blocks for securing grounds shall be built into concrete, or masonry.

2. Nailing schedule shall comply with CBC requirements.

3. Treated wood nailing strips for lightweight insulated concrete roof decks at eaves, ridges, rakes, base of curbs and wherever else indicated, shall be provided and installed. Strips shall be treated Douglas fir, 4 inches (nominal) width by thickness of insulated concrete.

K. Wood Backing: Provide wood backing as indicated and as required to receive plumbing, electrical fixtures and equipment, cabinets, door stop plates and other fixed equipment.

L. Wood Bucks: Furnish and set wood bucks to form openings for doors and other openings in concrete or masonry walls and in steel stud or channel partitions and furring. Bucks shall be Douglas fir, S1S2E, 2 inches (nominal) thickness and of width indicated or required. Bucks in connection with concrete shall be bolted thereto, and bucks in masonry walls shall be attached by means of strap anchors embedded in masonry joints. Bucks in

connection with steel studs and metal channels shall be secured with nails or screws spaced not to exceed 24 inches on centers.

M. Bench Tops and Backs: Tops and backs shall be 3/4 inch thick asbestos free board, fabricated to minimize number of joints. Edges shall be neatly cut, smoothly finished and joints accurately fitted and butted. Tops and backs shall be secured with countersunk flathead galvanized wood screws. At bench with steel pan, apply with manufacturer's recommended adhesive. Cut and drill as required for Work to be attached to benches.

3.3 CLEAN UP

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

3.4 PROTECTION

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

END OF SECTION

DIVISION 07
THERMAL & MOISTURE PROTECTION

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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 stem walls, 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 PPLICATION - 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 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® 540 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/ft^2 @ 1.57 lbs/ft^2 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® 540 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.

2.5 LIQUID SEAM AND PENETRATION SEALANTS

A. 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.

B. 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.

2.6 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® 540 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.

2.7 SELF-ADHERED THRU WALL FLASHING

A. 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 - STEEL WALL PANELS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes preformed steel wall, fascia and soffit 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. Insulation.
    b. Other flashing and sheet metal.
    c. Air/water barrier.
    d. Sealants.
3. Division 08 for glazed assemblies adjacent to the panels.

1.2 SYSTEM DESCRIPTION

A. General: Single-skin concealed fastener metal wall panel applied as the exterior component of an exterior wall system.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Review methods and procedures related to metal panel installation, including manufacturer's written instructions.
3. Review any interface with existing conditions, including existing metal panels.
4. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
5. Review flashings, special siding details, wall penetrations, openings, and condition of other construction that affect metal panels.
6. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.
7. Review temporary protection requirements for metal panel assembly during and after installation.
8. Review of procedures for repair of metal panels damaged after installation.
9. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.4 SUBMITTALS

A. Product Data: Include typical construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.

1. Fastener, and lap-seam metal wall panels.
2. Concealed-fastener, lap-seam metal wall panels.

B. Shop Drawings: Dimensioned Shop Drawings for the panel systems, including design and custom 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.
4. The shop drawings and calculations shall bear the seal of a California-registered professional engineer. The engineer shall also perform and submit structural calculations to document all panel conditions.

C. 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.

D. 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.

E. Calculations: Calculations, stamped and certified by a California-registered professional engineer, to demonstrate structural adequacy of panels and anchorage system, and compliance with criteria specified. Coordinate calculations submitted with shop drawing submittals.

F. Manufacturer instructions: Manufacturer instructions for care, repair and replacement procedures, and Samples showing repaired panels.

1.5 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.

1.6 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.

1.7 COORDINATION

A. Coordinate metal panel installation with existing metal panels, rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.8 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 and water leakage though the wall system 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 o 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 20 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 20 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 MANUFACTURER

A. Morin -Matrix Series Panels MX1, basis of design.
B. Acceptable manufactures include the following but their products must meet this specification and profile of the basis of design product:

1. Centria,
2. Peterson Matal Corporation (PAC CLAD).
3. Or equal.

2.2 METAL PANELS

A. Profile: Matrix Panel MX-1.0.
B. Panel width: 12 inches.
C. Panel depth: 1-1/2 inches.

D. Panel joint: Tongue and groove interlock.
E. Panel Attachment: Concealed floating [MIP] clip and fastener.

2.3 PERFORMANCE REQUIREMENTS

A. Air leakage: Maximum 0.020 CFM steel per square foot of roof area, measured at reference differential pressure across assembly of loading indicated on Structural Drawings, tested to ASTM E283.
B. Water leakage: None, tested to ASTM E331 at test pressure of 40 PSF.

2.4 MATERIALS

A. Aluminum-Zinc Alloy Coated Steel Sheet: ASTM A792, AZ50 coating class.
B. Material: Panels shall be fabricated from zinc coated steel conforming to ASTM A 653 SQ Grade 37, G90 coating, minimum 20-gage with smooth surface.
C. Flashing and trim: Fabricated in the same material, gage, finish, and color as the panels.
D. Subgirts: See Drawings.

2.5 ACCESSORIES

A. Fasteners: See Drawings.
B. Closures shall be metal and/or foam as required. Foam shall be a pre-cut profile closure of closed cell foam. Metal closures shall be fabricated from the same material, gage, finish, and color as the exterior metal panel.
C. Sealants:

1. Concealed sealant at side laps, end laps, and flashing details shall be gun grade non-curing butyl or polymeric non-skinning butyl tape to ensure weather tightness.
2. Exposed sealant shall be as specified in Section 07 92 00.

2.6 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.

2.7 FINISHING

A. Finish panel to match approved Samples.
B. Paint surfaces within panel cavity exposed to air or moisture.
C. Exposed Panels and Trim:

1. Coating type: Fluropon PVDF.
2. Color: Custom color to match existing panels.

D. Concealed Panels and Trim:

1. Interior surface finish shall consist of a 0.2 mill primer and 0.3 mil backer coat.

E. Panels shall be flat with no embossed or textured design.
F. For uniformity finish all panels for an entire elevation at the same time.

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.
B. Do not begin installation of panels until Architect has accepted secondary air/water barrier.

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 SEALANTS

A. Comply with the requirements of Section 07 92 00 for sealants, backer rods, and their installation.

3.5 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.

3.6 ACCEPTANCE

A. Each and every 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 54 19 - PVC ROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Adhered thermoplastic (PVC) roofing membrane.
2. Sheet metal flashings at the perimeter penetrations of the roof membrane.
3. Liquid applied membrane (LAM) flashings at equipment pads and penetrations where use of PVC flashing membrane is not practical or as noted on the design details
4. Flat and tapered insulation, crickets, and cover board.
5. Adhesive, fasteners and anchors to attach the roof membrane to concrete substrate and metal decks.

B. Related requirements: Division 07 for other sheet metal flashings and 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.

D. Warranty:

1. Roofing membrane manufacturer warranty form.
2. Roofer warranty form.

1.4 QUALITY ASSURANCE

A. 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.

B. 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.

C. 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.

1.5 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. Remove damaged materials from the job site and replace at no cost to the Owner.

1.6 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.

1.7 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: Manufacturer shall warrant roofing and flashings against defective materials for all supplied components, and roofer's workmanship, for 20 years after Substantial Completion. Warranty shall not be prorated, shall not include dollar limit, and shall not exclude, without time restriction, ponding water.
3. Signed by installing applicator, covering the work of a System Warranty, including all components of roofing system installation such as membrane roofing, base flashing, roof insulation, fasteners, cover boards, vapor retarders, and walkway products, for the following warranty period:

a. System Warranty Period: 2 years from date of substantial completion.

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.

2.3 FLASHING MATERIALS

A. As supplied by roofing membrane manufacturer.
B. 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 LIQUID-APPLIED FLASHINGS

A. Fluid-Applied Membrane System Sikalastic RoofPro 20 with Sika Reemat Premium, basis of design or equal:

1. Primer: Sikalastic EP Primer
2. Base Layer: Sikalastic 641 Lo-VOC, 50 mils wet film thickness, 32 sf/gal coverage rate approx.
3. Reinforcing Layer: Reemat Premium.
4. Top Layer: Sikalastic 641 Lo-VOC, 30 mils wet film thickness; 53 sf/gal coverage rate approx.
5. Sealant for fillet bead applications and membrane penetrations shall be Sikaflex® 11FC by Sika Corp.
6. Supplemental reinforcement shall be Sika Flexitape Heavy by Sika Corp.

2.5 ADHESIVES

A. Water-based adhesive for membrane attachment to cover board substrate.
B. Low rise foam adhesive for insulation and cover board attachments.
C. 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. Insulation Board Adhesive: Sarnacol 2163, Sarnacol AD or Sarnacol OM Adhesive: 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 beads. Additional adhesive may be required for rougher surfaces.
3. Stabond Adhesive.: Low VOC reactivating-type adhesive used to attach membrane to vertical flashing substrate.

2.6 INSULATION AND FASTENERS

A. Insulation: Flat and tapered polyisocyanurate insulation with inorganic coated fiberglass facers compatible with the specified roofing membrane, acceptable to the roof membrane manufacturer, and to obtain a thermal resistance (R value) indicated.
B. Fastener: Self-tapping, #12 corrosion-resistant fastener acceptable to the roofing membrane manufacturer.

1. Perform pullout tests by the fastener manufacturer.
2. Results of these tests plus and an assessment by the fastener manufacturer regarding the suitability of the fastener for the Project is required.

2.7 ACCESSORIES

A. Sarnaclad: PVC-coated, heat-weldable 25-gage, Type 316 stainless steel sheet with a 20-mil unsupported Sarnafil membrane laminated to one side.
B. Sarnastack Universal: Vent pipe flashing fabricated from 0.0604-inch-thick PVC membrane.
C. Sarnacircles “G”: Circular 0.048-inch thick G410 membrane patches welded of T-joints formed by overlapping thick membranes.
D. Sika 11FC: 2-component urethane sealant used for pitch pocket topping.
E. Sarnacorner: Prefabricated inside and outside corners made of 0.060-inch thick PVC membrane heat-welded to membrane or flashing.
F. Sarnaplate: 26 gage, 3-inch plate used with fasteners to clamp insulation boards in place.
G. Sarnafasteners:

1. XPS, #15 heavy-duty, corrosion resistant fastener, shank diameter of 0.21-inch and thread diameter of 0.26-inch, with a driving head of 0.435-inch and #3 Phillips design.
2. Sarnadisc XPS, 18 gage, 2-inch by 3-3/4-inch linear steel plate.

H. Sarnastop: Extruded aluminum, low profile bar installed over the membrane and made watertight with a welded cover-strip, used at all angle changes.
I. Sealants: Sarnafil multi-purpose sealant for termination details.
J. Aluminum tape: 2-inch wide pressure-sensitive tape acceptable or provided by Sarnafil.
K. Sarnasolv: Solvent cleaner for the specified membrane surface.
L. Walkway pads: Sarnatred-V (welded), or equal.
M. All other accessories: As recommended by the roofing membrane manufacturer.
N. Peelstop: 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.

2.8 MISCELLANEOUS MATERIALS

A. Wood nailers: Refer to Section 06 10 00.

1. Do not use creosote or asphaltic-treated lumber.
2. Wood nailers shall conform to FM Loss Prevention Data 1-49.

B. Cover board: “Dens-Dek Prime” or “DensDeck DuraGuard Roof Board” by Georgia Pacific – no substitution. Use 1/2-inch-thick board.

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. Inspect deck for defects that will adversely affect the quality of this work.
B. Substrates shall be clean, smooth, dry, free of flaws, sharp edges, loose and foreign material, oil and grease. Do not start roofing until defects are corrected, and work of penetrating and adjacent installations is completed.
C. Roof surfaces shall be free of water and other deleterious substances.
D. Apply roofing systems over compatible and acceptable substrates only.

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

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. Do not install more insulation board than can be covered with membrane by the end of the day or the onset of inclement weather.
C. Use at least 2 layers of insulation when the total thickness exceeds 2.5-inch. Stagger joints at least 12-inch between layers.
D. 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.
E. Adhesively adhere 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 & WALKWAY PADS

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 METAL 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 LIQUID APPLIED MEMBRANE FLASHING SYSTEM (LAM)

A. Install liquid applied flashing membrane system at irregular and non-standard penetrations and substrates only.

1. Mix and apply the specified primer per the instructions on the technical data sheet.
2. Allow to cure and dry in accordance with manufacturer's technical data sheet.
3. For all horizontal-to-vertical transitions, provide a 3/4-inch x 3/4-inch Sikaflex polyurethane sealant cant.
4. Apply a minimum of a 3-inch-wide strip of Joint Tape SA or Sika Flexitape Heavy.
5. Install liquid applied flashing resin and reinforcement per manufacturer's written instructions.

3.9 FIELD QUALITY CONTROL

A. Seams:

1. Check welded seams for continuity daily where directed by roofing membrane manufacturer's representative.
2. Take one-inch-wide cross-section Samples of welded seams at least 3 times a day.
3. Correct welds displaying failure from shearing of membrane prior to separation of weld. Patch each test cut.

B. Roofing membrane is subject to review by Architect and roofing membrane manufacturer.

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.

3.10 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. Copings.
2. Prefabricated counterflashing assemblies.
3. 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 54 19 for flashing provided by that section.
2. Section 09 90 0 for finish painting flashings and sheet metalwork.
3. 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. 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.

C. 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.

D. 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. Scupper.
3. Gutter including holding strap.
4. Conductor head and downspout.
5. Counterflashing with receiver.
6. 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" 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 design pressures indicated on Structural 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.

C. Stainless steel: 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.
3. Factory Prime Coating: Where painting after installation is required, pretreat metal with white or light-colored, factory-applied, primer coat. Coordinate primer with Section 09 96 00.
4. Color: As indicated 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. 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. 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.

B. 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. Laps: J2.
   b. Copings: As detailed in Drawings. Miter and solder inside and outside corners continuously to make watertight; the use of sealant for that purpose is unacceptable.

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. Fabricate in as long length as possible to minimize field joints.
C. Prefabricate intersections, including counterflashings, with mitered, riveted joints. Make corners and intersections with legs a minimum of 24-inch long extending in each direction.
D. 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.
G. Metal thicknesses: Per SMACNA Architectural Sheet Metal Manual except that copings must meet 2.1 C above.

2.7 FINISHES

A. Sheet Metal flashing: See Section 09 96 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

A. Examine conditions and measurements affecting the work of this Section at site.
B. 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 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.

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 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. Perimeter joints between interior wall surfaces and frames of interior doors, windows, and elevator entrances.
5. 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

D. Related requirements:

1. 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.

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.

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."

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:

a. Pecora Corp. “BA-98.”
b. US Gypsum Co. “Sheetrock Acoustical Sealant.”
c. Tremco, Inc. “Acoustical Sealant.”
d. WW Henry Co. “Henry 313.”
e. Or equal.

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 09
FINISHES

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SECTION 09 24 00 - LATH AND PORTLAND CEMENT PLASTER

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Repairing existing Portland cement plaster.
2. Lath and lathing accessories.
3. Portland cement plaster.

B. Related requirements:

1. Demolition is specified in Division 02 but preparation of existing plastered surfaces for this work is the responsibility of this Section.
2. 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. Expanded diamond mesh lath weighing 3.4 lbs./square yard. made from zinc-coated (galvanized) steel sheet to produce lath complying with ASTM C 847, by Western Metal Lath, Amico West, Cemco,, or equal.
2. On solid surfaces use self-furred lath.

a. Self-furring, 3.4-lb. diamond welded wire lath complete with accessories: Mega Lath by Structa, or equal.

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. Enrock “Image Smooth” custom colors selected by the Architect.
2. 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 PLASTER TROWELED ON CONCRETE STEM WALL

A. Plaster assembly basis of design: Omega Bondcrete base coat with AkroLoc top coat, or equal.
B. Apply primer to new concrete stem wall prior to applying plaster.
C. Total thickness: 1/2-inch.

2.5 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, RV-2 and RV-4 on Drawings for shapes.

1. Shop prime reveals to receive final paint under Section 09 90 00.

C. Reinforcement:

1. Interior Corners: #30 corner Master Control Joint by ClarkDietrich or equal.
2. Exterior Corners: #1A Expanded Corner Bead by ClarkDietrich or equal.

D. Screeds and Molds: Per Plaster and Drywall Systems Manual, size and profile as indicated on the Drawings and as necessary to suit application.
1. 22-gauge galvanized steel. Hem exposed edges. Furnish in longest possible lengths.
2. Furnish drip screeds with weep holes every 2-inches.

E. 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 Brand X or CEMCO as indicated, or equal by Amico, CEMCO, Keene/Metalex Corp., Superior, Stockton Products or Unimast Inc.
2. At locations where new trim will contact or continuation of existing trim, shapes shall be identical.

a. Plaster stops at window jambs: DFS-175 by Brand X.
b. Plaster stops at window trims with surrounds: DFS-1375 by Brand X.
c. Plaster stops with drip edges: DFWD-15375 by Brand X.
d. Control joint expanded wing control joint: “No. XJ15” by CEMCO.

PART 3 - EXECUTION

3.1 EXAMINATION/PREPARATION-GENERAL

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 EXAMINATION/PREPARATION-REPAIR AREAS

A. Inspect existing and new framing, and existing plaster. Correct conditions detrimental to the timely and proper performance of this work before proceeding with lathing and plastering.
B. Preparation:

1. Before plastering begins, ensure that the adjacent finish work is well protected with waterproof covers securely taped in place.
2. Install new metal lath and substrate as indicated.
3. Prepare existing weather barrier to receiving new weather barrier by lapping a minimum of 8-inch
4. Prepare existing lath to receive new lath by lapping a minimum of 4-inch and wire tying.
5. Prepare existing plaster to be patched. Where joined by new plaster, chip back each existing layer (scratch and brown) in steps, approximately 2-inch to 3-inch and apply a chemical bonder. Undercut edges to provide a mechanical key with patches.

C. Except for patching small areas, apply scratch coat forming good full keys over the metal lath. Follow by the brown and finish coat, damp curing each coat as specified below.
D. Repair cracks and openings by moistening adjacent plaster. Keep edges of patch wet for 24 hours prior to plastering to reduce suction. Filling with new material, trowel or tamp flush with adjoining surfaces. Point-up finish plaster surfaces around items which are built into or penetrate plaster.
E. After painting, patching must be invisible under normal lighting conditions from a distance of 2 feet when the patch is within 10 feet of a walking surface, and from a distance of 5 feet above that height.

3.3 GENERAL

A. The applicable provisions of ASTM C 1063 and ASTM C 926, govern the work of this Section, except as specified herein.

3.4 PAPER WEATHER BARRIER

A. Install over the gypsum or plywood 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 13.

3.5 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. Install metal lath panels so that each vertical joint is approximately centered in the panel beneath it. Wire-tie intermediate horizontal joints at 6 inches o.c. maximum.
E. Cut lath at control joints.
F. Attach lath to supports at 6 inches o.c.
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.

3.6 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 13.
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.

3.7 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.

3.8 CURING OF PATCHED CEMENT PLASTER

A. Damp cure each coat and each patch for a minimum of 48 hours after application. Begin curing as soon as plaster hardens sufficiently to permit it. Protect from uneven and excessive evaporation during hot, dry weather, and from strong windblasts.

B. Promptly remove plaster spatter and droppings from adjacent surfaces. Repair surfaces which are stained, marred or otherwise damaged during plastering.

3.9 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.

3.10 FINISH

A. Finishes for the cement plaster: Match the existing adjacent finish.

3.11 REPAIRING/CLEANING/PROTECTING NEW CEMENT PLASTER

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 29 00 - GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Gypsum board.
2. Repair of existing gypsum board damaged by this scope of work.
3. Fasteners, joint reinforcing and finishing compounds.

B. Related requirements:

1. Section 06 10 00 for framing supporting gypsum board (except for framing specified herein).

1.2 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.

1.3 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.

1.4 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.

1.5 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.
3. Select the type of new gypsum board that matches the existing gypsum board in both type and thickness.

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. 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.
F. 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.
3. Long Edges: Tapered.

G. For surfaces to be painted in toilet rooms: CertainTeed “Glasroc,” National Gypsum eXP Tile Backer, or equal embedded glass mat gypsum panels.
H. 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.

2.3 TILE BACKING PANELS

A. Match existing system.

2.4 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. Resilient channels: RC-1/FC-1 by Dale Industries, or equal, fabricated from steel sheet complying with ASTM A 924 or ASTM A 568.
C. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate
D. 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.

E. Acoustic sealants: As specified in Section 07 92 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 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 reference 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: 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 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. Apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
2. Fastening Methods: Fasten base layers with screws; fasten face layers with adhesive and supplementary fasteners at perimeters of boards.

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:

a. Match surrounding finishes.

G. Leave gypsum board surfaces smooth, undamaged and ready to receive scheduled finishes.

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 affected by this scope of work, except as excluded in Paragraphs B and C below. Where an patch or repair is in a wall/ceiling, the entire wall/ceiling shall be painted. is
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 new or restored 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. Finished (not primed) mechanical and electrical equipment including light fixtures, switchgear and distribution cabinets, except as specified in Article 3.4 below.
3. Signage.
4. Parking control equipment.
5. 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. Chain link partitions.
7. Finish hardware, except those items noted USP.
8. Flexible door and window seals and weatherstripping (paint exposed metal to match door frame).
9. Finished metal surfaces such as anodized aluminum, stainless steel, chromium-plating, copper, bronze, brass and similar finished materials will not require finish painting.
10. Painting is not required on walls or ceilings in concealed and inaccessible areas, such as furred areas, pipe spaces, duct shafts and elevator shafts.
11. 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 a 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 the 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 purposes. 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. The Architect will prepare a color schedule with samples for guidance in painting.
C. The Architect may select, allocate, and vary colors and sheens on different surfaces throughout the Work.
D. 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. Apply paint only under conditions that will insure finishes free from blemishes and defects. Leave corners with no undue amount of paint buildup.
3. Use a slightly different shade for each coat of paint so that it may be readily identified.
4. 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.
5. 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.
6. 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.

7. Paint interior surfaces of ducts, where visible through registers and grilles, with a flat nonspecular black paint.
8. 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.
9. 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.

10. 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.

11. 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.
12. 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.
13. 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.
14. 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 following schedule. 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. 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.

B. 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.

3. 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.

C. CMU, Concrete, Brick: Graffiti-Resistant Coating (Permanent Matte Flat)
D. Painted Surfaces

1. Clear Water Repellent

a. Monochem Aquaseal ME12 by Vista Paint.
b. Okon S-20 by Dunn-Edwards.
c. Loxon 7% Siloxane Water Repellent, A10T7 by Sherwin-Williams.

E. 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.

F. 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.

G. 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.

H. 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.

1.2 INTERIOR SURFACES

I. 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.

J. 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.

K. 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.

L. 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.

M. 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.

N. 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.

O. 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.

P. 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.

Q. 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.

R. 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.

S. 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.

T. 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.

U. 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.

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, including handrails and posts 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. Section 05 50 00 for shop-primed ferrous metal.
2. Section 09 90 00 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.

A. System Type: Aromatic Urethane, Zinc-Rich / Aliphatic Acrylic Polyurethane / Advanced Thermoset Solution Fluoropolymer
B. Surface Preparation: SSPC-SP6/NACE 3 Commercial Blast Cleaning with a minimum angular anchor profile of 1.5 mils.
C. 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.

D. Primer (Field Touch-Up): Aromatic Urethane, Zinc-Rich, with 83 percent zinc content by weight in dried film.

1. Tnemec Series 94 H2O Hydro-Zinc at 2.5 to 3.5 mils (65 to 90 microns) DFT.
2. Or equal.

E. Intermediate coat:

1. Tnemec Series 1095 Endura-Shield, 2 to 3 mils (50 – 75 microns) DFT.
2. Or equal.

F. Finish coat:

1. Tnemec Series 1078V at 3 to 5 mils (75 to 125 microns) DFT.
2. Or equal.

G. Gloss range: Semi-Gloss.
H. 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.

I. Finish shall be graffiti resistant.

2.5 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 Hi-Build Epoxoline II @ 2.0 to 4.0 mils DFT.
b. Finish Coat: Tnemec Series 690 Polysiloxane @ 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 22
PLUMBING

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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. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association.
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 the extent and general arrangement of Work under Division 22. Contractor shall coordinate work in accordance with Section 01 3113 requirements and make an adjustment 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 pipes 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, troubleshooting, 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. 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 the 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 the 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 the 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 the 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	

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.

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 the 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. 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.

B. 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
Storm and Overflow Drain	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 with 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: Not used.

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: Not used.

P-5: Not used.

PF-5a: Not Used

PF-5b: Not Used

C. Pipe Isolators:

PLA-1 Absorption pad shall be not less than ½ inch thick, unloaded. Pad shall completely encompass pipe. for copper piping

Manufacturer: Holdrite, LSP, Stoneman, Potter-Roemer, Trisolator, PR-Isolator.

D. 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.

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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.

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 compliances. 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 compliances 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.

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. 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.

3. Threads on pipe shall be cut with sharp, clean, unblemished dies and shall conform to ANSI/ASME B2.1 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. 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.

L. 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.

M. Stainless steel press joints: Joints shall be Vic-Press 304TM, made with Victaulic Series 'PFT' tools and the appropriated 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.

N. 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. 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. 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.

O. 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 counterflashing 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. Counterflashing 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.

P. 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

DIVISION 23

HEATING, VENTILATING, AND AIR-CONDITIONING (HVAC)

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SECTION 23 01 30 - HVAC AIR DUCT CLEANING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. This Section includes cleaning of the following existing air duct systems:

1. Supply system.
2. Return system.
3. Exhaust and Transfer system.

B. Related Requirements:

1. Division 01 - General Requirements.
2. Section 23 3000 - Air Distribution.
3. Section 23 0700 - HVAC Insulation.
4. NADCA Standard ACR.
5. NADCA General Specification for the Cleaning & Restoration of Commercial HVAC Systems.
6. UL181 Standard for Factory-Made Air Ducts and Air Connectors.

1.02 DEFINITIONS

A. ACR: Assessment, Cleaning, and Restoration of HVAC Systems.

B. ASCS: Air systems cleaning specialist.

C. HEPA: High Efficiency Particulate Arrestance.

D. HVAC: Heating, Ventilation and Air Conditioning.

E. NADCA: National Air Duct Cleaners Association.

F. OEHS: Office of Environmental Health & Safety.

G. SDS: Safety Data Sheet.

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

I. UL: Underwriters Laboratories.

1.03 SUBMITTALS

A. Qualification Data for ASCS as indicated on NADCA General Specification.

B. Strategies and Procedures Plan before starting the work.

C. Cleanliness Verification Report at the project completion.

1.04 QUALITY ASSURANCE

A. ASCS Qualifications:

1. Certification: Employ an ASCS certified by NADCA on a full-time basis.

2. Supervisor Qualifications: Certified as an ASCS by NADCA.

B. UL Compliance: Comply with UL 181 “Standard for Factory-Made Air Ducts and Air Connectors” requirement.

C. Cleaning Conference: Conduct conference at Project site. Review methods and procedures related to HVAC air-distribution system cleaning including, but not limited to, review of the cleaning strategies and procedures plan.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine HVAC air-distribution equipment systems to determine appropriate methods, tools, and equipment required for performance of the Work.

B. Perform "Project Assessment and Recommendation" according to current NADCA ACR Standard.

C. Prepare written report listing conditions detrimental to performance of the Work.

D. Proceed with work only after unsatisfactory conditions have been corrected, and OAR’s approval has been obtained.

3.02 PREPARATION

A. Prepare a written plan that includes strategies and step-by-step procedures. At a minimum, include the following:

1. Supervisor contact information.

2. Work schedule including location, times, and impact on occupied areas.

3. Methods and materials planned for each HVAC component type.

4. Required support from other trades.

5. Equipment and material storage requirements.

6. Exhaust equipment setup locations.

B. Use the existing service openings, as required for proper cleaning, at various points of the HVAC system for physical and mechanical entry and for inspection. Refer to Construction Documents for quantities.

C. Comply with current NADCA ACR Standard, "Guidelines for Constructing Service Openings in HVAC Systems" Section.

3.03 CLEANING

A. Comply with current NADCA ACR Standard Requirement.

B. Do not use any chemicals in the process of cleaning unless there is a significant reason. Using any kind of chemicals is subject to the OAR's approval. Prior to the application of any chemical, ASCS is required to submit SDS document of proposed cleaning materials to OAR in order to obtain product approval from OEHS. Do not apply any material unsafe for hard metal surfaces.

C. Systems and Components to be Cleaned by a qualified ASCS:

1. Air devices for supply and return air.

2. Ductwork:

a. Supply-air ducts, including turning vanes and reheat coils, to the air-handling unit.

b. Return-air ducts to the air-handling unit.

c. Exhaust-air and Transfer-air ducts.

D. Perform cleaning before air balancing or mark the position of manual volume dampers and air-directional mechanical devices inside the system prior to cleaning. Restore them to their marked position on completion of cleaning.

E. Use duct-mounted access doors, as required, for physical and mechanical entry and for inspection.

1. Install additional duct-mounting access doors to comply with duct cleaning standards. Comply with requirements in Section 23 3000 "Air Distribution" for additional duct-mounting access doors.

2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection. Replace damaged and deteriorated flexible ducts. Comply with requirements in Section 23 3000 "Air Distribution" for flexible ducts.

3. Disconnect and reconnect flexible connectors as needed for cleaning and inspection. Replace damaged and deteriorated flexible connectors Comply with requirements in Section 23 3000 "Air Distribution" for flexible connectors.

4. Replace damaged fusible links on fire and smoke dampers. Replacement fusible links shall be same rating as those being replaced. Comply with requirements in Section 23 3000 "Air Distribution" for fusible links.

5. Remove and reinstall ceiling components to gain access for duct cleaning. Clean ceiling components after they have been removed and replaced.

F. Particulate Collection and Odor Control:

1. Where venting vacuuming system inside building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron size or greater particles.

2. When venting vacuuming system outside building, use filtration to contain debris removed from the HVAC system and locate exhaust down wind and away from air intakes and other points of entry into building.

G. Clean the following metal-duct system components by removing visible surface contaminants and deposits:

1. Air outlets and inlets: registers, grilles, and diffusers.

2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.

3. Air-handling-unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.

4. Coils and related components.

5. Return-air ducts, dampers, and actuators, except in ceiling plenums and mechanical room.

6. Supply-air ducts, dampers, actuators, and turning vanes.

7. Dedicated exhaust and ventilation components.

H. Mechanical Cleaning Methodology:

1. Source-Removal Cleaning Methods: The HVAC system shall be cleaned using source-removal mechanical cleaning methods designed to extract contaminants from within the HVAC system and to safely remove these contaminants from the facility. No cleaning method, or combination of methods, shall be used that could potentially damage components of the HVAC system or negatively alter the integrity of the system.

a. Use continuously operating vacuum-collection devices to keep each section being cleaned under negative pressure.

b. Cleaning methods that require mechanical agitation devices to dislodge debris that is adhered to interior surfaces of HVAC system components shall be equipped to safely remove these devices. Cleaning methods shall not damage the integrity of HVAC system components or damage porous surface materials such as duct and plenum liners.

2. Cleaning Mineral-Fiber Insulation Components:

   a. Fibrous-glass thermal or acoustical insulation elements present in equipment or ductwork shall be thoroughly cleaned with HEPA vacuuming equipment while the HVAC system is under constant negative pressure and shall not be permitted to get wet according to current NADCA ACR Standard. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.

   b. Cleaning methods used shall not cause damage to fibrous-glass components and will render the system capable of passing the HVAC System Cleanliness Tests, refer to current NADCA ACR Standard.

   c. Fibrous materials that become wet shall be discarded and replaced in-kind.

3. Clean coils and coil drain pans according to current NADCA ACR Standard. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.

4. Provide operative drainage system for wash-down procedures.

5. Biocidal Agents and Coatings: Apply Biocidal agents and coatings if active fungal growth is reasonably suspected or where unacceptable levels of fungal contamination have been verified. Apply Biocidal agents and coatings according to manufacturer's written recommendations and OEHS registration listing after the removal of surface deposits and debris.

   a. When used, Biocidal treatments and coatings shall be applied after the system is rendered clean.

   b. Apply Biocidal agents and coatings directly onto surfaces of interior ductwork.

   c. Sanitizing agent products shall be registered by the OEHS as specifically intended for use in HVAC systems and ductwork.

6. Debris removed from the HVAC system shall be disposed of according to applicable Federal, state, and local requirements.

I. Cleanliness Verification:

1. Verify cleanliness according to current NADCA ACR Standard, "Verification of HVAC System Cleanliness" Section.

2. Verify cleanliness after mechanical cleaning and before application of treatment, including biocidal agents and protective coatings.

3. Perform visual inspection for cleanliness. If no contaminants are evident through visual inspection, the HVAC system shall be considered clean. If visible contaminants are evident through visual inspection, those portions of the system where contaminants are visible shall be re-cleaned and re-inspected.

4. Additional Verification:

   a. Perform surface comparison testing or NADCA vacuum test.

b. Conduct NADCA vacuum gravimetric test analysis for nonporous surfaces.

5. Prepare a written cleanliness verification report. At a minimum, include the following:

a. Written documentation of the success of the cleaning.

b. Site inspection reports, initialed by supervisor, including notation on areas of inspection, as verified through visual inspection.

c. Surface comparison test results if required.

d. Gravimetric analysis (nonporous surfaces only).

e. System areas found to be damaged.

3.04 CONNECTIONS

A. Reconnect ducts to fans and air-handling units with existing flexible connectors after cleaning ducts and flexible connectors. Replace existing damaged and deteriorated flexible connectors.

B. For fans developing static pressures of 5-inch w.g. and higher, cover replacement flexible connectors with loaded vinyl sheet held in place with metal straps.

C. Reconnect terminal units to supply ducts with existing flexible ducts or replace damaged and deteriorated existing flexible ducts with maximum 12-inch lengths of new flexible duct.

D. Reconnect diffusers to low-pressure ducts with existing flexible ducts or replace damaged and deteriorated existing flexible ducts with maximum 60-inch lengths of flexible duct clamped or strapped in place.

E. Reconnect existing and new flexible ducts to metal ducts. Comply with requirements in Section 23 3000 "Air Distribution" for flexible ducts.

3.05 RESTORATION

A. Restore and repair HVAC air-distribution equipment, ducts, plenums, and components according to current NADCA ACR Standard, "Restoration and Repair of Mechanical Systems" Section.

B. Restore service openings capable of future reopening. Comply with requirements in Section 23 3000 "Air Distribution" Include location of service openings in Project closeout report.

C. Replace fibrous-glass materials that cannot be restored by cleaning or resurfacing. Comply with requirements in Section 23 3000 "Air Distribution".

D. Replace damaged insulation according to Section 23 0700 "HVAC Insulation".

E. Ensure that closures do not hinder or alter airflow.

F. New closure materials, including insulation, shall match opened materials and shall have removable closure panels fitted with gaskets and fasteners.

G. Reseal fibrous-glass ducts. Comply with requirements in Section 23 3000 "Air Distribution".

3.06 FIELD QUALITY CONTROL

A. Gravimetric Analysis: Sections of metal-duct system, chosen randomly by OAR may be tested for cleanliness according to NADCA vacuum test gravimetric analysis.

1. If analysis determines that levels of debris are equal to or lower than suitable levels, system shall have passed cleanliness verification.

2. If analysis determines that levels of debris exceed suitable levels, system cleanliness verification will have failed and metal-duct system shall be re-cleaned and re-verified with no additional cost to OWNER.

B. Verification of Coil Cleaning: Cleaning shall restore coil pressure drop to within 10 percent of pressure drop measured when coil was first installed. If original pressure drop is not known, coil will be considered clean only if it is free of foreign matter and chemical residue, based on thorough visual inspection.

C. Report results of tests in writing.

END OF SECTION

SECTION 23 05 00 - COMMON WORK RESULTS FOR HVAC

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. This Section provides the basic mechanical requirements that apply to the Work of Division 23.

B. Related Requirements:

1. Division 01: General Requirements.

2. Division 26: Electrical.

1.02 REGULATORY REQUIREMENTS

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. AMCA - Air Movement and Control Association.

2. ANSI - American National Standards Institute.

3. ASME - American Society of Mechanical Engineers.

a. ASME Boiler and Pressure Vessel Code.

b. ASME B31 - Code for Pressure Piping.

4. AHRI - Air-Conditioning, Heating, and Refrigeration Institute.

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

6. ASTM - American Society for Testing and Materials.

a. ASTM A53 - Specification for Welded and Seamless Pipe.

7. CSA - Canadian Standards Association.

8. FM Global - Factory Mutual Global

9. IAPMO - International Association of Plumbing and Mechanical Officials.

10. NFPA - National Fire Protection Association.

11. OSHA - Occupational Safety and Health Administration.

12. SMACNA - Sheet Metal and Air Conditioning CONTRACTORs' National Association.

13. UL - Underwriters Laboratories Inc.

14. 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 Mechanical Code.

a. Latest edition as adopted by the City of Compton Los Angeles , 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 23 sections, as applicable.

B. After Architect's approval, 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 3113: 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 3113 and Section 01 3300 and shall indicate at a minimum:

1. Complete system layout of equipment, components, ductwork, and piping, indicating service clearances, duct and pipe sizes, fitting types and sizes, top or bottom of duct and pipe elevations, distances of ducts, pipes and equipment from building reference points and hanger / support locations. All the above items shall be coordinated on the shop drawings according to the requirements of Section 01 3113.

2. Schedule and description of equipment, ductwork, piping, fittings, valves, dampers, and controllers.

1.04 PROJECT RECORD DOCUMENTS

A. Comply with provisions of Section 01 7700: Contract Closeout.

B. Project Record Drawings:

1. Provide a complete set of mechanical and control system drawings in AutoCAD and, if available, 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 three 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 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 manuals. Manuals shall be bound in accordance to Section 01 7700. 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) Pre-start checklist and start-up procedures.

      3) Normal operation settings and checklists.

      4) Pre-shut down checklist and shut down procedures.

      5) Trouble shooting checklist and guidelines.

      6) Recommendations for optimum performance.

      7) 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 23 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 mechanical 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 01 4525.

   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 23. 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 mechanical 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 Project 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 8 hours of on-site overview of the overall Mechanical System.

2. Refer to Division 23 sections for specific training on each of the components of the Mechanical System.

3. A minimum of 8 hours of on-site overview identifying location and function of all Control Valves and Actuator assemblies.

4. A minimum of 40 hours of (in classroom) software training for a minimum of 20 OWNER personnel on EMS/BMS if such systems are utilized in the project. Training shall be conducted at control CONTRACTOR training facility with computer setup for each person attending.

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. HVAC equipment products from different manufacturers are never identical. Equipment approved as being equal is interpreted as being equivalent in capacity, performance and quality. The dimensions, weight, configuration and utility requirements could be quite different from the equipment used as the basis of design. Due to these differences, additional coordination and adjustments by the CONTRACTOR are required. For the equipment to be deemed truly equal, the additional coordination and adjustments by the CONTRACTOR should not incur any additional cost to the Owner and any additional labor to the design team.

D. 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. All the additional protective measures against outdoor weather required by the manufacturers' installation instructions and prevalent practice shall be provided.

E. For substitution of materials or products, refer to the General Conditions.

PART 3 – EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

A. CONTRACTOR shall arrange for a preconstruction meeting with IOR prior to the installation of refrigerant piping to discuss installation and testing requirement.

3.02 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.

3.03 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 or ducts pass through or are located within one inch of any construction element, install a resilient pad, 1/2 inch thick minimum, to prevent contact.

C. Furnish all necessary provisions for recesses, chases, and accesses and provide blocking and backing as necessary for proper reception and installation of mechanical Work.

3.04 LOCATION OF PIPING AND EQUIPMENT

A. Location of piping, apparatus and equipment as indicated on 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.

3.05 VALVE AND SPECIALTY APPLICATIONS

A. Install thermostatic/ electronic expansion valves as close as possible to distributors on evaporators.

1. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line.

2. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.

B. Install safety relief valves where required by ASME Boiler and Pressure Vessel Code. Pipe safety-relief-valve discharge line to outside according to ASHRAE 15.

C. Install moisture/liquid indicators in liquid line near condensing unit.

D. Install filter dryers in liquid line between compressor and thermostatic expansion valve.

E. Consult refrigeration equipment manufacturer to determine the need for a receiver.

F. Install receivers sized to accommodate pump-down charge.

G. See Evaluations for discussion of flexible connectors.

H. Install flexible connectors at condensing unit.

3.6 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems; indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings.

B. Install refrigerant piping according to ASHRAE 15.

C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping adjacent to machines to allow service and maintenance.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Select system components with pressure rating equal to or greater than system operating pressure.

J. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.

K. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Division 08 Section "Access Panels Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.

L. Install refrigerant piping in protective conduit where installed belowground.

M. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.

N. Slope refrigerant piping as follows:

1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
2. Install horizontal suction lines with a uniform slope downward to compressor.
3. Install traps and double risers to entrain oil in vertical runs.
4. Liquid lines may be installed level.

O. When brazing or soldering nitrogen must be presented and flow in the piping, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.

P. Retain first paragraph and subparagraphs below for steel pipe. Review the cost of steel pipe using these procedures versus the cost of copper piping. Also consider limiting the size of the refrigerant system and its piping to avoid the use of steel pipe.

Q. Install pipe sleeves at penetrations in exterior walls and floor assemblies.

R. Seal penetrations through fire and smoke barriers according to Division 07 Section "Penetration Firestopping."

S. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.

T. Install sleeves through floors, walls, or ceilings, sized to permit installation of full-thickness insulation.

U. Seal pipe penetrations through exterior walls according to Division 07 Section "Joint Sealants" for materials and methods.

V. Identify refrigerant piping and valves according to Division 23 Section "HVAC Identification."

3.7 PIPE JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Fill pipe and fittings with an inert gas (nitrogen), during brazing or welding, to prevent scale formation.

D. Soldered Joints: Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook."

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."

1. Use Type BcuP, copper-phosphorus alloy for joining copper socket fittings with copper pipe.
2. Use Type BAg, cadmium-free silver alloy for joining copper with bronze or steel.

F. Welded Joints: Construct joints according to AWS D10.12/D10.12M.

3.08 TESTS AND TESTING

A. Tests shall be as required under the applicable sections of Division 23, including this Section.

B. Tests required by other sections of the Contract Documents include the following:

1. Test and balance of mechanical equipment and systems: Refer to Section 01 4525: Testing, Adjusting, and Balancing for HVAC.

2. Hydrostatic test of boilers: Refer to Section 01 4525: Testing, Adjusting, and Balancing.

3. Test of smoke and fire detectors: Refer to Division 26: Electrical.

C. 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.

D. Piping Tests:

1. Perform tests required to demonstrate that operation of mechanical 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 Project Inspector of Record and Owner Authorized Representative. Work shall not be concealed or covered until required results are provided.

2. Pressure gages furnished in testing shall comply with CPC. Air shall be bled from lines requiring hydrostatic or water tests.

3. 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 48 hours at test pressures indicated. Where local codes require higher test pressures than specified herein for fire sprinkler systems, local codes shall govern.

4. 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.

5. Piping systems could be tested as a unit or in sections, but entire system shall successfully meet requirements specified herein, before final testing by the Project Inspector.

6. Repair of damage to pipes and their appurtenances or to any other structures resulting from or caused by these tests, shall be provided.

7. Refrigerant piping shall be pressure tested by using a calibrated electronic testing equipment.

8. Refrigerant Piping Brazing and Deburring Testing procedures for each building:

   a. OWNER will randomly select maximum Two installed split systems serving each building for the inspection of proper brazing and deburring of associated refrigerant piping systems. Maximum Two copper fittings within the piping systems shall be randomly selected by OWNER and cut and removed by CONTRACTOR for inspection.

   b. If a sign of oxidation is found on any selected fittings or adjacent piping, then the tested split system piping, and all connected equipment including evaporator and condensing unit with sign of oxidation shall be removed and replaced in entirety by CONTRACTOR at no additional cost to OWNER.

   c. If a burr is found on any selected joint, then the entire tested refrigerant piping system shall be removed and replaced by CONTRACTOR at no additional cost to OWNER.

   d. CONTRACTOR shall repair all tested systems after OWNER's inspection and approval at no additional cost to OWNER.

   e. Inspector of Record shall be present during the replacement of the defective systems and the repair of the tested systems by CONTRACTOR.

   f. If one or more selected split systems fail, then Two additional split systems (not including the ones previously tested) shall be selected for further testing. Selection of additional split systems and retesting will be performed until neither oxidation nor bur is found within the tested systems.

9. Pipe Testing Schedule:

System Tested	Test Pressure (psig)	Test With:
Steam piping, hot water heating system piping and chilled water piping	150	Water
Vacuum pump or condensate pump discharge and condensate return piping	150	Water
Refrigeration piping	600	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 heating, ventilating, and air conditioning equipment and systems for a period of not less than two 8 hour periods at 90 percent of the full specified heating and cooling capacities. If equipment passes, install new filters. If equipment fails, it shall be adjusted and retested until system meets all applicable codes.

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, mechanical equipment and systems shall be operated and tested as indicated in Paragraph 3.04.F above to demonstrate satisfactory overall operation of the installed systems.

3. Immediately before starting tests, air filter media shall be cleaned or renewed. Roll-type filters shall be advanced to provide new clean media. Cleanable type media shall be thoroughly cleaned and re-oiled with new, clean oil as recommended by manufacturer if they are of viscous impingement type. Disposable type filters shall be replaced with new filters. Replaceable media shall be replaced with new media.

4. An accurate means of measuring air flow and temperatures shall be furnished to balance air supply, return, and exhaust systems so uniform temperatures occur in every room and design airflow is obtained through registers, diffusers, and grilles.

5. Systems shall be adjusted to provide airflows indicated including maximum fresh air and maximum return air. Dampers shall be checked for proper settings and operation. Air and water inlet and leaving temperatures at coils shall be checked. Complete operational

data including airflows, room temperatures, fan speeds, motor currents, plenum, and duct static pressures shall be tabulated.

6. Welding performed as part of this Division may be subject to radiographic inspections at random in accordance with requirements specified in Section 23 0513: Basic HVAC Materials and Methods.

3.09 NOISE AND VIBRATION REDUCTION

A. Correct noise or vibration caused by mechanical 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.

3.10 PROTECTION, CARE AND CLEANING

A. In addition to storage criteria of the General Conditions, and provisions under Section 01 5000: 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, pipe coils, pumps, compressors and similar equipment.

5. Interior of ductwork shall be maintained free of dirt, grit, dust, loose insulation, and other foreign materials.

6. Air handling equipment shall not be operated until building is cleaned and air filters are installed.

7. 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.

8. 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. Refrigerant piping shall be cleaned as specified.

END OF SECTION

SECTION 23 05 48 - HVAC 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 4525: Testing, Adjusting, and Balancing for HVAC.

3. Section 23 0500: Common Work Results for HVAC.

4. Section 23 0513: Basic HVAC Materials and Methods.

6. Section 23 3000: Air Distribution.

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.

d 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 0513 under Hanger Spacing Schedule.

   d. SMACNA Seismic Restraint Manual: Guidelines for Mechanical Systems and approval by DSA.

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.

   c. Installer may provide a DSA or OSHPD approved system such as the SMACNA Seismic Restraint Manual with Addendum No. 1, the Mason Industries Seismic Restraint Guidelines or other proprietary pre-approved system.

7. For ductwork and other mechanical equipment restraints, comply with SMACNA Seismic Restraint Manual: Guidelines for Seismic Mechanical Systems and obtain approval by DSA.

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. 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.

C. Flexible pipe or conduit connections shall be provided at piping and conduit connections to HVAC units, pumps, compressors and other moving (reciprocating or rotating) mechanical or electrical equipment provided under this Section whether indicated on the drawings or not.

D. Flexible connections for Freon piping shall be seamless flexible metal hoses of type and length recommended by manufacturer and suitable for system operating pressure.

E. 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.

F. 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.

G. 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.

H. 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.

I. 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:

he 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 0700: HVAC Insulation.

C. Flexible Ducts: As indicated in Section 23 0700: HVAC 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.

ransferred to isolator until installation is complete and under full operational load.

H. Air Compressors, Water Chillers, 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. 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.

J. 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.

K. 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

L. 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.

M. 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.

N. 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.

O. 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.

P. 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 - HVAC 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 3000: Air Distribution.

1.02 SUBMITTALS

A. Submit in accordance with Division 01 and Section 23 0500: Common Work Results for HVAC.

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 0500: Common Work Results for HVAC.

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
Steam	Steam	Yellow	Black
Steam condensate	Stm. Cond.	Yellow	Black
Chilled water supply	Chill water supply	Green	White
Chilled water return	Chill water return	Green	White
Instrument air	Inst. Air	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. Yellow: Steam.

   b. Blue: Water.

   c. Red: Electric power lines, cables, conduit and lighting cables. By Division 26.

   d. 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 - HVAC INSULATION

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Condensate drain piping from air conditioning equipment.
2. Vacuum and condensate pump discharge lines over 50 feet in length.
3. High and low temperature equipment.
4. Heating hot water supply and return piping.
5. Chilled water supply and return piping.
6. Refrigerant piping.
7. Supply and return air ducts for heating and cooling systems air ducts.

B. Related Requirements:

1. Division 01: General Requirements.
2. Section 23 0500: Common Work Results for HVAC.
3. Section 23 0513: Basic HVAC Materials and Methods.
4. Section 23 0553: Mechanical Identification.
5. Section 23 3000: Air Distribution.

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 0500: Common Work Results for HVAC.

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 0500: Common Work Results for HVAC and Section 23 0513: Basic HVAC Materials and Methods.

B. Test Ratings:

1. Comply with provisions stated under Section 23 0500 and 23 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.

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: Common Work Results for HVAC and 23 0513: Basic HVAC 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)
Space Heating Systems (Steam, Steam Condensate and Hot Water)

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**
Hi Pres Temp	Above 350	1.5	2.5	2.5	3.0	3.5	3.5
Med Pres Temp	251 to 305	1.5	2.0	2.5	2.5	3.5	3.5
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
Steam Cond.	-	0.5	1.0	1.0	1.0	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/Brine	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 2016 Underground HVAC 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 HIGH TEMPERATURE EQUIPMENT INSULATION

A. General:

1. Insulate heat exchangers, hot water storage tanks, flash tanks, boiler breechings, and similar equipment operating at elevated temperatures up to 450 degrees F or 850 degrees F with high temperature insulation, jacket and material.

2. Do not insulate condensate receivers, hot water expansion tanks, hot water pump casings, chemical feeders, and factory insulated boilers.

B. Materials:

1. Equipment insulation shall be 1½-inch minimum fiberglass board or insulating blocks, or molded calcium silicate, ASTM C533-Type I, Johns Manville Thermo-12 Gold or 1000 Series Spin-Glas, Knauf Insulation Board, Owens Corning Fiberglas Series 700 or Fiberglas Insul-Quick, or equal.

2. Boiler breeching insulation shall be same as above except 2-inch thick minimum.

3. Adhesive: For calcium silicate, furnish fibrous adhesive of sodium silicate base.

2.05 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.

2.06 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 HEATING PIPING SYSTEM INSULATION

A. General: Space heating hot water, 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, hot water heating supply and return piping, steam and steam condensate 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 23 0513: Basic HVAC 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-inch thick aluminum jacket with 2-inches lap connected with 1-inch hem overlap joint located on side of pipe and turned down to shed water. Jacket shall be strapped 12-inch on center with ½-inch wide stainless-steel strapping and wing seals. Aluminum jacket shall be mitered to fit fittings.

3.03 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.

3.04 INSTALLATION OF HIGH TEMPERATURE EQUIPMENT INSULATION

A. General: Provide insulation over parts of heat exchangers and similar equipment requiring insulation having removable head or sections.

B. Application:

1. Equipment: Securely tie insulation on with copper clad wire. Install tack coat weather barrier coating at a thickness specified by manufacturer. While tack coat is still wet, a layer of 10 open weave glass cloth membrane shall be embedded with fabric seams overlapped a minimum of 2-inch. Install a finish coat fully covering membrane at coverage rate specified by manufacturer.

2. Boiler Breechings: Wire securely V-rib wire lath, ¾-inch minimum depth to boiler breechings, connections and stacks inside boiler rooms, and cover with insulation and jacket as specified above.

3. Manholes and Hand Holes: Maintain accessible by beveling off permanent insulation around manhole and cover manhole plate with removable blanket.

3.05 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.

3.06 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.

3.07 CLEANUP

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.

END OF SECTION

SECTION 23 30 00 - 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 9000: Painting and Coating.

3. Section 23 0500: Common Work Results for HVAC.

4. Section 23 0513: Basic HVAC Materials and Methods.

5. Section 23 0548: HVAC Sound, Vibration and Seismic Control.

6. Section 23 0700: HVAC Insulation.

1.02 SUBMITTALS

A. Provide in accordance with Division 01 and Section 23 0500: Common Work Results for HVAC.

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 0500: Common Work Results for HVAC.

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 0500: Common Work Results for HVAC.

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 0500: Common Work Results for HVAC.

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 SMACNA, and 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 SMACNA 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. Stainless Steel Duct: N/A

L. 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 SMACNA manual.

M. 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.

N. 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: N/A

C. Grilles - Return, Exhaust, Ceiling, Square, Rectangular: N/A

D. Registers, Supply, Return, Wall: N/A

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 the SMACNA manuals and CMC, 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 SMACNA 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 SMACNA and 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 SMACNA 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 SMACNA 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 SMACNA 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 trademark 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 SMACNA 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

DIVISION 26
ELECTRICAL

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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, 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 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.

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, 7'-6" 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 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	White (Common)Black

elementary schools)	
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 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

DIVISION 28
ELECTRONIC SAFETY & SECURITY

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SECTION 28 31 00 - FIRE DETECTION AND ALARM

PART 1 - GENERAL

1.1 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 21 13 13: Fire Suppression Sprinkler Systems.
3. Section 23 80 00: Mechanical Equipment.
4. Section 26 05 00: Common Work Results for Electrical.
5. Section 26 05 13: Basic Electrical Materials and Methods.
6. Section 26 05 19: Low-Voltage Wire (600 Volt AC).
7. Section 26 05 26: Grounding and Bonding.
8. Section 26 05 33: Raceways, Boxes, Fittings, and Supports.

1.2 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.

1.3 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.

1.4 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.

1.5 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. 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.

J. 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.

1.6 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.

1.7 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.

1.9 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.

1.10 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

2.1 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.

2.2 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.

2.3 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.

2.4 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.

2.5 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° 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° 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° 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

3.1 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. 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.

3.2 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 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.

M. 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.

3.3 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. 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.

9. 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.

10. 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.

11. 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.

12. 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.

13. 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.

14. 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.

15. 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
F	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

3.3 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. Duct type smoke detectors shall, in addition to the above functions, shut down the ventilation system or close associated control dampers as required.
5. Activation of fire sprinkler system low-pressure switches, post indicator valve or tamper switches shall initiate a system supervisory alarm indication.
6. UL listed central station shall be notified via – Universal Digital Alarm Communicator Transmitter (UDACT).

3.4 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.

3.5 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.

3.6 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).

3.7 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.

3.8 PROTECTION

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

3.9 CLEANUP

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

END OF SECTION

DIVISION 31
EARTHWORK

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SECTION 311100 - SITE CLEARING AND GRUBBING

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. Protection of existing trees indicated to remain.
2. Removal of trees and other vegetation.
3. Topsoil stripping.
4. Clearing and grubbing.
5. Removing above-grade improvements.

1.3 PROJECT CONDITIONS

A. Traffic: Conduct site-clearing operations to ensure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities. Do not close or obstruct city streets, walks, or other occupied or used facilities without permission from owner or authorities having jurisdiction.

B. Protection of Existing Improvements: Provide protections necessary to prevent damage t existing improvements indicated to remain in place.
1. Protect improvements on adjoining properties 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 all existing utility lines not scheduled for removal. Notify Owner immediately of any damage to or encounter with an unknown existing utility line. Immediately repair damage to existing utility lines.

C. Protection of 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.
1. 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.
2. Replace trees that cannot be repaired and restored to full-growth status, as determined by arborist.

D. Salvable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises where indicated or directed.

1.4 EXISTING SERVICES

A. Contractor to determine exact locations of utilities before commencing Work. Contractor to protect all existing utilities within limit of construction work.

B. Where necessary, contractor shall coordinate relocation of irrigation pipe and appurtenant structures with owner

PART 2 – PRODUCTS

2.1 MATERIALS

A. Tree Wound Paint: Bituminous based paint of standard manufacture specially formulated for the intended use.

PART 3 - EXECUTION

3.1 SITE CLEARING

A. General: 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. Topsoil: 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 erosion.
   3. Dispose of unsuitable or excess topsoil as specified for disposal of waste material.

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 312000 “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. Removal of Improvements: Remove existing above-grade improvements as indicated and as necessary to facilitate new construction.

3.2 DISPOSAL OF WASTE MATERIALS

A. Burning on Owner's Property: Burning is not permitted on Owner's property.

B. Removal from Owner's Property: Remove waste materials and unsuitable or excess top soil from Owner's property.

END OF SECTION

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SECTION 31 23 00 - EXCAVATING, BACKFILLING AND COMPACTING FOR PAVEMENT

PART 1 - GENERAL

1.01 SUMMARY

A. Provisions of Division 01 apply to this section.

B. Section Includes:

1. Excavating, backfill, and compacting for paved areas.

2. Installation of fill materials.

C. Related Sections:

1. Section 312200: Grading.

2. Section 312333: Excavating, Backfilling and Compacting for Utilities.

3. Section 311000: Site Clearing.

1.02 SYSTEM DESCRIPTION

A. Import and Export of Earth Materials:

1. Fees: Pay as required by authorities having jurisdiction over the area.

2. Bonds: Post as required by authorities having jurisdiction over the area.

3. Haul Routes and Restrictions: Comply with requirements of authorities having jurisdiction over the area.

1.03 SUBMITTALS

A. Imported Soils: A geotechnical engineer, retained by the Owner as an Owner Consultant, shall obtain initial product Sample for testing in accordance with the terms of sub-section 3.05 of this section.

1.04 QUALITY ASSURANCE

A. Comply with Standard Specifications for Public Works Construction, current edition, except as modified herein.

B. Sampling, testing, and certification of imported and/or exported soils shall be performed in accordance with Division 1.

1.05 PROJECT CONDITIONS

A. Information on Drawings or in soils report does not constitute a guarantee of accuracy or uniformity of soil conditions over the Project site.

B. A copy of the foundation investigation and soils report is available for examination at the Architect's office during regular office hours of Architect.

PART 2 - PRODUCTS

2.01 BASE MATERIALS

A. Concrete Slabs On Grade: Provide "Crushed Aggregate Base "as specified in the Standard Specifications for Public Works Construction, Section 200: "Rock Materials," with ¾ inch maximum size aggregates. Provide 3-inch-thick base, unless noted otherwise.

2.02 FILL AND BACKFILL MATERIALS

A. Fill and backfill materials shall be previously excavated materials or imported fill material, free of clods and stones larger than 3 inches, foreign materials, vegetable growths, sod, expansive soils, rubbish and debris. Material shall conform to these specified requirements and related sections.

B. Fill material exhibiting a wide variation in consistency and/or moisture content shall be blended and/or aerated to stabilize and upgrade the material.

C. Imported Fill Material:

1. Provide suitable materials obtained from Project site excavations for earthwork and fill materials. If excavated materials are not of suitable quality or sufficient quantity, import additional materials as necessary.

2. Imported fill shall be a granular material with sufficient binder to form a firm and stable unyielding subgrade and shall not have more than 60 percent of fines passing 200 mesh sieve. Material shall have a coefficient of expansion of not more than 2 percent from air dry to optimum moisture content and not more than 6 percent from air dry to saturation. Imported material shall be clean and free of rubbish, debris, and toxic or hazardous contaminants. Adobe or clay soils are not permitted.

D. Other Fill Materials: Brick rubble and broken concrete originating from the Project site may be legally disposed of off the Project site or incorporated in fill, if reviewed by a geotechnical engineer, retained by the Owner as an Owner Consultant. Unless otherwise required, no such materials may be imported from outside the Project site.

E. Permeable Backfill:

1. Provide permeable backfill material behind retaining structures consisting of gravel, crushed gravel, crushed rock, natural sands, manufactured sand, or combinations of these materials conforming to the following gradations:

Sieve Size:	Percentage Passing:
3/4 inch (19mm)	100
3/8 inch (10mm)	80-100
No. 100	0-8
No. 200	0-3

2. Those portions of fill material passing a No. 4 sieve shall provide a sand equivalent of at least 60.

3. Provided backing for weep-holes shall consist of 2 cu. ft. of aggregate in burlap sacks, securely tied. Aggregate shall conform to requirements for No. 3 concrete aggregate as specified in subsection 200-1.4 of the Standard Specifications for Public Works Construction.

4. Permeable Backfill Alternate Materials: Instead of the materials specified for retaining structures backfill, a drainage matting system such as Miradrain by Mirafi, Inc., or equal, may be provided if reviewed by the Architect.

PART 3 - EXECUTION

3.01 SITE PREPARATION

A. Clear the Project site as required in Section 02110: Site Clearing.

3.02 PROTECTION

A. Protect and guard excavations against danger to life, limb, and property as required by, but not limited to, OSHA regulations.

B. Protect adjacent existing improvements including landscaping against damage.

3.03 EXISTING UTILITY LINES

A. Protect existing utility lines from damage or displacement.

B. Remove conduits or pipes not in service, exposed during Work, unless a minimum cover of 2 feet is provided. Remove concrete, clay or other non-metallic pipe over 8 inches in diameter, unless otherwise indicated.

3.04 EXCAVATION

A. Unclassified Excavations: Comply with the Standard Specifications for Public Works Construction, Section 300: "Earthwork," except as modified herein.

3.05 FILL

A. Unclassified Fill and Compaction: Comply with the Standard Specifications for Public Works Construction, Section 300: "Earthwork," except as modified herein.

B. Provide fill materials as specified in Part 2 – Products. If excavated materials from the Project site are not of required quality or sufficient quantity, import additional materials as necessary.

C. In addition to the requirements of this section, import and/or exported materials shall comply with the requirements of Division 1.

D. Imported fill materials shall be sampled by a geotechnical engineer, retained by the Owner as an Owner Consultant, for compliance with the requirements of Part 2 of this section.

E. The geotechnical engineer, retained by the Owner as an Owner Consultant, shall submit all samples to a DSA approved independent approved testing laboratory for testing.

F. Initial sampling shall be performed by the geotechnical engineer, retained by the Owner as an Owner Consultant, before importing material to the Project site. Identify the location of the source site in addition to the address, name of the person and/or entity responsible for the source site. The geotechnical engineer, retained by the Owner as an Owner Consultant, shall obtain both the initial and additional samples from the identified site and shall submit all samples to the approved independent testing laboratory for testing.

G. The geotechnical engineer, retained by the Owner as an Owner Consultant, shall perform additional sampling during import operations. If the total quantity of import is determined to be greater than 1000 cubic yards of material, one sample shall be obtained and submitted for testing tested for each 250 cubic yards of imported material. If the total quantity of import is determined to be less than 1000 yards, one sample shall be obtained and submitted for testing for each 100 cubic yards of imported material.

H. The independent approved testing laboratory shall perform the required tests and report results of all tests noting if the tested material passed or failed such tests and shall furnish copies to the IOR, Architect, OAR, DSA, Contractor, and others as required. Report shall state tests were conducted under the responsible charge of a licensed State of California professional engineer and the material was tested in accordance with applicable provisions of the Contract Documents, Title 24, CCR and the DSA. Upon completion of the Work of this section, the independent testing laboratory and geotechnical engineer shall submit a verified report to the DSA as required by Title 24, CCR.

I. Bills of lading or equivalent documentation will be submitted to the IOR on a daily basis.

J. Upon completion of import operations, provide the OAR a certification statement attesting that all imported material has been obtained from the identified source site.

3.06 INSTALLATION OF MATERIALS

A. Fill or backfill materials shall be installed in horizontal layers of 6 inches, unless otherwise required. Each layer shall be evenly placed and moistened or aerated as necessary. Unless otherwise reviewed by the geotechnical engineer, retained by the Owner as an Owner Consultant, each layer of fill material shall cover the length and width of the area to be filled before the next layer of material is installed. Top surface of each layer shall be installed to an approximate level with a crown or crossfall of at least 1 in 50, but no more

than 1 in 20. Provide adequate drainage at all times during construction of the Work of this section.

3.07 COMPACTING

A. Each layer of fill material shall be compacted by tamping, sheepsfoot rollers, or pneumatic-tired rollers to provide specified relative compaction. At inaccessible locations, provide specified compaction by manually held, operated and directed compaction equipment.

B. Unless otherwise indicated, compact each layer of earth fill to a relative compaction of at least 90 percent.

C. When fill materials, or a combination of fill materials, are encountered or provided which develop densely packed surfaces as a result of installation or compacting operations, scarify each compacted layer before installing the next succeeding layer.

3.08 INSPECTION AND TESTING

A. The geotechnical engineer, retained by the Owner as an Owner Consultant, will inspect and test excavations, sample material quality as required in Part 2, and observe installation and compaction of fill materials.

B. The geotechnical engineer, retained by the Owner as an Owner Consultant, will sample imported fill materials from their designated source before delivery to the Project site.

C. Installation of backfill shall be observed by the geotechnical engineer, retained by the Owner as an Owner Consultant.

D. The geotechnical engineer, retained by the Owner as an Owner Consultant, will inspect and test excavation Work before the installation of fill and/or other materials.

E. Compaction: Test compaction in accordance with ASTM D 1557, Method C.

3.09 PROTECTION

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

3.10 CLEANING

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

END OF SECTION

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SECTION 31 23 33 - EXCAVATING, BACKFILLING AND COMPACTING FOR UTILITIES

PART 1 - GENERAL

1.01 SUMMARY

A. Provisions of Division 01 apply to this section.

B. Section Includes:

1. Excavating, backfilling, and compacting utility trenches such as water, gas, irrigation, storm drain, sewer lines, concrete-encased conduits, and manholes, vaults, valve boxes, catch basins, underground tanks, thrust blocks, yard boxes, pull boxes and other utility appurtenances.

C. Related Sections:

1. Section 311000: Site Clearing.
2. Section 312200: Grading.
3. Section 312333: Excavating, Backfilling and Compacting for Utilities.
4. Division 23: Mechanical.
5. Division 26: Electrical.

1.02 SYSTEM DESCRIPTION

A. Import and Export of Earth Materials:

1. Fees: Pay as required by authorities having jurisdiction over the area.

2. Bonds: Post as required by authorities having jurisdiction over the area.

3. Haul Routes and Restrictions: Comply with requirements of authorities having jurisdiction over the area.

1.03 SUBMITTALS

A. Imported Soil: A geotechnical engineer, retained by the Owner as an Owner Consultant, shall obtain initial product sample for testing in accordance with the terms of sub-section 3.05 of this section.

1.04 QUALITY ASSURANCE

A. Comply with the following as a minimum requirement: Standard Specifications for Public Works construction, current edition except as modified herein.

B. Sampling, testing, and certification of imported and/or exported soils shall be performed

in accordance with Division 1.

1.05 PROJECT CONDITIONS

A. Information on Drawings or in soils report does not constitute a guarantee of accuracy or uniformity of soil conditions over the Project site.

B. A copy of the foundation investigation and soils report is available for examination at the Architect's office during regular business hours of Architect.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Bedding material from trench bottom to one foot above the pipe:

1. Sand, gravel, crushed aggregate or native free-draining granular material providing a sand equivalent of at least 30 or a coefficient of permeability greater than 1.4 inches per hour.

2. Sand complying with the Specifications for cement concrete aggregates.

B. Backfill Materials:

1. Excavated trench material to be installed for backfilling shall be clean, free of large clods, and stones larger than 2-1/2 inches in any dimension.

2. Cement-sand slurry shall be provided with 1 sack of cement per cubic yard of the mixture.

3. Imported Fill Material: Imported fill material shall be a granular material with sufficient binder to form a firm and stable unyielding subgrade and shall not have more than 60 percent of fines passing a 200 mesh sieve. Material shall provide a coefficient of expansion of not more than 2 percent from air dry to optimum moisture content and not more than 6 percent from air dry to saturation. Imported materials shall be clean and free of rubbish, debris, and toxic or hazardous contaminants. Adobe or clay soils are not permitted.

PART 3 - EXECUTION

3.01 GENERAL

A. Before excavation, contact the "Underground Service Alert of Southern California" (USASC) for information on buried utilities and pipelines.

B. Barricade trenches, ditches, pits, sumps, and similar Work outside the barricaded working area with chain link fence as specified in Division 1 and in accordance with Cal-OSHA standards and requirements.

C. Saw-cut concrete or bituminous paving for trench installation.

D. Trenches over 5 feet in depth shall conform to the Construction Safety Orders of the California Division of Industrial Safety.

E. Where indicated and/or required to excavate in lawn areas, protect adjoining lawn areas outside of the Work area. Replace or install removed sod upon completion of backfill by installing sod level with adjacent lawns. If installation of removed sod fails, furnish sod and install to match existing lawns.

F. Backfill over excavations to the required elevations with earth, gravel, sand, or concrete and compact as required. Provide excavations free from standing water by pumping, draining, or providing protection against water intrusion. Slope adjacent grades away from excavations to minimize entry of water.

G. Do not install piping lengthwise under concrete walks without review by the Architect.

H. Do not excavate trenches parallel to footings closer than 18 inches from the face of the footing or below a plane having a downward slope of 2 horizontal to one vertical, from a line 9 inches above bottom of footings.

1. Unless otherwise indicated on Drawings, depth of excavations outside the buildings shall allow for a minimum coverage above top of pipe, tank, or conduit measured from the lowest adjoining finished grade, as follows:

Steel Pipe	24 inches below finished grade
Copper Water Tube	18 inches below finished grade
Cast-Iron Pressure Pipe	36 inches below finished grade
Plastic Pipe (other than waste)	30 inches below finished grade
Tanks or other structures	36 inches below finished grade
Soil, Sewer & Storm Drain	minimum 18 inches below finished grade, and as required for proper pitch and traffic load. (Install polypropylene sewer pipe with at least 24 inches coverage)
Irrigation Pipe:	non-pressure pipe - 12 inches, pressure pipe 24 inches

2. Trench width shall provide ample space for fitting and joining. Excavate for piping bells and fittings, bell and spigot pipe and other fittings.

I. Unless indicated otherwise, excavate trenches to the required depths for utilities, such as pipes, conduit and tanks, with minimum allowances of 6 inches at the bottom and 6 inches at the sides for bedding of unprotected piping or as required for concrete encasement of conduits as indicated on Drawings. Grade bottom of trenches to a uniform

smooth surface. Remove loose soil from the excavation before installing sand bedding or concrete encasement.

J. Provide excavations free from standing water by pumping, draining, or providing protection against water intrusion. If soil becomes soft, soggy, or saturated, excavate to firm undisturbed soil and fill as required. Slope adjacent grades away from excavations to minimize entry of water.

K. Provide a minimum clear dimension of 2 inches from sides of wall excavation to outer surfaces of buried pipes or conduits installed in the same trench or outside surfaces of containers and/or tanks.

L. Do not install backfill until required inspections and testing is completed.

M. Backfill electrical or other excavated utility trenches located outside of barricaded installation areas within 24 hours after inspection by the IOR.

N. Install backfill materials in layers not exceeding 4 inches in thickness and compact to 95 percent of the maximum density.

O. If materials excavated from the Project site are not permitted for trench backfill in paved areas, backfill trenches with a cement-sand slurry mix. Install backfill to an elevation of the existing undisturbed grade plus one inch.

P. Install and compact sand bedding to provide a uniform full length bearing under piping and conduits.

Q. Where portions of existing structures, walks, paving, or other improvements are removed or cut for piping or conduit installation, replace the material with equal quality, finished to match adjoining existing improvements. Repair pavement as specified in Section 02765: Pavement Repair.

3.02 IMPORT/EXPORT OF MATERIALS

A. Provide fill materials as specified in Part 2- Products. If excavated materials from the Project site are not of required quality or sufficient quantity, import additional materials as necessary.

B. In addition to the requirements of this section, import and/or exported materials shall comply with the requirements of Division 1.

C. Imported fill materials shall be sampled by a geotechnical engineer, retained by the City as a City Consultant, for compliance with the requirements of Part 2 of this section.

D. The geotechnical engineer, retained by the City as a City Consultant, shall perform the tests by utilizing an independent approved testing laboratory.

E. Initial sampling shall be performed by the geotechnical engineer, retained by the City as a City Consultant, before importing material to the Project site. Identify the location of the source site in addition to the address, name of the person and/or entity responsible for the source site. The geotechnical engineer, retained by the City as a City Consultant,

shall obtain both the initial sample and additional samples from the identified site and shall submit all samples to the approved independent testing laboratory.

F. The geotechnical engineer, retained by the City as a City Consultant, shall perform additional sampling during import operations. If the total quantity of import is determined to be greater than 1000 cubic yards of material, one sample shall be obtained and submitted for testing for each 250 cubic yards of imported material. If the total quantity of import is determined to be less than 1000 yards, one sample shall be obtained and submitted for testing for each 100 cubic yards of imported material.

G. The independent approved testing laboratory shall perform the required tests and report results of all tests noting if the tested material passed or failed such tests and shall furnish copies to the City, Architect and Contractor, and others as required. Report shall state tests were conducted under the responsible charge of a licensed State of California professional engineer and the material was tested in accordance with applicable provisions of the Contract Documents, Title 24, CCR. Upon completion of the Work of this section, the independent testing laboratory and geotechnical engineer shall submit a verified report to the City.

H. Bills of lading or equivalent documentation will be submitted to the City on a daily basis.

I. Upon completion of import operations, provide the City a certification statement attesting that all imported material has been obtained from the identified source site.

3.03 INSPECTION AND TESTING

A. The geotechnical engineer, retained by the City as a City Consultant, will inspect and test excavations, sample material quality as required in Part 2, observe installation and compaction of fill materials.

B. Compaction test shall be performed in accordance with ASTM D 1557, method "C."

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.

END OF SECTION

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SECTION 312500 - EROSION AND SEDIMENTATION CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

A. Provisions of Division 01 apply to this section, which are hereby made a part of this Section of the Specifications.

B. Equality of material, article, assembly or system other than those named or described in this Section shall be determined in accordance with the provisions of the CONTRACT and GENERAL CONDITIONS.

C. Section Includes:

1. For sites where more than one acre of disturbance will occur: Prepare, certify and upload to the State SMARTS system a Stormwater Pollution Prevention Plan (SWPPP) for management of the site construction in compliance with the U.S. Clean Water Act, NPDES Construction General Permit (CGP) and file a Notice of Intent with the CA State Water Recourses Control Board (SWRCB)

2. Control measures to prevent all erosion, siltation and sedimentation of environmentally sensitive areas, wetlands, waterways, construction sites, adjacent areas and off-site areas. Control measures shall include Best Management Practices (BMPs) as specified in the project plans and documents, and per standard California Stormwater Quality Association (CASQA) details and specifications.

3. Implementation of the requirements of the Construction General Permit (CGP) Order 2009-0009-DWQ as amended by Order 2010-0014-DWQ (and its latest revisions) and those specified in Section 33 41 00 Stormwater Pollution Prevention.

4. Additional means of protection shall be provided by the Contractor as required for continued or unforeseen erosion problems, at no additional cost to Owner.

5. Periodic maintenance of all sediment control structures shall be provided to ensure intended purpose is accomplished. Sediment control measures shall be in working condition at the end of each work day.

6. Inspection of erosion and sediment control structures for integrity shall be done per the Construction General Permit requirements. Any damaged device shall be corrected immediately.

B. Related Sections:

1. Section 013543 - Environmental Protection Procedures
2. Section 015000 - Temporary Facilities and Controls
3. Section: 310013 - Site Demolition
4. Section 311000 - Site Clearing and Grubbing
5. Section 312200 - Grading.
6. Section 312300 - Excavating, Backfilling and Compacting for Pavement
7. Section 312316 - Excavating, Backfilling and Compacting for Structures
8. Section 312333 - Excavating, Backfilling and Compacting for Utilities
9. Section 334100 - Stormwater Pollution Prevention
10. Section ~~312319 - Dewatering~~

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referenced in text by basic designation only. The list provided below is not intended to be all inclusive of each regulation prevailing over the work. The latest version of the document listed shall govern the work performed.

A. State Water Resources Control Board (SWRCB) Order No. 2009-0009-DWQ, National Pollutant Discharge Elimination System (NPDES), General Permit No. CAS000002, Waste Discharge Requirements (WDR's) for Discharges of Storm Water Runoff Associated with Construction Activity (General Construction Storm Water Permit) as amended, and/or modified.

2009-0009-DWQ Construction General Permit (Effective July 1, 2010)

B. California Storm Water Best Management Practices Handbook - Construction, January 2003, published by the California Stormwater Quality Association

(www.cabmphandbooks.com).

C. Caltrans Construction Site Best Management Practices Handbook, March 2003

(www.dot.ca.gov/hq/oppd/stormwtr/).

A. United States Environmental Protection Agency, Storm Water Discharges (applicable to State NPDES programs) 40 CFR 122.26.

1.3 DEFINITIONS

A. NOI: Notice of Intent (NOI) for coverage under the USEPA NPDES General Permit for Stomrwater Discharges Associated with Construction and Land Disturbance Activities.

B. NOT: Notice of Termination (NOT) ending coverage under the USEPA NPDES General Permit for Stomrwater Discharges Associated with Construction and Land Disturbance Activities. (General Construction Permit (GCP)).

C. NPDES: National Pollutant Discharge Elimination System

D. SWPPP: Stormwater Pollution Prevention Plan

E. USEPA: United States Environmental Protection Agency

F. CASQA: California Stormwater Quality Association (www.casqa.org)

G. BMPs: Best Management Practices

H. WDID: Waste Discharge Identification number

1.4 SCHEDULING AND SEQUENCING

A. WDID registration number shall be obtained from the Water Board prior to initiating any excavation and other land-disturbing activities, including demolition.

B. Erosion control measures shall be established at the beginning of construction and maintained during the entire period of construction and until the Notice of Termination has been accepted by the Water Board. On-site areas that are subject to severe erosion and off-site areas that are especially vulnerable to damage from erosion and/or sedimentation shall be identified and receive special attention.

C. All land-disturbing activities shall be planned and conducted to minimize the size of the area exposed at any one time and the length of the time of exposure.

D. All land-disturbing activities shall be planned and conducted in a manner that minimizes damage from sedimentation discharge to off-site areas.

E. All temporary erosion and sedimentation control measures shall be removed from the site at the completion of the project. Proper disposal of erosion and sediment control materials shall be the responsibility of the Contractor.

1.5 SUBMITTALS

A. The Contractor shall submit each item in this Section according to the Conditions of the Contract and the Submittals Specification [Section 013300], for information only, unless otherwise indicated.

B. Submit to the Engineer, material specifications for any of the materials and equipment furnished under this Section.

1.6 QUALITY ASSURANCE

A. The Contractor shall comply with the requirements of the Storm Water Pollution Prevention Plan (SWPPP) prepared in accordance with the General Construction Permit, which are incorporated herein by reference, and all applicable requirements of governing authorities having jurisdiction. The Specifications and Drawings are not represented as being comprehensive, but rather convey the intent to provide complete erosion and sedimentation control for both Owner's and adjacent properties.

B. Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to the site-specific Storm Water Pollution Prevention Plan or requirements of authorities having jurisdiction, whichever is more stringent.

C. Erosion control measures shall be established at the beginning of construction and maintained during the entire period of construction. On-site areas which are subject to severe erosion, and off-site areas which are especially vulnerable to damage from erosion and/or sedimentation, are to be identified and receive special attention.

D. All land-disturbing activities are to be planned and conducted to minimize the size of the area to be exposed at any one time, the length of time of exposure, and to minimize sedimentation damage outside of the Limits of Work.

E. Surface water runoff originating up-gradient of exposed areas (run-on) should be controlled to reduce erosion and sediment loss during the period of exposure.

F. When the increase in the peak rates and velocity of storm water runoff resulting from a land-disturbing activity is sufficient to cause accelerated erosion of the receiving stream bed, provide measures to control both the velocity and rate of release so as to minimize accelerated erosion and increased sedimentation of the stream.

G. The Contractor is responsible for cleaning out and disposing of all sediment once the storage capacity of the sediment controls is reduced by one-half.

H. The Contractor shall inspect, repair, and maintain erosion and sedimentation control measures as specified in the SWPPP for the project, and after storm events of greater than 1/2 inch, during construction until completion of the project.

I. Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.

J. Upon removal of temporary erosion and sedimentation controls, restore and stabilize areas disturbed during removal.

K. Erosion and sedimentation control measures employed will be subject to approval and inspection by governing agencies having jurisdiction over such work. All erosion and sedimentation control measures and work shall be implemented and conducted in accordance with the standard details and specifications provided in CASQA's Stormwater Best Management Practice (BMP) Handbooks / Portal. More information can be obtained at (www.cabmphandbooks.com)

L. Fines and related costs resulting from failure to comply with the GCP requirements or to provide adequate protection against any environmentally objectionable acts and corrective action to be taken are the obligations of the Contractor.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Straw Bales: Wire or nylon bound bales of straw, oriented around sides, rather than over and under.

B. Stakes: Stakes for bales shall be one of the following materials: Wood stakes of sound hardwood 2 by 2 inches in size or steel reinforcing bars of at least No. 4 size. Lengths shall be approximately three feet.

C. Fiber Logs: A fabric sock filled with wood cellulose fiber, coir fiber or other material intended to filter stormwater runoff and trap sediment.

D. Silt Fence: Filter fabric siltation fencing shall be a woven filter fabric having a permittivity of not less than 0.15 sec^{-1}, a water flow rate of a minimum 12 gallons per minute per square foot, and a grab tensile strength of a minimum of 90 lbs. The material shall have a high sediment filtration capacity, high slurry flow and minimum clogging characteristics. Ultraviolet Radiation Stability 90 (%) min per ASTM G26.

E. Protective Measures: As temporary coverings on ground areas subject to erosion, provide one of the following protective measures, and as directed by the Inspector of Record.

1. Hay or straw temporary mulch, 100 pounds per 1,000 square feet.
2. Wood fiber cellulose temporary mulch, 35 pounds per 1,000 square feet.
3. Tackafier for anchoring mulch or straw shall be a non-petroleum based liquid bonding agent specifically made for anchoring hay or straw.
4. Provide natural (jute, wood excelsior) or man-made (glass fiber) covering with suitable staples or anchors to secure to ground surface. Note that wire stapes

and non-biodegradable coverings shall not be used for any area that will be mown turf.

5. Temporary vegetative cover for graded areas shall be undamaged, air dry threshed straw or hay free of undesirable weed seed.

F. Catch basin inserts: "silt-sack" type inserts shall be manufactured from a specially designed woven polypropylene geotextile and sewn by a double needle machine, using a high strength nylon thread or equal. Inserts shall be manufactured to fit the opening of the catch basin or drop inlet.

G. Wooden Stakes: Oak wood, minimum 1-inch by 1-inch, by minimum 36 inches long.

H. Stabilized Construction Entrance/Exit:

1. Geotextile: A non-woven geotextile fabric that meets the requirements of Section 213-2 of the *Standard Specifications for Public Works Construction (SWPPC) Latest Edition.* “Geosynthetics”, table 213-2.2(A) type 90N.

2. Aggregate: The proposed aggregate shall have the following gradation:

Sieve Designation	Percentage by Weight Passing Square Mesh Sieves
6 in.	100
5-1/2 in.	90 to 100
2-1/2 in.	15 to 20
¾ in.	0 to 5

PART 3 - EXECUTION

3.1 CATCHBASIN INSERTS

A. The Contractor shall install "silt sack" type or approved equal in catch basins in accordance with manufacturer’s instructions.

B. Drawing Appendix B in the project SWPPP provides an inventory of catch basins requiring protection including the width, length, and approximate depth to inverts. The Contractor is responsible to conduct a pre-construction survey of catch basins to verify site conditions with design drawings.

3.2 STRAW BALE BARRIERS

A. Excavation shall be to the width of the bale and the length of the proposed barrier to a minimum depth of 4 inches.

B. Bales shall be placed in a single row, lengthwise on proposed line, with ends of adjacent bales tightly abutting one another. In swales and ditches the barrier shall extend to such a length that the bottoms of the end bales are higher in elevation than the top of the lowest middle bale.

C. Staking shall be accomplished to securely anchor bales by driving at least two stakes or rebars through each bale to a minimum depth of 18 inches.

D. The gaps between bales shall be filled by wedging straw in the gaps to prevent water from escaping between the bales.

E. The excavated soil shall be backfilled against the barrier. Backfill shall conform to ground level on the downhill side and shall be built up to 4 inches on the uphill side. Loose straw shall then be scattered over the area immediately uphill from a straw barrier.

F. Inspection shall be frequent and repair or replacement shall be made promptly as needed.

3.3 FILTER SOCKS

A. Install in location as shown on the Drawings and as directed by the Engineer. Installation shall be performed in accordance with the manufacturer's instructions.

3.4 SILT FENCE

A. Install a filter fabric siltation fence prior to construction and remove after full surface restoration has been achieved. Install siltation fence as indicated on the Drawings. Install as follows:

1. Hand shovel excavate a small trench on the upstream side of the desired fence line location.

2. Unroll the siltation fence system, position the post in the back of the trench (downhill side), and hammer the post at least 1½ feet into the ground.

3. Lay the bottom 6 inches of the fabric into the trench to prevent undermining by storm water run-off.

4. Backfill the trench and compact. Compaction is necessary to prevent the runoff from eroding the backfill.

3.5 CONSTRUCTION ENTRANCE

A. The Contractor shall install the stabilized construction entrance at all points where traffic will be leaving the Site. The location of the stabilized construction entrance shall be proposed by the Contractor and approved by the Engineer.

B. The stabilized construction entrance shall be a minimum of 12 feet wide by 20 feet long with a minimum of 6 inches of aggregate.

C. The Contractor shall remove all vegetation and any objectionable material from the proposed location. Divert all surface runoff and drainage from the aggregate to a sediment trap.

D. Install the geotextile prior to placing any aggregate. The geotexile shall be placed in accordance with the manufacturer's instructions.

E. Place a minimum of six inches of aggregate on top of the geotextile.

3.6 INLET PROTECTION

A. Install silt fence or straw bales around inlet as specified herein.

3.7 DUST CONTROL

A. Throughout the construction period the Contractor shall carry on an active program for the control of fugitive dust within all site construction zones, or areas disturbed as a result of construction. Control methods shall include the following: Apply calcium chloride at a uniform rate of one and one-half (1 ½) pounds per square yard in areas subject to blowing. For emergency control of dust apply water to affected areas. The source of supply and the method of application for water are the responsibility of the contractor.

B. The frequency and methods of application for fugitive dust control shall be as directed by the Inspector of Record.

3.8 CLEANING AND MAINTENANCE

A. The Contractor shall clean all catch basins at the beginning and end of the Project.

B. The Contractor shall inspect the stabilized construction entrance every seven days. The Contractor shall check for mud and sediment buildup and pad integrity. The Contractor shall wash, replace, and/or add stone whenever the entrance fails to perform effectively or as directed by the Engineer.

C. The Contractor shall inspect the control system immediately after each rainfall and daily during prolonged rainfall. Make repairs immediately.

D. Remove and dispose of accumulated sediments when they reach fifty percent of the aboveground height of the control system, and when directed by the Engineer.

E. Any catch basin that collects sediments as a result of the Contractor activities shall be thoroughly cleaned out by the Contractor.

F. Replace control system promptly if fabric decomposes or system becomes ineffective prior to the expected usable life.

G. Hay or straw shall be anchored in-place by one of the following methods and as approved by the Architect: mechanical “crimping” with a tractor drawn device specifically devised to cut mulch into top two inches of soil surface or application of non-petroleum based liquid tackifier, applied at a rate and in accordance with manufacturer's instructions for specific mulch material utilized.

H. Placement of mesh or blanket matting and anchoring in place shall be in accordance with manufacturer's printed instructions.

I. Inspect protective coverings periodically and reset or replace materials as required.

J. Maintain or replace system until no longer necessary for intended purposes.

3.9 REMOVAL AND RESTORATION

A. The Contractor shall notify the Engineer upon completion of the work but prior to the removal of control structures.

B. The Contractor shall not remove the control structures until the Engineer approves removal.

C. The Contractor shall remove and dispose of all control system at completion of the work.

D. The Contractor shall spread remaining sediment to conform to grade.

END OF SECTION