EXHIBIT A

Technical Specifications

for

Woodland Joint USD
Adult Education CTE
Classroom Renovations

Submitted: February 10, 2023

Architect's Project Number **21-W04-01**

SYNTHESIS PARTNERS, LLC
Managers • Architects

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DOCUMENT 000101 - PROJECT TITLE PAGE

1.1 PROJECT MANUAL

A. Project Name: Woodland Joint USD Adult Education CTE Classroom Renovation.

B. Owner's Project No. 2023-02-3.

C. Owner: Woodland Joint Unified School District, 435 6th Street, Woodland, CA 95695.

D. Architect's Project No. 21-W04-01.

E. Architect: Synthesis Partners, LLC, PO Box 1900, Yuba City, CA 95992.

F. Phone: 530.298.7298

G. Web Site: www.spinc-arch.com

H. SYNTHESIS PARTNERS, LLC Managers • Architects

I. Issued: Issued: 2/14/2023.

J.

END OF DOCUMENT 000101

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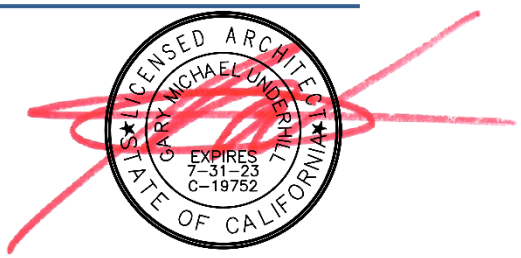

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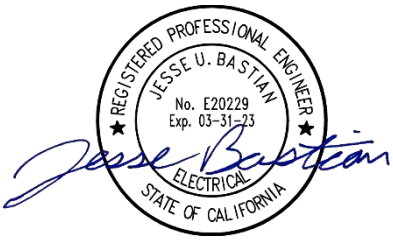

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SECTION 01 01 50 - ADDITIONAL REQUIREMENTS FOR DSA-REVIEWED PROJECTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The following additional requirements apply to this Project which is being reviewed by the Division of the State Architect (DSA).

1.2 ADDITIONAL REQUIREMENTS

A. In addition to the duties specified in the Contract Documents, the duties of the Contractor shall be in accordance with the requirements specified in Section 4-343 of Part 1, Title 24, California Code of Regulations (CCR).

B. In addition to the duties specified in the Contract Documents, the duties of the Architect and the Architect's consultants shall be in accordance with the requirements specified in Section 4-333(a) and 4-341 of Part 1, Title 24, CCR.

C. DSA is not subject to arbitration proceedings.

D. Notify DSA at start of construction in accordance with Section 4-341 of Part 1, Title 24, CCR.

E. All addenda shall be submitted for DSA approval.

F. All substitutions and change orders affecting structural safety, accessibility, or fire and life safety shall be submitted for DSA approval in the form of a Construction Change Directive (CCD). Do not begin any work under an addendum or change order until DSA approval of the CCD is obtained. CCDs shall be in accordance with Section 4-338 of Part 1, Title 24, CCR.

G. Do not begin work under a written order until a CCD has been submitted to and approved by DSA in accordance with Section 4-338 or Part 1, Title 24, CCR.

H. Unless otherwise indicated or specified, perform the work in conformance with the latest edition of applicable regulatory requirements. A copy of Parts 1 through 5 of Title 24, CCR shall be available on the Project site. The codes adopted by the City, County, State and Federal agencies shall govern minimum requirements for this Project.

I. Contractor shall submit verified reports in accordance with Sections 4-341 and 4-343(c) of Part 1, Title 24, CCR.

J. DSA may supervise construction, reconstruction, or repair in accordance with Section 4-334 of Part 1, Title 24, CCR.

K. Construction shall be observed by a full-time Project Inspector approved by DSA in accordance with Section 4-333(b) and 4-342 of Part 1, Title 24, CCR.

L. Testing requirements of Owner's Testing Laboratory shall be in accordance with Section 4-335 of Part 1, Title 24, CCR and shall be approved by DSA.

M. Special Inspection on masonry construction, glued laminated lumber, wood framing using timber connectors, ready-mixed concrete, gunite, prestressed concrete, high strength steel bolt installation, welding, pile driving, and mechanical and electrical work shall be as required by Section 4-333(c) of Part 1, Title 24, CCR. The costs of special inspection will be paid for by the Owner.

N. The intent of these drawings and specifications is that the work of the alteration, rehabilitation or reconstruction is to be in accordance with Title 24, California Code of Regulations. Should any existing conditions such as deterioration or non-complying construction be discovered which is not covered by the contract documents wherein the finished work will not comply with Title 24, California Code of Regulations, a change order, or a separate set of plans and specifications, detailing and specifying the required work shall be submitted to and approved by the Office before proceeding with the work.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION – NOT USED

END OF SECTION

SECTION 024119 - SELECTIVE DEMOLITION

PART 1 - GENERAL

A. Section Includes:

1. Demolition and removal of selected portions of building.

2. Demolition and removal of selected site elements.

B. Related Requirements:

1. Section 011000 "Summary" for restrictions on the use of the premises, Owner-occupancy requirements, and phasing requirements.

2. Section 017300 "Execution" for cutting and patching procedures.

1.2 DEFINITIONS

A. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged or removed and reinstalled.

B. Remove and Salvage: Carefully detach from existing construction, in a manner to prevent damage, and deliver to Owner.

C. Remove and Reinstall: Detach items from existing construction, prepare for reuse, and reinstall where indicated.

D. Existing to Remain: Existing items of construction that are not to be permanently removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and 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 PREINSTALLATION MEETINGS

A. Predemolition Conference: Conduct conference at Project site.

1. Inspect and discuss condition of construction to be selectively demolished.

2. Review structural load limitations of existing structure.

3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.

4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.

5. Review areas where existing construction is to remain and requires protection.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For refrigerant recovery technician.

B. Proposed Protection Measures: Submit report, including drawings, that indicates the measures proposed for protecting individuals and property. Indicate proposed locations and construction of barriers.

C. 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 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. Use of elevator and stairs.

5. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.

D. Inventory: Submit a list of items to be removed and salvaged and deliver to Owner prior to start of demolition.

E. Predemolition Photographs or Video: 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 indicated that existing warranties are still in effect after completion of selective demolition.

1.6 CLOSEOUT SUBMITTALS

A. Inventory: Submit a list of items that have been removed and salvaged.

B. Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.

1.7 QUALITY ASSURANCE

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

1.8 FIELD CONDITIONS

A. Owner will occupy portions of building 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 unknown if 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.

1.9 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties. Notify warrantor before proceeding.

B. Notify warrantor on completion of selective demolition and obtain documentation verifying that existing system has been inspected and warranty remains in effect. Submit documentation at Project closeout.

PART 2 - PRODUCTS

2.1 PEFORMANCE 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 ANSI/ASSE A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped before starting selective demolition operations.

B. Review record documents of existing construction provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in record documents.

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

D. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.

E. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.

1. Comply with requirements for existing services/systems interruptions specified in Section 011000 "Summary."

B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.

1. Owner will arrange to shut off indicated services/systems when requested by Contractor.

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

3. 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.

4. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated 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.
    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.

C. Refrigerant: Remove refrigerant from mechanical equipment to be selectively demolished according to 40 CFR 82 and regulations of authorities having jurisdiction.

3.3 PREPARATION

A. 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.

1. Comply with requirements for access and protection specified in Section 015000 "Temporary Facilities and Controls."

B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.

2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.

3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.

4. Cover and protect furniture, furnishings, and equipment that have not been removed.

5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Section 015000 "Temporary Facilities and Controls."

3.4 SELECTIVE DEMOLITION, GENERAL

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.

2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.

3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.

4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain fire watch and portable fire-suppression devices during flame-cutting operations.

5. Maintain adequate ventilation when using cutting torches.

6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.

7. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.

8. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.

9. Dispose of demolished items and materials promptly.

B. Removed and Salvaged Items:

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 designated by Owner.

5. Protect items from damage during transport and storage.

C. Removed and Reinstalled Items:

1. Clean and repair items to functional condition adequate for intended reuse.

2. Pack or crate items after cleaning and repairing. Identify contents of containers.

3. Protect items from damage during transport and storage.

4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

D. 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 reinstalled in their original locations after selective demolition operations are complete.

3.5 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

A. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, then remove concrete between saw cuts.

B. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, then break up and remove.

3.6 DISPOSAL OF DEMOLISHED MATERIALS

A. General: Except for items or materials indicated to be recycled, reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill.

1. Do not allow demolished materials to accumulate on-site.

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

3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.

B. Burning: Do not burn demolished materials.

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

3.7 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION 024119

SECTION 033053 - MISCELLANEOUS CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes cast-in-place concrete, including reinforcement, concrete materials, mixture design, placement procedures, and finishes.

B. Related Sections:

1. Section 321313 "Concrete Paving" for concrete pavement and walks.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Other Action Submittal:

1. Design Mixtures: For each concrete mixture.

1.3 QUALITY ASSURANCE

A. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

B. Comply with the following sections of ACI 301unless modified by requirements in the Contract Documents:

1. "General Requirements."

2. "Formwork and Formwork Accessories."

3. "Reinforcement and Reinforcement Supports."

4. "Concrete Mixtures."

5. "Handling, Placing, and Constructing."

C. Comply with ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

PART 2 - PRODUCTS

2.1 FORMWORK

A. Furnish formwork and formwork accessories according to ACI 301.

2.2 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A 615, Grade 60, deformed.

B. Plain-Steel Wire: ASTM A 82, as drawn.

C. Plain-Steel Welded Wire Reinforcement: ASTM A 185, fabricated from as-drawn steel wire into flat sheets.

D. Deformed-Steel Welded Wire Reinforcement: ASTM A 497, flat sheet.

2.3 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source throughout Project:

1. Portland Cement: ASTM C 150, **Type I/II**
   a. Fly Ash: ASTM C 618, Class F or C.
   b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.

B. Normal-Weight Aggregate: ASTM C 33, graded, **1-1/2-inch** nominal maximum aggregate size.

C. Lightweight Aggregate: ASTM C 330, **1-inch**nominal maximum aggregate size.

D. Water: ASTM C 94.

2.4 ADMIXTURES

A. Air-Entraining Admixture: ASTM C 260.

B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C 494, Type A.

2. Retarding Admixture: ASTM C 494, Type B.

3. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.

4. High-Range, Water-Reducing Admixture: ASTM C 494, Type F.

5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494, Type G.

6. Plasticizing and Retarding Admixture: ASTM C 1017, Type II.

2.5 RELATED MATERIALS

A. Sheet Vapor Retarder: ASTM E 1745, Class A. Include manufacturer's recommended adhesive or pressure-sensitive tape.

1. Products: Subject to compliance with requirements, provide the following:
   a. Stego Industries, LLC; Stego Wrap 15 mil Class A or approved equal.

B. Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber, or ASTM D 1752, cork or self-expanding cork.

2.6 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming; manufactured for application to fresh concrete.

B. Absorptive Cover: AASHTO M 182, Class 3, burlap cloth or cotton mats.

C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

D. Water: Potable.

2.7 LIQUID FLOOR TREATMENTS

A. Penetrating Liquid Floor Treatment (used where drawings call for concrete to be the finished floor): Clear, chemically reactive, waterborne solution of inorganic silicate or siliconate materials and proprietary components; odorless; that penetrates, hardens, and densifies concrete surfaces.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. ChemMasters; Chemisil Plus.
   b. ChemTec Int'l; ChemTec One.
   c. Conspec by Dayton Superior; Intraseal.
   d. Curecrete Distribution Inc.; Ashford Formula.
   e. Dayton Superior Corporation; Day-Chem Sure Hard (J-17).
   f. Edoco by Dayton Superior; Titan Hard.
   g. Euclid Chemical Company (The), an RPM company; Euco Diamond Hard.
   h. Kaufman Products, Inc.; SureHard.
   i. L&M Construction Chemicals, Inc.; Seal Hard.
   j. Meadows, W. R., Inc.; LIQUI-HARD.
   k. Metalcrete Industries; Floorsaver.
   l. Nox-Crete Products Group; Duro-Nox.
   m. Symons by Dayton Superior; Buff Hard.
   n. US SPEC, Division of US Mix Products Company; US SPEC Industraseal.
   o. Vexcon Chemicals, Inc.; Vexcon StarSeal PS Clear.

2.8 CONCRETE MIXTURES

A. Comply with ACI 301requirements for concrete mixtures.

B. Normal-Weight Concrete: Prepare design mixes, proportioned according to ACI 301, as follows:

1. Minimum Compressive Strength: 3000 **psi** at 28 days.

2. Slump Limit: **4 inches**, plus or minus 1 inch.

3. Air Content: Maintain within range permitted by ACI 301. Do not allow air content of trowel-finished floor slabs to exceed 3 percent.

2.9 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94, and furnish batch ticket information.

1. When air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Mix concrete materials in appropriate drum-type batch machine mixer.

1. For mixer capacity of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.

2. For mixer capacity larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd..

3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mix type, mix time, quantity, and amount of water added. Record approximate location of final deposit in structure.

PART 3 - EXECUTION

3.1 FORMWORK

A. Design, construct, erect, brace, and maintain formwork according to ACI 301.

3.2 VAPOR RETARDERS

A. Install, protect, and repair vapor retarders according to ASTM E 1643; place sheets in position with longest dimension parallel with direction of pour.

1. Lap joints 6 inches and seal with manufacturer's recommended adhesive or joint tape.

3.3 STEEL REINFORCEMENT

A. Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

3.4 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Locate and install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least **one-fourth** of concrete thickness, as follows:

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with groover tool to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover marks on concrete surfaces.

2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

D. Isolation Joints: Install joint-filler strips at junctions with slabs-on-grade and vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

1. Extend joint fillers full width and depth of joint, terminating flush with finished concrete surface, unless otherwise indicated.

3.5 CONCRETE PLACEMENT

A. Comply with ACI 301for placing concrete.

B. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.

C. Consolidate concrete with mechanical vibrating equipment.

D. Equipment Bases and Foundations:

1. Coordinate sizes and locations of concrete bases with actual equipment provided.

2. Construct concrete bases 4 **inches** high unless otherwise indicated; and extend base not less than 6 inches in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated or unless required for seismic anchor support.

3. Minimum Compressive Strength: **3000 psi** at 28 days.

4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.

5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base, and anchor into structural concrete substrate.

6. Prior to pouring concrete, place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

7. Cast anchor-bolt insert into bases. Install anchor bolts to elevations required for proper attachment to supported equipment.

3.6 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defective areas repaired and patched. Remove fins and other projections exceeding 1/2 inch.

1. Apply to concrete surfaces **not exposed to public view**.

B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defective areas. Remove fins and other projections exceeding 1/8 inch.

1. Apply to concrete surfaces e**xposed to public view**.

3.7 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and with ACI 301 for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.

D. Curing Methods: Cure formed and unformed concrete for at least seven days by one or a combination of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

a. Water.
b. Continuous water-fog spray.
c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.8 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Tests: Perform according to ACI 301.

1. Testing Frequency: One composite sample shall be obtained for each day's pour of each concrete mix exceeding 5 cu. yd. but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.

3.9 REPAIRS

A. Remove and replace concrete that does not comply with requirements in this Section.

END OF SECTION 033053

SECTION 061053 - MISCELLANEOUS ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Framing with dimension lumber.

1.2 DEFINITIONS

A. Dimension Lumber: Lumber of 2 inches nominal or greater but less than 5 inches nominal in least dimension.

B. Lumber grading agencies, and the abbreviations used to reference them, include the following:

1. WWPA: Western Wood Products Association.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.

2. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

3. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

1.4 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For the following, from ICC-ES:

1. Preservative-treated wood.

2. Power-driven fasteners.

3. Powder-actuated fasteners.

4. Expansion anchors.

5. Metal framing anchors.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Stack lumber flat with spacers beneath and between each bundle to provide air circulation. Protect lumber from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

A. Lumber and Plywood: FSC-certified.

B. Maximum Moisture Content of Lumber: 19 percent.

2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

A. Preservative Treatment: AWPA U1; use Category UC2 except use Category UC3b for exterior construction and use Category UC4a for items in contact with the ground.

1. Preservative Chemicals: Containing no arsenic or chromium.

B. Application: Items indicated and the following:

1. Items in contact with roofing or waterproofing.

2. Items in contact with concrete or masonry.

3. Framing less than 18 inches (460 mm) above ground in crawlspaces.

4. Floor plates installed over concrete slabs-on-grade.

2.3 DIMENSION LUMBER FRAMING

A. Non-Load-Bearing Interior Partitions: Construction or No. 2 grade.

B. Other Framing: No. 2 grade.

2.4 MISCELLANEOUS LUMBER

A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:

1. Blocking.

2. Nailers.

B. For items of dimension lumber size, provide Construction or No. 2 grade lumber of any species.

2.5 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

1. Where carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153.

B. Nails, Brads, and Staples: ASTM F 1667.

C. Power-Driven Fasteners: NES NER-272.

D. Wood Screws: ASME B18.6.1.

E. Lag Bolts: ASME B18.2.1.

F. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers.

G. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.

1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.

2.6 METAL FRAMING ANCHORS

A. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, G60 coating designation.

1. Use for interior locations unless otherwise indicated.

B. Hot-Dip Heavy-Galvanized Steel Sheet: ASTM A 653/A 653M; Structural Steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G185 coating designation; and not less than 0.036 inch thick.

1. Use for wood-preservative-treated lumber and where indicated.

2.7 MISCELLANEOUS MATERIALS

A. Adhesives: Low VOC.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry to other construction; scribe and cope as needed for accurate fit. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.

B. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.

C. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.

D. Metal Framing Anchors: Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.

E. Do not splice structural members between supports unless otherwise indicated.

F. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.

1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches o.c.

G. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:

1. Fire block furred spaces of walls, at each floor level, at ceiling, and at not more than 96 inches o.c. with solid wood blocking or noncombustible materials accurately fitted to close furred spaces.

2. Fire block concealed spaces of wood-framed walls and partitions at each floor level, at ceiling line of top story, and at not more than 96 inches o.c. Where fire blocking is not inherent in framing system used, provide closely fitted solid wood blocks of same width as framing members and 2-inch nominal thickness.

3. Fire block concealed spaces between floor sleepers with same material as sleepers to limit concealed spaces to not more than 100 sq. ft. and to solidly fill space below partitions.

H. Sort and select lumber so that natural characteristics will not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

I. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.

1. Use inorganic boron for items that are continuously protected from liquid water.

2. Use copper naphthenate for items not continuously protected from liquid water.

J. Securely attach carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

1. NES NER-272 for power-driven fasteners.

2. Table 2304.10.1, "Fastening Schedule," in the California Building Code.

K. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

3.2 WOOD BLOCKING, AND NAILER INSTALLATION

A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.

3.3 PROTECTION

A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

B. Protect miscellaneous rough carpentry from weather. If, despite protection, miscellaneous rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 061053

SECTION 064116 - PLASTIC-LAMINATE-FACED ARCHITECTURAL CABINETS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Plastic-laminate-faced architectural cabinets.

2. Wood furring, blocking, shims, and hanging strips for installing plastic-laminate-faced architectural cabinets unless concealed within other construction before cabinet installation.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing cabinets and concealed within other construction before cabinet installation.

2. Section 123623.13 "Plastic-Laminate-Clad Countertops."

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product, including panel products, adhesives, and cabinet hardware and accessories.

B. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.

1. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.

C. Samples for Initial Selection or Verification:

1. Plastic laminates.

1.3 INFORMATIONAL SUBMITTALS

A. Product Certificates: For the following:

1. Composite wood and agrifiber products.

2. Thermoset decorative panels.

3. High-pressure decorative laminate.

4. Adhesives.

B. Evaluation Reports: For fire-retardant-treated materials, from ICC-ES.

1.4 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.

B. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver cabinets until painting and similar operations that could damage woodwork have been completed in installation areas. If cabinets must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1.6 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install cabinets until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

B. Field Measurements: Where cabinets are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Locate concealed framing, blocking, and reinforcements that support cabinets by field measurements before being enclosed, and indicate measurements on Shop Drawings.

C. Established Dimensions: Where cabinets are indicated to fit to other construction, establish dimensions for areas where cabinets are to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.7 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that cabinets can be supported and installed as indicated.

PART 2 - PRODUCTS

2.1 GENERAL

A. Quality Standard: Unless otherwise indicated, comply with the "North American Architectural Woodwork Standards" for grades of architectural plastic-laminate cabinets indicated for construction, finishes, installation, and other requirements as currently published at naaws.com.

B. Grade: Custom.

C. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or if not indicated, as required by woodwork quality standard.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Formica Corporation.
b. Wilsonart International.

D. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:

1. As selected by Architect from laminate manufacturer's full range in the following categories:

a. Solid colors, matte finish.
b. Solid colors with core same color as surface, matte finish.
c. Wood grains, matte finish.
d. Patterns, matte finish.

2.2 PLASTIC-LAMINATE-FACED ARCHITECTURAL CABINETS

A. Type of Construction: Frameless.

B. Cabinet, Door, and Drawer Front Interface Style: Flush overlay.

C. Reveal Dimension: 1/2 inch.

D. Laminate Cladding for Exposed Surfaces:

1. Horizontal Surfaces: Grade HGS.

2. Postformed Surfaces: Grade HGP.

3. Vertical Surfaces: Grade VGS.

4. Edges: Grade HGS.

5. Pattern Direction: Vertically for drawer fronts, doors, and fixed panels.

E. Materials for Semiexposed Surfaces:

1. Surfaces Other Than Drawer Bodies: High-pressure decorative laminate, NEMA LD 3, Grade VGS.

a. Edges of Plastic-Laminate Shelves: PVC T-mold matching laminate in color, pattern, and finish.
b. Edges of Thermoset Decorative Panel Shelves: PVC or polyester edge banding.
c. For semiexposed backs of panels with exposed plastic-laminate surfaces, provide surface of high-pressure decorative laminate, NEMA LD 3, Grade VGS.

2. Drawer Sides and Backs: [Solid-hardwood lumber] [Thermoset decorative panels with PVC or polyester edge banding].

3. Drawer Bottoms: Hardwood plywood.

F. Concealed Backs of Panels with Exposed Plastic-Laminate Surfaces: High-pressure decorative laminate, NEMA LD 3, Grade BKL.

G. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.

1. Join subfronts, backs, and sides with glued rabbeted joints supplemented by mechanical fasteners.

2.3 PLASTIC-LAMINATE COUNTERTOPS

A. High-Pressure Decorative Laminate: NEMA LD 3, Grade HGS.

B. Edge Treatment: Waterfall.

C. Backsplash: 4” unless otherwise indicated on the drawings.

D. Core Material: Particleboard, medium-density fiberboard, plywood, or otherwise approved engineered core.

E. Core Thickness: 3/4 inch.

1. Build up countertop thickness to 1-1/2 inches at front, back, and ends with additional layers of core material laminated to top.

F. Colors:

1. Formica Trespa Black craquele, CO-09.

2.4 WOOD MATERIALS

A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.

1. Wood Moisture Content: 5 to 10 percent.

B. Composite Wood and Agrifiber Products: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.

1. Medium-Density Fiberboard: ANSI A208.2, Grade 130, made with binder containing no urea formaldehyde.

2. Particleboard: ANSI A208.1, Grade M-2, made with binder containing no urea formaldehyde.

3. Softwood Plywood: DOC PS 1.

4. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1, containing no urea formaldehyde.

5. Thermoset Decorative Panels: Particleboard or medium-density fiberboard finished with thermally fused, melamine-impregnated decorative paper and complying with requirements of NEMA LD 3, Grade VGL, for test methods 3.3, 3.4, 3.6, 3.8, and 3.10.

2.5 CABINET HARDWARE AND ACCESSORIES

A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets.

B. Butt Hinges: 2-3/4-inch, five-knuckle steel hinges made from 0.095-inch- thick metal, and as follows:

1. Semiconcealed Hinges for Overlay Doors: BHMA A156.9, B01521.

2. Color: Black.

3. Hafele Advantage 5 K (#354.65.300) or approved equal.

C. Wire Pulls: Back mounted, solid metal, 4 inches long, 5/16 inch in diameter.

1. Color: Black.

2. Provide 2 pulls for drawers more than 24” wide.

3. Jamison (#SWP4-BLK) or approved equal.

D. Adjustable Shelf Standards and Supports: BHMA A156.9, B04071; with shelf rests, B04081.

E. Fixed Shelf Supports

1. Knape & Vogt, KV208WH or approved equal.

F. Shelf Rests: BHMA A156.9, B04013; metal. Provide earthquake pins or clips on at least two corners of each shelf.

1. Peter Meier 02.7923.104 for earthquake pin supports or approved equal.

2. Peter Meier 02.7879.104 for standard shelf supports or approved equal.

G. Drawer Slides: BHMA A156.9.

1. Grade 1HD-100: Side mounted; full-extension type; zinc-plated-steel ball-bearing slides.

a. Knape & Vogt, KV8400 or approved equal.

2. For computer keyboard shelves, provide Grade 1.

3. For trash bins not more than 20 inches high and 16 inches wide, provide Grade 1HD-200.

H. Aluminum Slides for Sliding Glass Doors: BHMA A156.9, B07063.

I. Drawer and Hinged Door Locks: Cylindrical (cam) type, 5-pin tumbler, brass with chrome-plated finish, and complying with BHMA A156.11, Grade 1. Manufacturer; Olympus Lock 700 SC and 800 SC or approved equal.

1. Provide a minimum of two keys per lock and six master keys.

2. Provide locks where indicated.

J. Door and Drawer Silencers: BHMA A156.16, L03011.

K. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.

1. Flat Black Coated: BHMA 622 for brass or bronze base; BHMA 631 for steel base; BHMA 671 for aluminum base.

2. Satin Chromium Plated: BHMA 626 for brass or bronze base; BHMA 652 for steel base.

3. Satin Stainless Steel: BHMA 630.

4. Satin Aluminum: BHMA 628.

5. Satin Nickel: BHMA 632.

L. Grommets for Cable Passage through Countertops: 2-inch OD, black, molded-plastic grommets and matching plastic caps with slot for wire passage.

M. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.

2.6 MISCELLANEOUS MATERIALS

A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln dried to less than 15 percent moisture content.

B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.

C. Adhesives: Do not use adhesives that contain urea formaldehyde.

2.7 FABRICATION

A. Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.

B. Fabricate cabinets to dimensions, profiles, and details indicated.

C. Complete fabrication, including assembly and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

D. Shop-cut openings to maximum extent possible to receive hardware, appliances, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition cabinets to average prevailing humidity conditions in installation areas.

B. Before installing cabinets, examine shop-fabricated work for completion and complete work as required.

3.2 INSTALLATION

A. Grade: Install cabinets to comply with same grade as item to be installed.

B. Assemble cabinets and complete fabrication at Project site to the extent that it was not completed in the shop.

C. Install cabinets level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches.

D. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

E. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing. Use fine finishing nails for exposed fastening, countersunk and filled flush with woodwork.

1. Use filler matching finish of items being installed.

F. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.

1. Install cabinets with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.

2. Fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches o.c. with No. 10 wafer-head sheet metal screws through metal backing or metal framing behind wall finish.

3.3 ADJUSTING AND CLEANING

A. Repair damaged and defective cabinets, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.

B. Clean, lubricate, and adjust hardware.

C. Clean cabinets on exposed and semiexposed surfaces.

END OF SECTION 064116

SECTION 07 92 00 - JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Silicone joint sealants.
2. Latex joint sealants.
3. Acoustical joint sealants.

B. Related Sections:

1. Section 09 29 00 "Gypsum Board" for sealing perimeter joints.

1.2 ACTION SUBMITTALS

A. Product Data: For each joint-sealant product indicated.

B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

1.3 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each kind of joint sealant and accessory, from manufacturer.

B. Field-Adhesion Test Reports: For each sealant application tested.

C. Warranties: Sample of special warranties.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Source Limitations: Obtain each kind of joint sealant from single source from single manufacturer.

1.5 PROJECT CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer.

2. When joint substrates are wet.

3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.

4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.6 WARRANTY

A. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:

1. Movement of the structure caused by structural settlement or errors attributable to design or construction resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.

2. Disintegration of joint substrates from natural causes exceeding design specifications.

3. Mechanical damage caused by individuals, tools, or other outside agents.

4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

B. Liquid-Applied Joint Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied joint sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.

C. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range to closely match adjacent surfaces.

2.2 SILICONE JOINT SEALANTS

A. Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 100/50, for Use NT.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Dow Corning Corporation; 790.
b. GE Advanced Materials - Silicones; SilPruf LM SCS2700.
c. Sika Corporation, Construction Products Division; SikaSil-C990.

B. Mildew-Resistant, Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25, for Use NT.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Pecora Corporation; 898.

2.3 JOINT SEALANT BACKING

A. General: Provide sealant backings of material that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin) or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

2.4 MISCELLANEOUS MATERIALS

A. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way and formulated to promote optimum adhesion of sealants to joint substrates.

PART 3 - EXECUTION

3.1 PREINSTALLATION CONFERENCE

A. Prior to applying joint sealants that will be visible in the finished construction, the contractor shall meet with the architect at the site to review colors of sealants to be applied in exposed locations.

3.2 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.

2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:

    a. Concrete.

3. Remove laitance and form-release agents from concrete.

4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:

    a. Metal.
    b. Glass.
    c. Porcelain enamel.
    d. FRP.

3.4 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of sealant backings.

2. Do not stretch, twist, puncture, or tear sealant backings.

3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.

2. Completely fill recesses in each joint configuration.

3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealant from surfaces adjacent to joints.

2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.

3. Provide concave joint profile per Figure 8A in ASTM C 1193, unless otherwise indicated.

4. Provide flush joint profile where indicated per Figure 8B in ASTM C 1193.

5. Provide recessed joint configuration of recess depth and at locations indicated per Figure 8C in ASTM C 1193.

G. Acoustical Sealant Installation: At sound-rated assemblies and elsewhere as indicated, seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written recommendations.

3.5 FIELD QUALITY CONTROL

A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:

1. Extent of Testing: Test completed and cured sealant joints as follows:

a. Perform 1 tests for the first 1000 feet of joint length for each kind of sealant and joint substrate.

2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.

a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.

3. Inspect tested joints and report on the following:

a. Whether sealants filled joint cavities and are free of voids.
b. Whether sealant dimensions and configurations comply with specified requirements.
c. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind

of product and joint substrate. Compare these results to determine if adhesion passes sealant manufacturer's field-adhesion hand-pull test criteria.

4. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant fill, sealant configuration, and sealant dimensions.

5. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.

B. Evaluation of Field-Adhesion Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.6 CLEANING

A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.7 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.8 JOINT-SEALANT SCHEDULE

A. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Locations:

a. Perimeter joints between materials for frames of doors, windows, louvers and in-fill opening where flashing maybe required or indicated on drawings.

2. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors to closely match existing.

B. Joint-Sealant Application: Interior joints in horizontal traffic surfaces.

1. Joint Locations:

a. Isolation joints in cast-in-place concrete slabs.

2. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors to closely match existing.

C. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Locations:

a. Perimeter joints of exterior openings where indicated.
b. Vertical joints on exposed surfaces of walls.
c. Perimeter joints between interior wall surfaces and frames of interior doors windows.

2. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors to closely match existing.

D. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Sealant Location:

a. Joints between plumbing fixtures and adjoining walls, floors, and counters.

2. Joint Sealant: Mildew resistant, single component, nonsag, neutral curing, Silicone.

3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors to closely match existing.

E. Joint-Sealant Application: Interior acoustical joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint-Sealant Color: As selected by Architect from manufacturer's full range to closely match existing.

END OF SECTION

SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes hollow-metal work.

B. Related Requirements:

1. Section 087100 "Door Hardware" for door hardware for hollow-metal doors.

1.2 DEFINITIONS

A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or SDI A250.8.

1.3 COORDINATION

A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, core descriptions, and finishes.

B. Shop Drawings: Include the following:

1. Elevations of each door type.

2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.

3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.

4. Locations of reinforcement and preparations for hardware.

5. Details of each different wall opening condition.

6. Details of anchorages, joints, field splices, and connections.

7. Details of accessories.

8. Details of moldings, removable stops, and glazing.

C. Schedule: Provide a schedule of hollow-metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final Door Hardware Schedule.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow-metal work palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.

1. Provide additional protection to prevent damage to factory-finished units.

B. Deliver welded frames with two removable spreader bars across bottom of frames.

C. Store hollow-metal work vertically under cover at Project site with head up. Place on minimum 4-inch- high wood blocking. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

PART 2 - PRODUCTS

2.1 INTERIOR DOORS AND FRAMES

A. Construct interior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

B. Standard-Duty Doors and Frames: SDI A250.8, Level 1.

1. Physical Performance: Level C according to SDI A250.4.

2. Doors:

a. Type: As indicated in the Door and Frame Schedule.
b. Thickness: 1-3/4 inches.
c. Face**:** Uncoated**,** cold-rolled steel sheet, minimum thickness of 0.032 inch.
d. Edge Construction:Model 1, Full Flush.
e. Core: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core at manufacturer's discretion.

3. Frames:

a. Materials: Uncoated, cold-rolled steel sheet, minimum thickness of 0.042 inch.
b. Construction: Full profile welded.

4. Exposed Finish: Prime.

2.2 EXTERIOR HOLLOW-METAL DOORS AND FRAMES

A. Construct exterior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

B. Heavy-Duty Doors and Frames: SDI A250.8, Level 2.

1. Physical Performance: Level B according to SDI A250.4.

2. Doors:

a. Type: As indicated in the Door and Frame Schedule.
b. Thickness: 1-3/4 inches
c. Face: Metallic-coated steel sheet, minimum thickness of 0.042 inch, with minimum A40 coating.
d. Edge Construction:Model 1, Full Flush.
e. Core: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core at manufacturer's discretion.

3. Frames:

a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch, with minimum A40 coating.
b. Construction: Full profile welded.

4. Exposed Finish: Prime.

2.3 FRAME ANCHORS

A. Jamb Anchors:

1. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch thick.

B. Floor Anchors: Formed from same material as frames, minimum thickness of 0.042 inch, and as follows:

1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.

2.4 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B.

D. Frame Anchors: ASTM A 879/A 879M, Commercial Steel (CS), 04Z coating designation; mill phosphatized.

1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.

E. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.

F. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.

G. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.

H. Glazing: Comply with requirements in Section 088000 "Glazing."

2.5 FABRICATION

A. Fabricate hollow-metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for metal thickness. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.

B. Hollow-Metal Doors:

1. Steel-Stiffened Door Cores: Provide minimum thickness 0.026 inch, steel vertical stiffeners of same material as face sheets extending full-door height, with vertical webs spaced not more than 6 inches apart. Spot weld to face sheets no more than 5 inches o.c. Fill spaces between stiffeners with glass- or mineral-fiber insulation.

2. Vertical Edges for Single-Acting Doors: Bevel edges 1/8 inch in 2 inches.

3. Top Edge Closures: Close top edges of doors with inverted closures of same material as face sheets.

4. Bottom Edge Closures: Close bottom edges of doors with end closures or channels of same material as face sheets.

5. Exterior Doors: Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.

C. Hollow-Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.

1. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.

2. Floor Anchors: Weld anchors to bottoms of jambs with at least four spot welds per anchor; however, for slip-on drywall frames, provide anchor clips or countersunk holes at bottoms of jambs.

3. Jamb Anchors: Provide number and spacing of anchors as follows:

    a. Stud-Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:

        1) Three anchors per jamb up to 60 inches high.
        2) Four anchors per jamb from 60 to 90 inches high.
        3) Five anchors per jamb from 90 to 96 inches high.
        4) Five anchors per jamb plus one additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.

4. Head Anchors: Two anchors per head for frames more than 42 inches wide and mounted in metal-stud partitions.

5. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.

    a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
    b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.

D. Fabricate concealed stiffeners and edge channels from either cold- or hot-rolled steel sheet.

E. Hardware Preparation: Factory prepare hollow-metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.

1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

2. Comply with applicable requirements in SDI A250.6 and BHMA A156.115 for preparation of hollow-metal work for hardware.

F. Stops and Moldings: Provide stops and moldings around glazed lites and louvers where indicated. Form corners of stops and moldings with butted or mitered hairline joints.

1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow-metal work.

2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.

3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.

4. Provide loose stops and moldings on inside of hollow-metal work.

5. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.

2.6 STEEL FINISHES

A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.

1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

2.7 ACCESSORIES

A. Louvers: Provide sightproof louvers for interior doors, where indicated, which comply with SDI 111C, with blades or baffles formed of 0.020-inch- thick, cold-rolled steel sheet set into 0.032-inch- thick steel frame.

1. Sightproof Louver: Stationary louvers constructed with inverted-V or inverted-Y blades.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.

B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.3 INSTALLATION

A. General: Install hollow-metal work plumb, rigid, properly aligned, and securely fastened in place. Comply with Drawings and manufacturer's written instructions.

B. Hollow-Metal Frames: Install hollow-metal frames of size and profile indicated. Comply with SDI A250.11 or NAAMM-HMMA 840 as required by standards specified.

1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.

a. Remove temporary braces necessary for installation only after frames have been properly set and secured.
b. Check plumb, square, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.

2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.

    a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.

3. Stud Partitions: Solidly pack mineral-fiber insulation inside frames.

4. Installation Tolerances: Adjust hollow-metal door frames for squareness, alignment, twist, and plumb to the following tolerances:

    a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
    b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
    c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
    d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.

C. Hollow-Metal Doors: Fit hollow-metal doors accurately in frames, within clearances specified below. Shim as necessary.

1. Non-Fire-Rated Steel Doors:

    a. Between Door and Frame Jambs and Head: 1/8 inch plus or minus 1/32 inch.
    b. Between Edges of Pairs of Doors: 1/8 inch to 1/4 inch plus or minus 1/32 inch.
    c. At Bottom of Door: 1/2-inch plus or minus 1/32 inch.
    d. Between Door Face and Stop: 1/16 inch to 1/8 inch plus or minus 1/32 inch.

D. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollow-metal manufacturer's written instructions.

1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

3.4 ADJUSTING AND CLEANING

A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow-metal work that is warped, bowed, or otherwise unacceptable.

B. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

C. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION 081113

SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Mechanical door hardware for the following:

a. Swinging doors.

B. Related Sections:

1. Section 064116 "Plastic-Laminate-Faced Architectural Cabinets" for cabinet door hardware provided with cabinets.

2. Section 081113 "Hollow Metal Doors and Frames" for door silencers provided as part of hollow-metal frames.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction and installation details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Other Action Submittals:

1. Door Hardware Schedule: Prepared by or under the supervision of Installer, detailing fabrication and assembly of door hardware, as well as installation procedures and diagrams. Coordinate final door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

a. Submittal Sequence: Submit door hardware schedule concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate the fabrication of other work that is critical in Project construction schedule.
b. Format: Use same scheduling sequence and format and use same door numbers as in the Contract Documents.
c. Content: Include the following information:

1) Identification number, location, hand, fire rating, size, and material of each door and frame.
2) Locations of each door hardware set, cross-referenced to Drawings on floor plans and to door and frame schedule.
3) Complete designations, including name and manufacturer, type, style, function, size, quantity, function, and finish of each door hardware product.
4) Fastenings and other pertinent information.
5) Explanation of abbreviations, symbols, and codes contained in schedule.

6) Mounting locations for door hardware.
7) List of related door devices specified in other Sections for each door and frame.

2. Keying Schedule: Prepared by or under the supervision of Installer, detailing Owner's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations that are coordinated with the Contract Documents.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Warranty: Special warranty specified in this Section.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of door hardware to include in maintenance manuals. Include final hardware and keying schedule.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Supplier of products and an employer of workers trained and approved by product manufacturers and an Architectural Hardware Consultant who is available during the course of the Work to consult with Contractor, Architect, and Owner about door hardware and keying.

1. Scheduling Responsibility: Preparation of door hardware and keying schedules.

B. Source Limitations: Obtain each type of door hardware from a single manufacturer.

C. Accessibility Requirements: For door hardware on doors in an accessible route, comply with Chapter 11B of the California Building Code.

1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf.

D. Comply with the following maximum opening-force requirements:

1. Latches do not require more than 5 lbf to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.

2. All Hinged Doors: 5 lbf applied perpendicular to door.

3. Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than 1/2 inch high.

4. Adjust door closer sweep periods so that, from an open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches from the latch, measured to the leading edge of the door.

E. Keying Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination." In addition to Owner Contractor, and Architect, conference participants shall also include Installer's Architectural Hardware Consultant. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including, but not limited to, the following:

1. Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.

2. Preliminary key system schematic diagram.

3. Requirements for key control system.

4. Requirements for access control.

5. Address for delivery of keys.

F. 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. Inspect and discuss preparatory work performed by other trades.

3. Review required testing, inspecting, and certifying procedures.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up for door hardware delivered to Project site.

B. Tag each item or package separately with identification coordinated with the final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.

C. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.

D. Deliver keys and permanent cores to Owner by registered mail or overnight package service.

1.7 COORDINATION

A. Coordinate layout and installation of floor-recessed door hardware with floor construction. Cast anchoring inserts into concrete.

B. Installation Templates: Distribute for doors, frames, and other work specified to be factory prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

C. Security: Coordinate installation of door hardware, keying, and access control with Owner.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including excessive deflection, cracking, or breakage.
b. Faulty operation of doors and door hardware.
c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.

2. Warranty Period: Three years from date of Substantial Completion, unless otherwise indicated.

a. Exit Devices: Two years from date of Substantial Completion.
b. Manual Closers: 10 years from date of Substantial Completion.
c. Concealed Floor Closers: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

A. Provide door hardware for each door as scheduled on Drawings to comply with requirements in this Section.

B. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of door hardware are indicated in Part 3 "Door Hardware Schedule" Article. Products are identified by using door hardware designations, as follows:

1. Named Manufacturers' Products: Manufacturer and product designation are listed for each door hardware type required for the purpose of establishing minimum requirements. Manufacturers' names are abbreviated in Part 3 "Door Hardware Schedule" Article.

2.2 HINGES

A. Hinges: BHMA A156.1.

2.3 MECHANICAL LOCKS AND LATCHES

A. Lock Functions: As indicated in door hardware schedule.

B. Lock Throw: Comply with testing requirements for length of bolts required for labeled fire doors, and as follows:

1. Bored Locks: Minimum 1/2-inch latchbolt throw.

2. Deadbolts: Minimum 1-inchbolt throw.

C. Lock Backset: 2-3/4 inches, unless otherwise indicated.

D. Lock Trim:

1. Description: Lever handle as indicated on Drawings.

E. Strikes: Provide manufacturer's standard strike for each lock bolt or latchbolt complying with requirements indicated for applicable lock or latch and with strike box and curved lip extended to protect frame; finished to match lock or latch.

F. Bored Locks: BHMA A156.2; Grade 1; Series 4000.

2.4 EXIT DEVICES AND AUXILIARY ITEMS

A. Exit Devices and Auxiliary Items: BHMA A156.3.

2.5 LOCK CYLINDERS

A. Lock Cylinders: Tumbler type, constructed from brass or bronze, stainless steel, or nickel silver.

1. Manufacturer: Same manufacturer as for locking devices.

B. Standard Lock Cylinders: BHMA A156.5; Grade 1; permanent cores that are interchangeable; face finished to match lockset.

C. Construction Master Keys: Provide cylinders with feature that permits voiding of construction keys without cylinder removal. Provide 10 construction master keys.

D. Construction Cores: Provide construction cores that are replaceable by permanent cores. Provide 10 construction master keys.

2.6 KEYING

A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, Appendix A. Incorporate decisions made in keying conference.

1. Master Key System: Change keys and a master key operate cylinders.

2. Grand Master Key System: Change keys, a master key, and a grand master key operate cylinders.

3. Great-Grand Master Key System: Change keys, a master key, a grand master key, and a great-grand master key operate cylinders.

4. Existing System:

a. Master key or grand master key locks to Owner's existing system.
b. Re-key Owner's existing master key system into new keying system.

5. Keyed Alike: Key all cylinders to same change key.

B. Keys: **Nickel silver**.

1. Stamping: Permanently inscribe each key with a visual key control number and include the following notation:

    a. Notation: Information to be furnished by Owner.

2. Quantity: In addition to one extra key blank for each lock, provide the following:

    a. Cylinder Change Keys: Three.
    b. Master Keys: Five.
    c. Grand Master Keys: Five.
    d. Great-Grand Master Keys: Five.

2.7 KEY CONTROL SYSTEM

A. Coordinate with Owner for requirements with existing Key Control system.

2.8 SURFACE CLOSERS

A. Surface Closers: BHMA A156.4; rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves and forged-steel main arm. Comply with manufacturer's written recommendations for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.

2.9 MECHANICAL STOPS AND HOLDERS

A. Wall- and Floor-Mounted Stops: BHMA A156.16.

2.10 DOOR GASKETING

A. Door Gasketing: BHMA A156.22; air leakage not to exceed 0.50 cfm per foot of crack length for gasketing other than for smoke control, as tested according to ASTM E 283; with resilient or flexible seal strips that are easily replaceable and readily available from stocks maintained by manufacturer.

2.11 THRESHOLDS

A. Thresholds: BHMA A156.21; fabricated to full width of opening indicated.

2.12 FABRICATION

A. Base Metals: Produce door hardware units of base metal indicated, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18.

B. Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine, wood, and sheet metal screws. Provide screws that comply with commercially

recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware, unless otherwise indicated.

2.13 FINISHES

A. Provide finishes complying with BHMA A156.18 as indicated in door hardware schedule.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Steel Doors and Frames: For surface applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.

B. Wood Doors: Comply with DHI WDHS.5 "Recommended Hardware Reinforcement Locations for Mineral Core Wood Flush Doors."

3.3 INSTALLATION

A. Mounting Heights: Mount door hardware units at heights to comply with the following unless otherwise indicated or required to comply with governing regulations.

1. Standard Steel Doors and Frames: ANSI/SDI A250.8.

2. Custom Steel Doors and Frames: HMMA 831.

3. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."

B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be

painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing. Do not install surface-mounted items until finishes have been completed on substrates involved.

1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.

2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

C. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than the number recommended by manufacturer for application indicated or one hinge for every 30 inches of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.

D. Lock Cylinders: Install construction cores to secure building and areas during construction period.

1. Replace construction cores with permanent cores as directed by Owner.

2. Furnish permanent cores to Owner for installation.

E. Thresholds: Set thresholds for exterior doors and other doors indicated in full bed of sealant complying with requirements specified in Section 079200 "Joint Sealants."

F. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they will impede traffic.

G. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.

H. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

3.4 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

1. Spring Hinges: Adjust to achieve positive latching when door is allowed to close freely from an open position of 30 degrees.

2. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.

3. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.

3.5 CLEANING AND PROTECTION

A. Clean adjacent surfaces soiled by door hardware installation.

B. Clean operating items as necessary to restore proper function and finish.

C. Provide final protection and maintain conditions that ensure that door hardware is without damage or deterioration at time of Substantial Completion.

END OF SECTION 087100

SECTION 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior gypsum board.

2. Texture finishes.

B. Related Requirements:

1. Section 061600 "Sheathing".

2. Section 061000 “Rough Carpentry” for framing and blocking.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 DELIVERY, STORAGE AND HANDLING

A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.4 FIELD CONDITIONS

A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.

B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.

C. Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.

2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Low Emitting Materials: For ceiling and wall assemblies, provide materials and construction identical to those tested in assembly and complying with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.2 GYPSUM BOARD, GENERAL

A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.3 INTERIOR GYPSUM BOARD

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. American Gypsum.
2. CertainTeed Corp.
3. Georgia-Pacific Gypsum LLC.
4. National Gypsum Company.
5. PABCO Gypsum.
6. USG Corporation.

B. Gypsum Board, Type X: ASTM C 1396.

1. Thickness: 5/8 inch.
2. Long Edges: Tapered.

C. Gypsum Ceiling Board: ASTM C 1396.

1. Thickness: 1/2 inch.
2. Long Edges: Tapered.

D. Moisture- and Mold-Resistant Gypsum Board: ASTM C 1396. With moisture- and mold-resistant core and paper surfaces.

1. Core: 5/8 inch, Type X.
2. Long Edges: Tapered.
3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

2.4 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.

1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.

2. Shapes:

a. Cornerbead.

2.5 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475.

B. Joint Tape:

1. Interior Gypsum Board: Paper.

2. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.

3. Tile Backing Panels: As recommended by panel manufacturer.

C. Joint Compound for Interior Gypsum Board: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints and damaged surface areas, use setting-type taping compound.

2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.

a. Use setting-type compound for installing paper-faced metal trim accessories.

3. Fill Coat: For second coat, use setting-type, sandable topping compound.

4. Finish Coat: For third coat, use setting-type, sandable topping compound.

5. Skim Coat: For final coat of Level 5 finish, use setting-type, sandable topping compound.

2.6 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.

B. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.

1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick.

2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.

2.7 TEXTURE FINISHES

A. Primer: As recommended by textured finish manufacturer.

B. Non-Aggregate Finish: Pre-mixed, vinyl texture finish for spray application.

1. Products: Subject to compliance with requirements,

a. CertainTeed Corp.; ProRoc Easi-Tex Spray Texture.
b. USG Corporation; BEADEX FasTex Wall and Ceiling Spray Texture.

2. Texture: Match existing adjacent.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates including welded hollow-metal frames and framing, with Installer present, for compliance with requirements and other conditions affecting performance.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLYING AND FINISHING PANELS, GENERAL

A. Comply with ASTM C 840.

B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.

D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.

E. Form control and expansion joints with space between edges of adjoining gypsum panels.

F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.

1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.

2. Fit gypsum panels around ducts, pipes, and conduits.

3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- wide joints to install sealant.

G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

I. Wood Framing: Install gypsum panels over wood framing, with floating internal corner construction. Do not attach gypsum panels across the flat grain of wide-dimension lumber, including floor joists and headers. Float gypsum panels over these members or provide control joints to counteract wood shrinkage.

3.3 APPLYING INTERIOR GYPSUM BOARD

A. Install interior gypsum board in the following locations:

1. Wallboard Type: As indicated on Drawings.

2. Type X: As indicated on Drawings.

3. Ceiling Type: As indicated on Drawings.

4. Moisture- and Mold-Resistant Type: As indicated on Drawings.

B. Single-Layer Application:

1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.

2. On partitions/walls, apply gypsum panels horizontally (perpendicular to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.

a. Stagger abutting end joints not less than one framing member in alternate courses of panels.

3. On Z-furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.

4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

3.4 INSTALLING TRIM ACCESSORIES

A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

B. Interior Trim: Install in the following locations:

1. Cornerbead: Use at outside corners unless otherwise indicated.

3.5 FINISHING GYPSUM BOARD

A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.

B. Prefill open joints and damaged surface areas.

C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.

D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:

1. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.

a. Primer and its application to surfaces are specified in Section 09 91 23 "Interior Painting."

3.6 APPLYING TEXTURE FINISHES

A. Surface Preparation and Primer: Prepare and apply primer to gypsum panels and other surfaces receiving texture finishes. Apply primer to surfaces that are clean, dry, and smooth.

B. Texture Finish Application: Mix and apply finish using powered spray equipment, to produce a uniform texture matching approved mockup and free of starved spots or other evidence of thin application or of application patterns.

C. Prevent texture finishes from coming into contact with surfaces not indicated to receive texture finish by covering them with masking agents, polyethylene film, or other means. If, despite these precautions, texture finishes contact these surfaces, immediately remove droppings and overspray to prevent damage according to texture-finish manufacturer's written recommendations.

3.7 PROTECTION

A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.

B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

C. Remove and replace panels that are wet, moisture damaged, and mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.

2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 092900

SECTION 096513 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Resilient base.

B. Related Sections:
1. Section 09 65 19 "Resilient Tile Flooring".

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples for Initial Selection: For each type of product indicated.

C. Product Schedule: For resilient products.

1.3 MATERIALS MAINTENANCE SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Furnish not less than 10 linear feet for every 300 linear feet or fraction thereof, of each type, color, pattern, and size of resilient product installed.

1.4 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F.

1.6 PROJECT CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive resilient products during the following time periods:

1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.

C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 RESILIENT BASE

A. Resilient Base:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Forbo Industries, Inc.
   b. Burke Mercer Flooring Products; Division of Burke Industries, Inc. Endura.

B. Resilient Base Standard: ASTM F 1861.

1. Material Requirement: Type TV (vinyl, thermoplastic).
2. Manufacturing Method: Group II (layered).
3. Style: Cove (base with toe).

C. Minimum Thickness: 0.125 inch.

D. Height: 4 inches unless otherwise indicated on Drawings.

E. Lengths: Coils in manufacturer's standard length.

F. Outside Corners: Job formed.

G. Inside Corners: Job formed.

H. Finish: To match existing or as selected by Architect from manufacturer's full range.

I. Colors and Patterns: Match existing or as selected by Architect from full range of industry colors.

2.2 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

B. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.

C. Do not install resilient products until they are same temperature as the space where they are to be installed.

1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.

D. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

3.3 RESILIENT BASE INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient base.

B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.

C. Install resilient base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.

D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

E. Do not stretch resilient base during installation.

F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.

G. Job-Formed Corners:

1. Outside Corners: Use straight pieces of maximum lengths possible. Form without producing discoloration (whitening) at bends.
2. Inside Corners: Use straight pieces of maximum lengths possible.

3.4 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protection of resilient products.

B. Perform the following operations immediately after completing resilient product installation:

1. Remove adhesive and other blemishes from exposed surfaces.
2. Sweep and vacuum surfaces thoroughly.
3. Damp-mop surfaces to remove marks and soil.

C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Floor Polish: Remove soil, visible adhesive and surface blemishes from resilient stair treads before applying liquid floor polish.

1. Apply two coat(s).

E. Cover resilient products until Substantial Completion.

END OF SECTION 096513

SECTION 096519 - RESILIENT TILE FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Vinyl Tile floor covering.

B. Related Sections:

1. Section 09 65 13 "Resilient Base and Accessories" for resilient base, reducer strips, and other accessories installed with resilient floor coverings.

1.2 PERFORMANCE REQUIREMENTS

A. Static Coefficient of Friction: For resilient sheet flooring installed on floor surfaces, provide products with the following values as determined by testing identical products per ASTM D 2047:

1. Level Surfaces: Minimum 0.60.
2. Step Treads: Minimum 0.80.
3. Ramp Surfaces: Minimum 0.60.

B. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified agency.
1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples for Initial Selection: For each type of floor covering indicated. Site verification to match existing per District request.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of floor covering to include in maintenance manuals.

1.5 MATERIALS MAINTENANCE SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Floor Covering: Furnish quantity not less than 10 linear feet for every 500 linear feet or fraction thereof, in roll form and in full roll width for each color, pattern, and type of floor covering installed.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs workers for this Project who are competent in techniques required by manufacturer for floor covering installation and seaming method indicated.

1. Engage an installer who employs workers for this Project who are trained or certified by floor covering manufacturer for installation techniques required.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store floor coverings and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F. Store rolls upright.

1.8 PROJECT CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 68 deg F or more than 85 deg F, in spaces to receive floor coverings during the following time periods:

1. 48 hours before installation.

B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.

C. Close spaces to traffic during floor covering installation.

D. Close spaces to traffic for 48 hours after floor covering installation.

E. Install floor coverings after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 RESILIENT COMPOSITION FLOOR TILE

A. Products: Subject to compliance with requirements, provide the following:

1. Forbo Flooring, Inc.; Marmoleum Composition Tile.
2. Contact: Humboldt Industrial Park, P.O. Box 667, Hazleton, PA 18202; Tel, 800.842.7839.

B. Thickness: 0.080”.

C. Size: Approximately 13 by 13 inches.

D. Colors and Patterns: 3048 Graphite, quarter-turn tiles as recommended by the manufacturer.

E. Adhesive: As recommended by the manufacturer.

F. Wearing Surface: Top shield finish.

2.2 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by manufacturer to suit floor covering and substrate conditions indicated.

C. Seamless-Installation Accessories:

1. Heat-Welding Bead: Manufacturer's solid-strand product for heat welding seams.

a. Color: Match floor covering.

D. Integral-Flash-Cove-Base Accessories:

1. Cove Strip: 1-inch (25-mm) radius provided or approved by manufacturer.
2. Cap Strip: Square metal, vinyl, or rubber cap to best match existing, or approved by manufacturer.

E. Floor Polish: Provide protective liquid floor polish products as recommended by manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor coverings.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of floor coverings.

B. Concrete Substrates: Prepare according to ASTM F 710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.

2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
4. Moisture Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.

    a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 5 lb of water/1000 sq. ft. in 24 hours.
    b. Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
    c. Concrete pH Test: Perform pH tests on concrete floors regardless of the age or grade level. If pH is greater than 10, it must be neutralized prior to beginning the installation.

C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.

D. Do not install floor coverings until they are same temperature as space where they are to be installed.

1. Move floor coverings and installation materials into spaces where they will be installed at least 48 hours in advance of installation.

E. Sweep and vacuum clean substrates to be covered by floor coverings immediately before installation.

3.3 FLOOR TILE INSTALLATION

A. Comply with manufacturer's written instructions for installing floor tile.

B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.

1. Lay tiles in pattern indicated.

C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.

1. Lay tiles in pattern of colors and sizes indicated.

D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.

E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.

F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent marking device.

G. Install floor tiles on covers for telephone and electrical ducts, building expansion-joint covers, and similar items in finished floor areas. Maintain overall continuity of color and pattern between pieces of tile installed on covers and adjoining tiles. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.

H. Adhere floor tiles to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

I. Seamless Installation:

1. Heat-Welded Seams: Comply with ASTM F 1516. Rout joints and heat weld with welding bead to permanently fuse sections into a seamless flooring. Prepare, weld, and finish seams to produce surfaces flush with adjoining flooring surfaces.

2. Chemically Bonded Seams: Bond seams with chemical-bonding compound to permanently fuse sections into a seamless flooring. Prepare seams and apply compound to produce tightly fitted seams without gaps, overlays, or excess bonding compound on flooring surfaces.

3.4 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protecting floor tile.

B. Perform the following operations immediately after completing floor tile installation:

1. Remove adhesive and other blemishes from exposed surfaces.

2. Sweep and vacuum surfaces thoroughly.

3. Damp-mop surfaces to remove marks and soil.

C. Protect floor tile from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Floor Polish: Remove soil, adhesive, and blemishes from floor tile surfaces before applying liquid floor polish.

1. Apply coat(s) as recommended by the manufacturer.

E. Cover floor tile until Substantial Completion.

END OF SECTION 096519

SECTION 099113 - EXTERIOR PAINTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes surface preparation and the application of paint systems on exterior substrates.

1. Concrete.
2. Steel.
3. Galvanized metal.
4. Wood.

B. Related Requirements:

1. Section 09 91 23 "Interior Painting" for surface preparation and the application of paint systems on interior substrates.
2. Section 07 62 00 “Sheet Metal Flashing and Trim”.
3. Section 08 11 13 “Hollow Metal Doors and Frames”.
4. Section 08 91 19 “Fixed Louvers”
5. Division 22 Plumbing for painting of exposed piping.
6. Division 23 Mechanical for painting of exposed ductwork.
7. Division 26 Electrical for painting of exposed conduit.

1.2 DEFINITIONS

A. Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.

B. Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.

C. Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.

D. Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.

E. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.

F. Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.

B. Samples for Verification: For each type of paint system and each color and gloss of topcoat.

1. Submit Samples on rigid backing, 8 inches square.

2. Step coats on Samples to show each coat required for system.

3. Label each coat of each Sample.

4. Label each Sample for location and application area.

C. Product List: For each product indicated, include the following:

1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.

2. Printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.

3. VOC content.

1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Paint: 5 percent, but not less than 1 gal. of each material and color applied.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.

1. Maintain containers in clean condition, free of foreign materials and residue.

2. Remove rags and waste from storage areas daily.

1.6 FIELD CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.

B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Basis-of-Design Product: Subject to compliance with District requirements, provide product indicated (Comparable products subject to review and accepted by District prior to bid. Substitution form required):

1. Sherwin-Williams Company (The).

2.2 PAINT, GENERAL

A. MPI Standards: Provide products that comply with MPI standards indicated and that are listed in its "MPI Approved Products List."

B. Material Compatibility:

1. Provide materials for use within each paint system 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.

2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

C. VOC Content: Provide materials that comply with VOC limits of authorities having jurisdiction.

D. Colors:

1. Colors selected will match the existing District standard.

2.3 BLOCK FILLERS

A. Block Filler, Latex, Interior/Exterior: MPI #4.

2.4 PRIMERS/SEALERS

A. Primer, Alkali Resistant, Water Based: MPI #3.

B. Wood-Knot Sealer: Sealer recommended in writing by topcoat manufacturer for exterior use in paint system indicated.

2.5 METAL PRIMERS

A. Primer, Alkyd, Anti-Corrosive for Metal: MPI #79.

B. Primer, Galvanized, Water Based: MPI #134.

C. Primer, Galvanized: As recommended in writing by topcoat manufacturer.

2.6 WOOD PRIMERS

A. Primer, Latex for Exterior Wood: MPI #6.

B. Primer, Alkyd for Exterior Wood: MPI #5.

C. Primer, Oil for Exterior Wood: MPI #7.

2.7 WATER-BASED PAINTS

A. Latex, Exterior Flat (Gloss Level 1): MPI #10.

B. Latex, Exterior Semi-Gloss (Gloss Level 5): MPI #11.

C. Latex, Exterior, Gloss (Gloss Level 6): MPI #119.

D. Light Industrial Coating, Exterior, Water Based (Gloss Level 3): MPI #161.

E. Light Industrial Coating, Exterior, Water Based, Semi-Gloss (Gloss Level 5): MPI #163.

F. Light Industrial Coating, Exterior, Water Based, Gloss (Gloss Level 6): MPI #164.

2.8 SOLVENT-BASED PAINTS

A. Alkyd, Exterior Flat (Gloss Level 1): MPI #8.

B. Alkyd, Exterior, Semi-Gloss (Gloss Level 5): MPI #94.

C. Alkyd, Exterior Gloss (Gloss Level 6): MPI #9.

2.9 TEXTURED AND HIGH-BUILD COATINGS

A. Primer for Textured Coating, Latex, Flat: As recommended in writing by topcoat manufacturer.

B. Intermediate Coat for Textured Coating, Latex, Flat: As recommended in writing by topcoat manufacturer.

C. Textured Coating, Latex, Flat: MPI #42.

D. Primer for Latex, Exterior, High Build: As recommended in writing by topcoat manufacturer.

E. Intermediate Coat for Latex, Exterior, High Build: As recommended in writing by topcoat manufacturer.

F. Latex, Exterior, High Build: MPI #40.

2.10 SOURCE QUALITY CONTROL

A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:

1. Owner will engage the services of a qualified testing agency to sample paint materials. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.

2. Testing agency will perform tests for compliance with product requirements.

3. Owner may direct Contractor to stop applying coatings if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Concrete: 12 percent.

2. Wood: 15 percent.

3. Portland Cement Plaster: 12 percent.

C. Portland Cement Plaster Substrates: Verify that plaster is fully cured (Patch and repair).

D. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

E. Proceed with coating application only after unsatisfactory conditions have been corrected.

1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Manual" applicable to substrates and paint systems indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.

C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulates.

1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.

D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

E. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by paint manufacturer but not less than the following:

1. SSPC-SP 2, "Hand Tool Cleaning."

2. SSPC-SP 3, "Power Tool Cleaning."

F. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

G. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

3.3 APPLICATION

A. Apply paints according to manufacturer's written instructions and recommendations in "MPI Manual."

1. Use applicators and techniques suited for paint and substrate indicated.

2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.

3. Paint both sides and edges of exterior doors and entire exposed surface of exterior door frames.

4. Paint entire exposed surface of window frames and sashes.

5. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

6. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.

B. Tint undercoats same color as topcoat but tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

E. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:

1. Paint the following work where exposed to view:
   a. Equipment, including panelboards and switch gear.
   b. Uninsulated metal piping.
   c. Pipe hangers and supports.
   d. Metal conduit.
   e. Tanks that do not have factory-applied final finishes.
   f. Metal cages for secondary heat-pumps located at ground level.

3.4 FIELD QUALITY CONTROL

A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.

1. Contractor shall touch up and restore painted surfaces damaged by testing.

2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 EXTERIOR PAINTING SCHEDULE

A. Painting Sub-contractor and supplier shall conduct a preinstallation conference with Owner and Architect to review limits of work and the contractor shall create a detailed paint schedule to fit proposed project.

END OF SECTION 099113

SECTION 099123 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes surface preparation and the application of paint systems on the following interior substrates:

1. Steel.
2. Gypsum board.

B. Related Requirements:

1. Section 09 29 00 “Gypsum Board”

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.

B. Samples for Initial Selection: For each type of topcoat product.

C. Product List: For each product indicated, include the following:

1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
2. Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.
3. VOC content.

1.3 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Paint: 5 percent, but not less than 1 gal. of each material and color applied.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.5 FIELD CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.

B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Basis-of-Design Product: Subject to compliance with District requirements, provide product indicated (Comparable products subject to review and accepted by District prior to bid. Substitution form required):

1. Sherwin-Williams Company (The): ProMar 400 Interior
2. Sherwin-Williams Company (The): High Build Drywall Primer
3. Sherwin-Williams Company (The): Southwest Builders Summit Exterior Pure Acrylic Primer
4. Sherwin-Williams Company (The): Pro-Cryl Universal Metal Primer
5. Sherwin-Williams Company (The): SOLO Int/Ext 100% Acrylic Low VOC Semi-gloss
6. Sherwin-Williams Company (The): W/R Alkyd In/Ext Fast Dry Primer.

2.2 PAINT, GENERAL

A. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated including but not limited to; Primer/Sealers for dry wall, wood, steel and concrete, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience and MPI Index.
2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

B. Colors:

1. Walls: SW 7056, Reserved White.
2. Accent Wall (one full wall per classroom):
   a. Dental: SW color TBD.
   b. Medical: SW 6211, Rainwashed.
   c. Manufacturing Lab & Classroom: SW 7067, Cityscape.
   d. Culinary: NONE.
3. Doors: Match existing.
4. Trim: Match existing.

C. Sheens:

1. Walls: Eggshell.
2. Ceiling: Eggshell.
3. Doors: Match existing.

4. Trim: Match existing.

2.3 PRIMERS/SEALERS

A. Primer Sealer, Latex, Interior: MPI #50.

1. VOC Content: E Range of E2
2. Environmental Performance Rating: EPR3.

B. Primer Sealer, Alkyd, Interior: MPI #45.

1. VOC Content: E Range of E2.

C. Wood-Knot Sealer: Sealer recommended in writing by topcoat manufacturer for use in paint systems indicated.

2.4 METAL PRIMERS

A. Primer, Alkyd, Quick Dry, for Metal: MPI #76.

1. VOC Content: E Range E2.

2.5 SOURCE QUALITY CONTROL

A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:

1. Owner will engage the services of a qualified testing agency to sample paint materials. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
2. Testing agency will perform tests for compliance with product requirements.
3. Owner may direct Contractor to stop applying coatings if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Wood: 15 percent.

2. Gypsum Board: 12 percent.

C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.

D. Plaster Substrates: Verify that plaster is fully cured.

E. Spray-Textured Ceiling Substrates: Verify that surfaces are dry.

F. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

G. Proceed with coating application only after unsatisfactory conditions have been corrected.

1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Manual" applicable to substrates indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.

D. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer.

E. Wood Substrates:

1. Scrape and clean knots and apply coat of knot sealer before applying primer.
2. Sand surfaces that will be exposed to view and dust off.
3. Prime edges, ends, faces, undersides, and backsides of wood.
4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.

3.3 APPLICATION

A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual.". See also District standards.

1. Use applicators and techniques suited for paint and substrate indicated.

2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.

B. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

C. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

D. Painting Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:

1. Paint the following work where exposed in occupied spaces:

a. Equipment, including panel boards.
b. Uninsulated metal piping.
c. Pipe hangers and supports.
d. Metal conduit.
e. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
f. Other items as directed by Architect.

2. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

3.4 FIELD QUALITY CONTROL

A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.

1. Contractor shall touch up and restore painted surfaces damaged by testing.
2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 INTERIOR PAINTING SCHEDULE

A. Painting Sub-contractor and supplier shall conduct a preinstallation conference with Owner and Architect to review limits of work and the contractor shall create a detailed paint schedule to fit proposed project.

END OF SECTION 099123

SECTION 22 00 00 - PLUMBING GENERAL CONDITIONS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section specifies the Division 22 Work coordination requirements with general work provisions.

B. For convenience and reference the Specifications are separated into Divisions and Sections. Such separations shall not operate to make the Engineer an arbitrator to establish subcontract limits between the Prime Contractor and his Subcontractors. In any case, the Prime Contractor is responsible to the owner for a complete job.

C. This section consists of General Requirements and Standard Specifications covering certain parts of work under Division 22 and is supplemented by other Division 22 sections covering additional work, requirements, and materials specifically applicable to the work of each section.
   1. Requirements of subsequent sections of the specifications, if in conflict with these General Requirements, shall govern.

D. No material installed as part of this WORK shall contain asbestos in any form.

1.2 CONDITIONS OF THE CONTRACT

A. The Conditions of the Contract (General, Supplementary, and other Conditions) and the General Requirements (Sections of Division 1) are hereby made a part of this Section.

B. This section is a Division-22 Basic Materials and Methods section and is a part of each Division -22 section.

1.3 DESCRIPTION OF REQUIREMENTS

A. Provide finished work, tested and ready for operation including apparatus, appliances, materials, and work. Provide incidental accessories necessary to make the work complete and ready for operation without additional expense to the Owner.

B. Before beginning work or ordering materials, consult Architect for clarification of discrepancies between, or questionable intent, of the Contract Documents.

C. Contractor shall visit the site and field survey the existing site conditions prior to bid. Any site conditions which may cause significant deviation from the design drawings shall be brought to the attention of the Owner’s representative for clarification prior to bid.

1.4 REQUIREMENTS OF REGULATORY AGENCIES:

A. Provide work and materials in full accordance with the latest rules and regulations of the following:
1. California Code of Regulations - Title 24 - Parts 2, 3, 4,5, and 9
2. California Code of Regulations - Title 22 - Chapter 7
3. California Building Code, 2019
4. California Mechanical Code, 2019
5. California Plumbing Code, 2019
6. California Electric Code, 2019
7. California Fire Code, 2019
8. California Building Energy Efficiency Standards 2019
9. California Green Building Standards 2019
10. California Energy Code 2019
11. National Fire Protection Association
12. CAL-OSHA
13. Occupational Safety and Health Administration
14. State Fire Marshal, Title 19 CCR
15. Other applicable state laws

B. Nothing in Drawings or specifications shall be construed to permit work not conforming to these codes.

C. Conform to State of California Energy Conservation Standards for all systems, equipment, and construction.

D. The above Codes and Standards define minimum requirements required for the project. Where Contract Documents differ from governing codes, furnish and install higher standard.

1.5 FEES, PERMITS, AND UTILITY SERVICES:

A. Arrange for required inspections and permits required in installation of the work.

B. The Owner will pay charges for permits required.

C. Arrange for utility connections and pay charges incurred, including excess service charges, if any.

D. Obtain the first permits to operate any compressed air tanks that are required to be furnished under this work, pay all costs, and perform all tests required to obtain permits. Post permits under glass in a conspicuous place on or near the tanks, as required by these authorities.

1.6 UTILITY CONNECTIONS:

A. Prior to start of Construction and within 30 days of award of Contract, contact local gas company representative and coordinate location of gas meter and piping. In addition, coordinate time required for installation in order to avoid delay to the project.

B. Arrange for utility connection and coordinate work with utility company.

C. Contractor to bear the cost of all construction related to utility services from the point of connection shown on the Contract Documents. This includes any piping, excavation, backfill, boring, etc.

1.7 SITE EXAMINATION:

A. Examine site, verify dimensions and locations against Drawings, and inform self of conditions under which work is to be done before submitting proposal. No allowance will be made for extra expense on account of error.

B. Information shown relative to existing services is based upon available records and data but is approximate only. Make minor deviations found necessary to conform with actual locations and conditions without extra cost. Verify location and elevation of utilities prior to commencement of excavation for new piping or its installation.

C. Exercise care in excavating near existing utilities to avoid any damage thereto. This Contractor is responsible for any damage caused by his operations.

1.8 ACTION SUBMITTALS / MATERIAL LIST AND SUBSTITUTIONS:

A. Prior to commencement of work, and within 35 days after award of Contract, submit to Architect for review electronic copies of a complete list of equipment and materials to be furnished, including all substitutions. All submittals to be in electronic format as follows:
   1. Submittals to be in PDF Format.
   2. Individual PDF cut sheets shall be inserted into a single file for review.
   3. All sheets to be “unprotected” and “writable”.

B. Provide submittal information for all materials proposed for use as part of this project. Provide standard items on specified equipment at no extra cost to the contract regardless of disposition of submittal data. Other material or methods shall not be used unless approved in writing by the Architect. The Architect’s review will be required even though “or equal” or synonymous terms are used.

C. It is the responsibility of the Contractor to assume all costs incurred because of additional work and/or changes required to incorporate the proposed substitute into the project including possible extra compensation due to the Architect. Refer to Division 1 for complete instructions.

D. Contractor to provide complete Submittal packages for all plumbing items clearly separated by system. At a maximum, submittals to be broken into the following packages:
   1. Plumbing – Common Work, Valves & Accessories, Insulation, and Piping.
      a. When required by schedule, a separate Plumbing Underground submittal package will be reviewed upon request.
   2. Plumbing – Fixtures
   3. Plumbing – Medical Gas Piping & Valves.
   4. Incomplete submittals or submittals broken down by spec section shall be returned un-reviewed.

E. Identify each item by manufacturer, brand, trade name, model number, size, rating, or whatever other data is necessary to properly identify and review materials and equipment.
   1. Where submittal sheets indicate more than one product, Contractor to clearly identify product being submitted. Contractor to cross-out information not being submitted for review.

2. Submittals that do not clearly identify submitted item will be returned to the Contractor un-reviewed.

F. Identity each submitted item by reference to specification section number and paragraph in which item is specified. Cross reference submittals by equipment ID where applicable.

G. Quantities are the Contractor's responsibility and will not be reviewed.

H. If Contractor desires to make a substitution, he shall submit complete information or catalog data to show equality of equipment or material offered to that specified.
1. Only one request for substitution will be considered on each item of material or equipment. No substitutions will be considered thereafter.
2. Scheduled Products and first named manufacturer/product forms basis of design. All other manufacturers' products are substitutions.
3. No substitutions will be allowed unless requested and reviewed in writing.
4. The Architect shall review and take appropriate action on shop Drawings, product data, samples, and other submittals required by the Contract Documents. Such review shall be only for general conformance with the design concept and general compliance with the information given in the Contract Documents. It shall not include review of quantities, dimensions, weights or gauges, fabrication processes, construction methods, coordination with the work of other trades, or construction safety precautions, all of which are the sole responsibility of the Contractor.
5. Review of a specific item shall not indicate acceptance of an assembly of which the item is a component. The Architect shall not be required to review and shall not be responsible for any deviations from the Contract Documents not clearly noted by the Contractor, nor shall the Architect be required to review partial submissions or those for which submissions for correlated items have not been received. Architect reserves right to require originally specified item.
6. Named non-basis-of-design manufacturer does not guarantee approval of equipment submittals. Manufacturers must comply with all the performance and features as specified within the specifications and as indicated on the design documents.

I. Installation of reviewed substitution is Contractor's responsibility. Any changes required for installation of reviewed substituted equipment must be made without additional cost to the owner. Review by the Architect of the substituted equipment and/or dimensional Drawings do not waive these requirements.

1.9 CLOSEOUT SUBMITTALS / MAINTENANCE AND OPERATING INSTRUCTIONS:

A. Instruct the Owners' authorized representatives in the operation, adjustment, and maintenance of all mechanical equipment and systems. Provide 3 copies of certificate signed by Owner's representatives attesting to their having been instructed.

B. Furnish Architect with three complete sets of operating and maintenance (O&M) instructions.
1. O&M manuals to be bound in hardboard binder and indexed.
2. O&M manuals to include: descriptive literature, catalog cuts, and diagrams covering all items of operation and maintenance for each and every mechanical system and piece of equipment furnished under these specifications.
3. Include in each set a copy of the air balance test report specified hereinafter.

C. Contractor must start compiling the above data (including obtaining operating and maintenance instruction data and catalog cuts and diagrams from the manufacturer of the

reviewed equipment) immediately upon review of his list of materials, so as not to delay the final installation of the work.

D. Bind and index each set in a durable, hardboard binder. Final observation will not be made until booklets are submitted and have been reviewed by the Architect.

E. O&M manuals to incorporate the following:
1. Complete operating instructions for each item of plumbing equipment.
2. Test data and system balancing reports as specified.
3. Manufacturer's bulletins with parts numbers, instructions, etc. for each item of equipment. Remove information not applicable to project.
4. Typewritten maintenance instructions for each item of equipment listing in detail the lubricants to be used, frequency of lubrications, inspections required, adjustment, etc.
5. A complete list and/or schedule of all major valves giving the valve ID, location of valve, and the rooms or area controlled by the valve.
6. Provide copies of start-up reports for each piece of equipment provided as part of this work.
7. Name, address, and phone number of contractors involved in work under this Division.
8. Detailed step-by-step instructions for starting, summer operation, winter operation, and shutdown of each system.
9. Detailed maintenance instructions for starting, summer operation, winter operation, and shutdown of each system.
10. Spare parts list.
11. Full size Record as built shop drawings in hard copies and PDF files.

1.10 COORDINATION SHOP DRAWINGS

A. General:
1. Prepare and submit for review coordination drawings where work by separate entities requires fabrication of products and materials which must accurately interface or for which space provided is limited.
2. Coordination drawings shall indicate how the work will interface and installation will be sequenced. It is the intent of this provision to find, bring forth, and resolve potential constructability problems prior to actual construction, thereby allowing for the resolution of issues before construction cost and schedule are impacted.
3. Submittal of copies of the Plumbing Contract Documents shall not take place of Coordinated Shop drawings.

B. The General Contractor shall oversee preparation of coordination drawings, assign priority space, and bring to the attention of the Architect any conflicts or interferences of an unresolved nature found during preparation of coordination drawings. Expedite conflict or interferences and submit solutions/ recommendations for approval review.

C. Drawings: Shop drawings shall include but are not necessarily limited to the following:
1. Submit 1/4" = 1'-0" minimum scale, a combined, comprehensive mechanical coordination drawing. Coordination drawing shall include all plumbing piping overlaid and coordinated with all HVAC ductwork, mechanical piping, sprinkler systems, and ceiling systems overlaid on structural frame and architectural plan. Shop drawings are to be coordinated with all electrical and Telecom systems.
2. Criteria: Plumbing Piping, Ductwork, mechanical piping, and sprinkler system components shall be sized as shown on Drawings. Seismic restraints shall be shown where required.

a. Nonconforming Mechanical work installed within designated coordination areas is subject to removal and replacement by the installing contractor at no additional cost to Owner.

3. Provide sections for congested areas.
4. Identify typical areas, start preparation of coordination drawings for such areas first.

D. Coordination drawings shall be signed and dated by individual trade contractors. By act of signature and submittal of singular combined coordination drawing, each trade contractor acknowledges their coordinated portion of the work with all other mechanical, electrical, telecom, architectural, and structural work contractors.

E. After completion of coordination shop drawings signed by individual trade contractors. Submit copies to the architect for review. Once approved, provide copy at the job site for reference. No work shall be performed without the complete coordination shop drawings.

F. No request for information regarding the routing of pipes and placement of equipment will be reviewed and responded to without a completed shop drawings.

1.11 SITE CONDITIONS

A. Information of the drawings relative to existing conditions is approximate only. Deviations found necessary during progress of construction to conform to actual conditions as approved by the Architect shall be made without additional cost to the Owner. The Contractor shall be held responsible for any damage caused to existing services. Promptly notify the Architect if services are found which are not shown on the Drawings.

1.12 WARRANTY

A. Be responsible for work done and material installed under these plans and specifications. Repair or replace, as may be necessary, any defective work, material, or part which may show damage to itself or other materials, furnishing, equipment, or premises caused by such defects during this period, if in the opinion of the Architect said defect is due to imperfection of material or workmanship. Provide all such work and materials at no cost to Owner.

B. Be responsible for damage to any part of premises during guarantee period caused by leaks or breaks in work furnished and/or installed under this section. Replace refrigerant, lubricants, or gasses lost as result of defects, breaks, or leaks in work.

C. Provide manufacturer's written warranties covering defects in material and workmanship of products and equipment utilized for the project.

D. Warranties shall be for a period of 1 years from the date of substantial completion unless more stringently specified within individual Sections of this Division.

PART 2 - PRODUCTS

2.1 GENERAL:

A. Mention herein or on Drawings requires that this Contractor provide each item listed of quality noted or equal. Refer to subsequence division 22 specification sections for specific equipment and system materials and accessories.

B. All material shall be new, full weight, standard in all respects, and in first- class condition.

C. Provide materials of the same brand or manufacture throughout for each class of material or equipment wherever possible.

D. The grade or quality of materials desired is indicated by the trade names or catalog numbers stated herein.

E. Dimensions, sizes, and capacities shown are a minimum and shall not be changed without permission of the Architect.

F. Conform to the State Energy Conservation Standards for all material and equipment.

2.2 MATERIALS FURNISHED:

A. Identify all materials and equipment by manufacturer's name and model number. Remove unidentified materials and equipment from site.

B. Equipment specified by manufacturer's number shall include all accessories, controls, etc. listed in catalog as standard with equipment. Furnish optional or additional accessories as specified.

C. Equipment or material damaged during transportation, installation, or operation is considered as totally damaged. Replace with new equipment. Variance from this permitted only with written consent of the Architect.

D. Deliver, Protection, and Care:
   1. Deliver materials or equipment to the Project in the manufacturer's original, unopened, labeled containers.
   2. Added costs associated with reordering, expediting orders, or project delays due to rejected materials shall be borne by the Contractor.
   3. Protect from damage which may be caused by theft, weather, and building operations. Failure to protect materials and apparatus adequately shall be sufficient cause for rejection of any damaged material or equipment.
   4. Close pipe and equipment openings to prevent intrusion of obstructions and damage.
   5. Owner or Architect will require removal and replacement of such material or work from the premises which is not in accordance with Contract Documents. Replace unsatisfactory work without delay, at no additional cost to the Owner.
   6. All material and equipment shall be protected against moisture, dirt and damage. Protective coverings shall be provided for bearings, open connections to pumps and tanks, coils, pipes and similar equipment that is vulnerable to grit and dirt.
   7. The interior of the pipes shall be kept clean at all times.

PART 3 - EXECUTION

3.1 GENERAL:

A. General arrangement and location of piping, equipment, etc. are shown on Drawings or herein specified. Carefully examine other work that may conflict with this work. Install this work in harmony with other crafts and at proper time to avoid delay of work. Provide all offsets as required to avoid other trades at no additional cost to the owner.

B. In advance of construction, work out minor changes and relocations to suit actual conditions and work of other trades to avoid conflict therewith. This shall not be cause for additional cost.

C. Execute any work or apparatus shown on the Drawings and not mentioned in the specifications, or vice versa, the same as if specifically mentioned by both. Omission from Drawings or specifications of any minor details of construction, installation, materials, or essential specialties does not relieve this Contractor from furnishing same in place complete.

D. Furnish and install any incidental work not shown or specified which can reasonably be inferred as part of the work and necessary to provide a complete and workable system.
   1. Minor piping associated with instrumentation and control is generally not shown. Interconnection of sensors, transducers, control devices, instrumentation panels, is the responsibility of the contractor. Small piping associated with water cooling, drips, drains and other minor piping may not be shown to avoid confusion in the plan presentation but shall be provided as part of contract work. Drains shall be piped to the nearest floor drains.

E. Furnish materials and work at proper time to avoid delay of the work.

F. Coordinate with testing and balancing contractor to review drawings for proposed additional balancing components required for proper system testing and balancing.

3.2 ACCESS:

A. Continuously check Architectural Drawings for clearance and accessibility of equipment specified herein to be placed. No allowance of any kind will be made for negligence on part of Contractor to foresee means of installing his equipment into proper position.

3.3 CLOSING IN OF UNINSPECTED WORK:

A. Do not allow or cause work installed to be covered up or enclosed before it has been inspected and tested. Should work be enclosed or covered up before it has been inspected and tested, uncover work at own expense. After it has been inspected and tested, make repairs necessary to restore work of other contractors to condition in which it was found at time of cutting.

3.4 PROJECT MODIFICATIONS:

A. During the progress of construction, if such conditions arise that require revisions, modifications, or relocations to any mechanical equipment or materials incorporated in this project, such alterations shall be immediately called to the attention of the Architect.

Contractor shall then prepare necessary Drawings showing proposed changes. Submit proposed changes for review by the Architect prior to actual revision work in the field.

B. Two sets of Drawings showing all revisions shall be immediately presented to Architect for his records. Maintain additional copies on the project as necessary to comply with "RECORD DRAWINGS" requirement of the General Requirements.

C. Incorporate all revisions into record Drawings.

3.5 FORMING, CUTTING AND PATCHING:

A. Coordinate with other contractors as necessary to provide any special forming, recesses, chases, etc., and provide wood blocking, backing, and grounds as necessary for proper installation of mechanical work.

B. If this Contractor fails to coordinate with other contractors at proper time or fails to locate items properly, resulting in extra work, then this Contractor is responsible.

C. This Contractor is responsible for proper placement of pipe sleeves, hangers, inserts, and supports for work.

D. Cutting, patching, and repairing of existing (old) construction to permit installation of piping, etc. is responsibility of this Contractor. Repair or replace damage to existing work with skilled mechanics for each trade involved in first-class manner.

E. Cut existing construction in a neat and workmanlike manner by the use of a concrete saw. Use of pneumatic devices will not be allowed.

F. Core openings through existing construction as required for the passage of new piping and conduits. Cut holes of the minimum diameter to suit size of pipe installed and associated insulation.

3.6 DEMOLITION AND SALVAGE:

A. Provide demolition of mechanical work under this SECTION as indicated on Drawings.

B. Removed materials which will not be re-used and which are not claimed by the owner shall become the property of the Contractor and shall be removed from the premises. Consult Owner before removing any material from the premises. Carefully remove materials claimed by the owner to prevent damage. Coordinated delivery of such items to owner.

C. Removed materials which are to be reused are to be removed, cleaned, and stored in a safe location. If such items are lost or damaged by the Contractor, item shall be replaced with new item at no added cost to owner. If item is found to be damaged prior to removal, inform Architect prior to removal so that item may be examined by Architect and owner for further instructions.

3.7 WELDING FOR MECHANICAL WORK

A. All mechanical welding and inspection requirement shall be in accordance with the California Mechanical Code.

B. Qualify welding procedures, welders and operators shall be in accordance with ASME Boiler and Pressure Vessel Code, Section IX, welding and brazing qualifications. Welding procedures and testing shall comply with ANSI standard B31.9 - Standard Code for Pressure Piping, and the American Welding Society (AWS) welding handbook.

C. Soldering and brazing procedures shall conform to ANSI B9.1 standard safety code and NFPA 99.

D. All welders shall be certified by a state approved welding bureau. Fabricator shall have current and valid certificated registration by the building official for the types of welds required by the project. Prior to start of the project, the fabricator shall submit a copy of certificate of registration for approval. Prior to project close out, the fabricator shall submit a certificate of compliance that the work was performed in accordance with the approved plans and specifications to the building official and to the Engineer or Architect of record.

3.8 EXISTING SERVICES:

A. Provide and install all required connections to existing systems as required by the Drawings and specifications.

B. Integrate existing systems with all new work to provide a complete working system.

C. Provide minimum 72-hour minimum notice to Owner of service interruptions. All service interruptions shall be kept to the minimum possible time. When requested by Owner service interruptions shall occur outside of normal working hours at no additional cost to owner.

3.9 ASBESTOS ABATEMENT:

A. Existing systems within the area of this scope of work may have asbestos-bearing materials. Testing, encapsulation, removal, treatment, or correction of existing asbestos-bearing materials is not a part of this scope of work and is not the responsibility of the mechanical contractors.

3.10 STRUCTURAL DESIGN OF EQUIPMENT AND SEISMIC RESTRAINTS:

A. All mechanical equipment supports shall be designed by a licensed Structural Engineer and shall comply with the 2019 California Building Code, Section 1616A.1.18 through 1616A.1.26 and ASCE 7-16. Chapters 13, 26, and 30.

3.11 START-UP PROVISIONS FOR MECHANICAL WORK

A. General: Major equipment (such as booster pumps) start-up shall be performed by the equipment manufacturer or authorized representative.

B. Adjusting and Aligning Equipment: Adjust all equipment. Check all motors for proper rotation.

C. Lubrication:
1. Extend grease fittings on bearings to points of ready and easy accessibility.
2. Lubricate fan bearings, etc., before operation of any equipment.
3. Provide a final lubrication to equipment immediately before turning over to Owner.

D. Provide training and orientation of Owners operating staff in proper care and operation of equipment, systems and controls.

E. During test period, make final adjustments and balancing of equipment, systems, controls, and circuits so that all are placed in first-class operating condition.

F. Mark final positions of balancing valves after balancing is complete.

G. Final observation will not be made until all of the above have been completed and a preliminary copy of the balance report has been submitted and reviewed.

3.12 PLUMBING RECORD AS-BUILT DRAWINGS:

A. During the course of Project Construction, Mechanical Contractor shall maintain recorded “As-built” information by distinctively marking up approved shop drawings prints to depict all actual work installed on a daily basis form but not limited to field conditions, addendums, architectural supplemental instructions (ASIs), instruction bulletins (IBs), change orders (COs), responses to Request For Information (RFIs), and approved product substitutions.

B. The marked-up shop drawings will be made available at the Construction Site to the Architect upon request, at any time.

C. The marked-up shop drawings with the recorded information shall then be used to create Record As-built drawings at the completion of the project. Contractor shall submit the Record As-built drawings in full-size hard copies and also in PDF format.
1. Provide 2 complete sets of full-size drawings on 20 pound white bond paper.
2. Provide 1 CD (compact disc) or Thumb Drive with Record drawings in PDF format. Files to be names the same as sheets.
3. Record as-built drawings are to be full size drawings (same size as Contract Documents) and all plans are to be to standard engineering scale. The minimum drawing scale to match those provided within the Contract Documents.

3.13 CLEANING UP:

A. Remove tools, scaffolding, surplus materials, barricades, temporary walks, debris, and rubbish from the Project promptly upon completion of the work of each Section. Leave the area of operations completely clean and free of these items.

END OF SECTION

SECTION 22 05 00 - COMMON WORK FOR PLUMBING

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes general mechanical materials and methods required within the project. Items included within this specification section include:
   1. Piping Supports
   2. Valve Boxes
   3. Access Doors
   4. Roof Flashing
   5. Dielectric Unions
   6. Pipe and Equipment Identification
   7. Painting
   8. Concrete
   9. Excavating And Backfill
   10. Electrical Work
   11. Commissioning and preliminary operational tests

1.2 ACTION SUBMITTALS

A. Product data: submit complete data of materials proposed including:
   1. Manufacturer and model number
   2. Clearly indicate all options, trim, and accessories.
   3. Cross reference manufacturer's cut sheet to fixture callout ID on submittal sheet.

1.3 CLOEOUT SUBMITTALS

A. Warranty: Submit executed warranty.

B. Certification: Submit Contractors Certification

C. Operation and Maintenance Data: submit complete O&M data including:
   1. Maintenance data and parts lists for each component.
   2. Provide "trouble- shooting" maintenance guide
   3. Include this data within maintenance manual

1.4 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacturer of plumbing piping systems products, of types, materials, and sizes required whose products have been in satisfactory use in similar service for not less than 5 years.

B. Contractor's Qualifications: Firm with at least 5 years of successful installation experience on projects with piping systems work similar to that required of project.

1.5 WARRENTY

A. Manufacturer: In addition to the Contractor's Standard Guarantee, furnish Owner with manufacturer's warranty for all plumbing valves and accessories against defects in materials and workmanship. Warranty shall cover replacement of product plus labor to install.

PART 2 - PRODUCTS

2.1 PIPING SUPPORTS:

A. STRUCTURAL DESIGN OF EQUIPMENT AND SEISMIC RESTRAINTS:

B. All mechanical equipment supports shall be designed by a licensed Structural Engineer and shall comply with the 2019 California Building Code, Section 1617A.1.18 through 1617A.1.26 and ASCE 7-16. Chapters 13, 26, and 30.

C. Mechanical equipment supports shall be designed by a licensed Structural Engineer.

D. Provide seismic sway bracing for all suspended piping in accordance with the Seismic Restraint System Guidelines, OPM-0043-13 by Mason.

E. Acceptable Manufacturer:
1. Mason
2. B-Line
3. Or Equal

F. Vertical Piping:
1. Support vertical piping risers securely with riser clamps, B-Line B3373, or equal. Attach clamps to the pipe above each concrete floor slab, with the arms of the clamp resting on the slab or the structural supports. Provide Superstrut B3373C, or equal clamp when used on copper piping.
2. Support pipe lines passing up through the building at each floor of the building.

G. Horizontal Piping:
1. Use B-Line B3100, or equal, steel strap hanger for uninsulated steel or cast-iron pipe through 8-inch size, and for insulated steel or cast-iron pipe through 4-inch size.
2. Use Superstrut C-710 or equal, steel hanger in pipe sizes where suitable. Use saddle shield as specified for insulated pipes.
3. For uninsulated copper tubing, use B-Line B3100F, or equal, felt lined hanger.

H. Pipe Saddles:
1. Use B-Line B3153, or equal, protective insulation shield with "loc" tabs.

I. Concrete Inserts: Provide B-Line B2500, or equal, concrete inserts.

2.2 VALVE BOXES:

A. Provide at each valve or cock in ground a Christy, Brooks, or equal valve box with cover marked for service.

B. Valve boxes in traffic areas: Provide Christy No. G5 traffic valve box, 10-3/8" inside diameter with extensions to suit conditions, with cast iron locking cover.

C. Valve Boxes in non-traffic areas: Provide Christy No F22, 8" inside diameter by 30" long with cast iron locking cover. Cut bottom of plastic body for operation of valve as required.

D. Extension Handles
1. Handle to be Alhambra Foundry Co., or equal, model A-3008 extension handle.
2. Furnish 2 extension handles per project for underground valves.

2.3 ACCESS DOORS:

A. Where floors, walls, or ceilings must be penetrated for access to mechanical equipment, provide access doors, 14-inch by 14-inch minimum size in usable opening. Where entrance of a serviceman may be required, provide 18-inch by 24-inch minimum usable opening.
1. All access doors less than 7'-0" above finished floors and exposed to public access shall have keyed locks.

B. Provide stainless steel access doors where installed on stainless steel panels.

C. Access doors shall match those supplied in Division 8 in all respects, except as noted herein.

D. Where specific information or details relating to access panels different from the above is shown or given on the Drawings or other Divisions of work, then that information shall supersede this specification.

E. Do not locate access doors in highly visible public areas such as lobbies, waiting areas, and primary entrance areas. Coordinate with the architect when access is required within these areas.

F. Available Manufacturers:
1. Milcor
2. Karp
3. Nystrom
4. Cesco

G. Access doors to be equivalent to the following Milcor access doors:
1. Style M (plaster)
2. Style A (A/C tile, gypsum board)
3. Style M (Masonry)
4. Style "Fire Rated" where required.

2.4 ROOF FLASHING:

A. Flashings in metal deck or membrane type roofing:
1. Flashing for penetrations of the roof for mechanical items such as flues and pipes will be furnished and installed under other sections of these specifications. The work of this section shall include layout, sizing, and coordination of penetrations required for the mechanical work.
2. Furnish and install counterflashings above each flashing required in the mechanical work. Flues shall have 24-gauge galvanized sheet metal storm collar securely clamped to the flue above the flashing.

3. Sewer vents and other piping extending through roof structure shall have flashing provided and installed as part of the roofing work. This contractor shall coordinate his Work accordingly.

B. Flashing in built-up roofing assemblies:
1. Where flashing is not provided and installed as part of other Work, furnish and install a waterproof flashing and counterflashing for pipe and flue passing through roof. The flashing shall extend a minimum of 9 inches in all directions from the outside of the pipe or flue.
2. Sewer vents and other piping extending through roof structure shall have four-pound sheet lead flashings and Semco, Smith, or equal to Semco #1100-4, counterflashing sleeves installed as detailed.
   a. Provide Hydroseal at underside of counterflashings as recommended in Semco installation instructions.
3. Flues shall have 24-gauge galvanized steel flashings on all roofs. Securely clamp a storm collar (counterflashing) around the flue above the flashing. Storm collars shall be of same material as flashing.
4. Seal all pipes or flues passing through exterior walls in an approved, watertight manner.

2.5 DIELECTRIC UNIONS:

A. Furnish and install dielectric unions at all locations described herein, whether shown on Drawings or not, and except as noted herein. Construct couplings and flanges so that the two pipes being connected are completely insulated from each other with no metal-to-metal contact. Heavily line the couplings with a hard, insulating, phenolic plastic threaded in standard pipe sizes. Make up the flanges with insulating components consisting of a hard, phenolic gasket, bolt sleeves, and bolt washers. Supplement the insulating gasket with neoprene faces to form a seal.

B. Acceptable Manufacturers:
1. Watts Regulator Co.
2. Eclipse, Inc.
3. Perfection Corp.

2.6 PIPING AND EQUIPMENT IDENTIFICATION:

A. Pipe Identification:
1. Each piping system furnished and installed under this work shall be identified and the direction of flow indicated by a prefabricated coiled plastic colored label.
2. Labels shall comply with ASME A13.1 with regard to color, letter height, and marker size. The labels shall have black or white lettering and flow arrows on colored backgrounds and shall not require adhesive. The background colors shall conform to the color schedule shown in this Article.
3. For use indoors use 20 mil vinyl labels, MSI model MS-970, or equal. For piping with an outside diameter greater than 6 inches provide the label manufacturers nylon straps to secure label to piping.
4. For use outdoors use Polyester/Tedlar laminated material, MSI model MS-977, or equal. For piping with OD greater than 6” provide the label manufacturers stainless steel straps to secure label to piping.
5. The size of the lettering and label shall be such that the lettering can be easily read from the floor and the colors easily discernible.

6. Acceptable Manufacturers:
    a. Marking Services Incorporated (MSI)
    b. Idento Metal Products Co., Idento Bands
    c. Setmark

B. Equipment Identification:
1. Provide white lamacoid plate for each and every piece of equipment installed in this work.
    a. Lettering on plate shall be black, with size of lettering to suit equipment.
    b. Lettering shall be minimum of 3/8-inch in height.
    c. Plates shall be riveted or bolted to equipment.
2. Equipment to include, but not limited to:
    a. Pumps
    b. Water Heaters
    c. Air Compressors
    d. Vacuum Pumps
    e. Etc.

C. Acceptable Manufacturers:
1. Marking Services Incorporated, (MSI)
2. LEM Products
3. Seton
4. Craftmark

2.7 FIREPROOFING

A. Fireproofing to be installed at all pipe, fixture and equipment penetrations of rated assemblies.

B. Fireproofing to be UL Rated fire stop material.

C. Acceptable Manufacturers:
1. Hilti
2. 3M Pro-Set
3. Or Equal

PART 3 - EXECUTION

3.1 INSTALLATION OF HANGERS AND SUPPORTS:

A. Fasten all piping securely to structure with hangers, supports, guides, anchors, or sway braces to maintain pipe alignment, to prevent any sagging, and to prevent noise or excessive strain on the piping due to uncontrolled movement under operating conditions. Relocate hangers as necessary to correct unsatisfactory conditions that may become evident when system is put into operation.

B. Follow drawing requirements and details where special pipe support requirements are detailed on the Drawings.

C. Do not support piping by perforated tape, wire, rope, wood, nails, or other makeshift devices.

D. Design hangers and supports to support the weight of the pipe, weight of fluid, and weight of the pipe insulation with a minimum factor of safety of five based on the ultimate tensile strength of the material used.

E. Burning or welding on any structural member under load shall not be attempted. Field welding not called for on the Drawings or reviewed shop Drawings may only be done with consent and advice of the Architect and after proper provisions have been made to relieve the stress on the member. The boring of holes in beam flanges or narrow members will not be allowed.

F. Install hanger on insulated piping in a manner which will not produce damage to insulation. Provide steel pipe saddles as required to protect pipe covering. Install pipe hangers on piping covered with insulation on the outside of the insulation and not in contact with the pipe.

G. Fasten hanger rods to concrete structural members with concrete inserts set flush with surface. Install a reinforcing rod through the opening provided in the concrete inserts. Fasten hanger rods to structural members with suitable beam clamps, and provide beam clips to lock clamp securely to beam.

H. Use of powder-actuated fasteners will not be permitted for the support of any overhead piping.

I. Turnbuckles, if used, shall have a load-carrying capacity at least equal to that of the pipe hanger with which they are being used.

J. All threaded parts of pipe hanger assemblies shall have full length of thread in service while in use.

K. Hanger material shall be reviewed by the Architect before installation.

L. Pipe Hanger or Support Spacing:
   1. Provide pipe hangers or supports at 6-foot maximum spacing on steel pipe 3/4-inch diameter and smaller and for copper pipe 1-1/2 inches and smaller.
   2. Support steel piping 1" and larger and copper larger than 1-1/2 inches at 10-foot maximum spacing.
   3. Support steel piping used for gas at the following lengths:
      a. 1/2-inch diameter at 6-feet maximum
      b. 3/4-inch and 1-inch at 8-feet maximum
      c. 1-1/4-inch and larger at 10-feet maximum spacing

M. Provide continuous support channel for all polypropylene piping, and provide 6-foot maximum spacing for hangers, with a minimum of one hanger per length of pipe.

N. Provide hangers or supports for horizontal and vertical cast-iron drainage pipe at every other joint, except that when the developed length between hangers or supports exceeds 4 feet, provide hangers or supports at each joint. Provide adequate sway bracing to prevent shear.

3.2 VALVE BOXES:

A. Provide valve box for all buried valves. Install per manufacturer’s written instructions with top of box flush with finished grade.

B. Clean all valve boxes of debris.

3.3 ACCESS DOORS:

A. Access doors shall be furnished and installed wherever valves, balance valves, damper operating mechanisms, air terminal boxes, fans, and similar items normally requiring adjustment or servicing are installed in concealed or inaccessible spaces. Coordinate with access doors shown on architectural Drawings.

B. Comply with manufacturer's instructions for installation of access doors.

C. Where access panels are detailed on architectural or mechanical Drawings, sizes indicated thereon shall be used.

D. Keyed access doors shall be keyed alike.
1. Provide owner with 4 copies of keys for access doors.

3.4 ROOF FLASHING:

A. Provide pipe flashings as noted on the Drawings.

B. Flue flashings and storm collars shall be securely clamped around flue or storm collar or counterflashing, above flashing.

3.5 DIELECTRIC UNIONS:

A. Install dielectric unions in the following locations:

1. In all metallic water and gas service connections into the building within 5 feet of the building wall. Install adjacent to the shut-off valve or cock and above ground where possible.

2. At points of connections where copper water lines connect to steel domestic water heater tanks and other equipment.

3. At points in piping where dissimilar metal pipes are connected together.

4. Any special applications shown on the Drawings.

5. Where steel or cast-iron pipe in the ground connects to copper or brass piping above the ground, the transition from steel or cast- iron pipe to the copper or brass pipe shall be made above ground in all cases and in an accessible location where practicable.

6. Where copper or brass piping is connected to steel or cast-iron piping and the connection is buried in the ground, the connection shall be covered with coal tar protective tape extending outward a minimum of 5 feet on all pipes, from the point of connection. The tape shall have a minimum thickness of 10 mils and a maximum thickness of 12 mils and shall be applied so as to provide at least two full thicknesses of the tape over the piping. A primer, specifically designed for use with the tape, shall be used. The piping shall be thoroughly cleaned before any tape or primer is applied.

3.6 PIPE AND EQUIPMENT IDENTIFICATION:

A. Identification shall be applied to all piping, except piping located in furred spaces without access to permit entrance of personnel, and piping buried in the ground or concrete.

B. Underground pipe identification shall consist of a buried, continuous, preprinted, bright colored, plastic ribbon cable marker provided for each underground pipe.

C. The legend and flow arrow shall be applied at the following locations:
1. All valve locations,
2. All points where piping enters or leaves a wall, partition, cluster of piping, or similar obstruction
3. All exposed locations
4. At approximately 20-foot intervals on pipe runs.

D. Practical variations or changes in locations and spacing may be made with the specific approval of the Architect to meet specific conditions.

E. Wherever two or more pipes run parallel, the printed legend and other markings shall be applied in the same relative location so that all piping is easily identified.

F. The marking shall be located so as to be readily conspicuous at all times from any reasonable point of vantage.

G. Where different equipment, such as fire sprinklers, are supplied from a common main, such as domestic water, the main should be identified as "Domestic Water" and each respective branch takeoff as "Fire Water," etc.

H. The non-potable water plumbing piping shall be marked with the legend "Danger - Unsafe Water". This legend shall be applied to both hot and cold water systems along the length of the pipe in fluorescent orange at a maximum of five foot intervals.

I. Lettering size and label colors are to be per ASME/ANSI A13.1 Pipe Marking Standards.

3.7 FIREPROOFING:

A. Pack the annular space between the pipe sleeves and the pipe through all floors and walls with UL listed fire stop.

B. Fireproofing system to be installed in strict accordance with manufacturer’s written instructions and details.

3.8 PAINTING:

A. Perform all priming and painting on the equipment and materials as specified herein.

B. Exposed piping and unfinished portions of equipment to be painted shall be cleaned of grease, oil, rust, or dirt in preparation for painting.

C. Where applicable, remove pipe clamps prior to painting so that entire pipe is painted. Provide temporary support as required. Re-install clamps after priming/painting is complete.

D. Priming:
   1. Contractor to prime all exposed ferrous metals, including piping, which are not galvanized or factory-finished.
      a. Black steel pipe exposed to weather shall be cleaned and primed with one coat of Rust-Oleum, or equal, #1069 primer. Color to be Grey.

E. See Painting Section for detailed requirements.

3.9 CONCRETE

A. Where specifically indicated on the Drawings or specified as part of Mechanical Work, this Contractor shall furnish and install concrete work, such as thrust blocks or spring isolator bases.

B. Concrete and reinforcing steel shall be equal to that specified for General Construction.

C. Except as noted above, concrete work will be furnished and installed under General Work. This Contractor shall coordinate requirements accordingly.

3.10 EXCAVATING AND BACKFILL

A. Perform all excavating required for work of this Section. Do excavating required for installation of piping and service lines and other work that applies as indicated on Drawings. Verify location and elevation of all existing utilities prior to excavation for installation of new piping. Provide the services of a pipe/cable locating service prior to excavating activates to determine location of existing utilities

B. Excavations shall be of open vertical construction of sufficient width to provide free working space at both sides of trench and around pipe as required for caulking, joining, backfilling, and compacting. Unless shown otherwise, provide a minimum of 2'-6" cover above top of pipe to finished grade for all service piping unless otherwise noted. Trim trench bottom by hand or provide a minimum of 4" deep sand bed to provide a uniform grade and firm support throughout entire length of pipe. For PE gas pipe, bed the pipe in a 4" sand bed.

C. Dig trenches straight and true to line and grade with holes for bells for bell-and-spigot pipe. Evenly support piping for its entire length upon outside periphery of lower one-third of pipe. Where rock is encountered, undercut trenches 3 inches and fill with well-tamped, clean sand and pea gravel to correct pipe elevation.

D. After pipe lines in excavation have been installed and tested, backfill excavation to point 6 inches above pipe using sand, fine earth, or other materials free of rocks and large lumps. Proceed evenly on both sides of pipe and continuously tamp. Except as hereinafter noted, backfill above 6 inches above top of pipe shall be made by using earth from excavation placed in layers of 8-inch maximum depth. Compaction of each successive layer will be made with mechanical compactor.

E. Take special care in backfilling over wrapped piping to prevent damage to protective wrapping.

F. Bed sewers under pavements, wrapped piping, and PVC piping in sand prior to backfilling. Backfill to point 6 inches above pipe with sand.

G. This Contractor shall replace sod, concrete, asphalt paving, curbs, pavement, walks, and any other type of existing work or surface disturbed by excavation, using workmen skilled in trade involved.

H. When pipe or underground conduit with a protective wrapping is to be placed in the trench, sand only shall be used for bedding the pipe or conduit. The sand used shall be certified to have a minimum resistance of 5,000 ohms per cubic centimeter when wetted to any moisture content with distilled water and shall consist of clean, natural, washed-sand, hard, and durable particles varying from fine particles to particles of such size that all will pass through a 3/8-inch screen, not less than 90 percent will pass through a 1/4-inch screen, and not more than 25 percent will pass through a No. 50 screen.

I. Any backfill placed under this contract which subsides or settles below the adjacent finished grade or paving level during the guarantee period shall be brought to grade by the Contractor by adding compacted backfill or additional paving in paved areas.

3.11 ELECTRICAL WORK:

A. Adequate working space shall be provided around electrical equipment in compliance with the National Electric Code and other applicable codes or ordinances. The mechanical work shall be coordinated with the Electrical Work in order to comply with these requirements. Any work which does not conform to these regulations shall be properly corrected without additional cost to the Owner.

B. Furnish and install all line voltage and low-voltage temperature control wiring in the Mechanical Work by the Temperature Control Sub-Contractor, including all interlock wiring between motor starter coils, interlock relays, and temperature control equipment. Unless noted otherwise, this does not include primary control wiring between starters and push button or other manual starter switch or branch power circuits required for temperature control systems.

C. Temperature control equipment, including relays shown on control diagram, shall be furnished and installed by the Temperature Control Subcontractor.

D. Electrical devices with piping connections, such as solenoid valves, insertion thermostats, strap-on aquastats, and similar items which are to be wired under the Electrical Work or by the Temperature Control Subcontractor, shall be installed by the Mechanical Contractor.

E. Equipment furnished in this work that is factory wired but requires modification to internal wiring to meet specifications or drawing requirements shall have such internal modifications made at factory before shipment.

F. All electrical work and equipment, including internal wiring, must comply with applicable codes and applicable portions of electrical specifications. Run line and low-voltage control wiring in conduit. Conduit for temperature control wiring shall be responsibility of Mechanical Contractor and shall be of type specified in electrical specifications.

3.12 DEMOLITION

A. Refer to Division 1 sections for general demolition requirements and procedures.

B. Disconnect, dismantle, and remove plumbing systems, equipment, and components indicated to be removed. Coordinate with all other trades

1. Piping to be removed: Remove portion of piping indicated to be removed. Cap or plug remaining piping with same or compatible piping material.
2. Piping to be abandoned in Place: Drain piping and cap or plug piping to remain with same or compatible piping material. Refrigerant system to be evacuated per EPA requirements.
3. Equipment to be removed: Drain down and cap remaining services and remove equipment.
4. Equipment to be removed and re-installed: Disconnect and cap services and remove, clean, and store equipment. When appropriate, re-install, reconnect, and make equipment operational.
    a. If existing equipment which is to be re-installed is damage, contact architect prior to removal. Contractor to take pictures of any damaged equipment prior to its removal and submit pictures to Architect.
    b. Equipment damaged during removal, storage, or re-installation shall be the Contractor's responsibility and is to be replaced with new at no additional cost to the owner.
5. Equipment to be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.

C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, removed damaged or unserviceable portions and replace with new products of equal capacity and quality.

D. Non-Destructive Testing Of Existing Concrete Slabs:
1. When drilling or saw cutting existing reinforced concrete, use care and caution to avoid cutting or damaging the existing reinforcing bars, conduit, or tendons. Use a non-destructive method to locate metals poured into the slab prior to doing any work.

3.13 CARE AND CLEANING:

A. Repair or replace broken, damaged, or otherwise defective parts, materials, and work. Leave entire work in condition satisfactory to Architect. At completion, carefully clean and adjust equipment, fixtures, and trim that are installed as part of this work. Leave systems and equipment in satisfactory operating condition.

B. Drain and flush piping to remove grease and foreign matter. Thoroughly clean out flush valves, traps, strainers, and pressure-reducing valves.

C. Keep the interior of all piping free of dirt, dust, loose insulation, and other foreign materials at all times.

D. Clean out and remove surplus materials and debris resulting from the work, including surplus excavated material.

3.14 OPERATION TEST:

A. Test each piece of equipment to show that it will operate in accordance with indicated requirements.

3.15 CLEANING UP:

A. Upon completion of Work remove materials, equipment, apparatus, tools, and the like, and leave premises clean, neat, and orderly.

END OF SECTION

SECTION 22 05 23 - VALVES AND ACCESSORIES FOR PLUMBING

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes plumbing accessories including the following:
   1. Valves
   2. Miscellaneous piping products
   3. Miscellaneous Drains
   4. Cleanouts
   5. Floor Drains and Floor Sinks
   6. Interceptors

1.2 REFERENCES AND STANDARDS

A. Requirements of Regulatory Agencies: Contractor to conform to the publications listed below. Requirements of these publications are to be considered as a minimum standard. If details and specifications which require more stringent work are indicated within project, Contractor to provide the more stringent.
   1. California Plumbing Code (CPC) Compliance: Comply with applicable portions of the California Plumbing Code pertaining to selection and installation of plumbing materials and products.
   2. ASME B31.9 for building services piping valves.
   3. NSF Compliance: NSF 61 for valve materials for potable-water service

B. All plumbing components intended to dispense water for human consumption shall comply with requirements of California Assembly Bill AB1953. Components to include (but not limited to): piping, faucets, angle stops, valves, bubblers, drinking fountains, piping, etc.

1.3 ACTION SUBMITTALS

A. Product data: submit complete data of materials proposed including:
   1. Manufacturer and model number
   2. Clearly indicate all options, trim, and accessories.
   3. Cross reference manufacturer's cut sheet to fixture callout ID on submittal sheet.

B. Named non-basis-of-design manufacturer does not guarantee approval of equipment submittals. Manufacturers must comply with all the performance and features as specified within the specifications and as indicated on the design documents.

1.4 CLOSEOUT SUBMITTALS

A. Warranty: Submit executed warranty.

B. Certification: Submit Contractors Certification

C. Operation and Maintenance Data: submit complete O&M data including:
   1. Maintenance data and parts lists for each component.
   2. Provide "trouble- shooting" maintenance guide
   3. Include this data within maintenance manual

D. Provide Valve list and half size floorplan(s) showing valve locations and function and valve ID cross-referenced on floorplan.

1.5 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacturer of plumbing piping systems products, of types, materials, and sizes required whose products have been in satisfactory use in similar service for not less than 5 years.

B. Contractor's Qualifications: Firm with at least 5 years of successful installation experience on projects with piping systems work similar to that required of project.

1.6 WARRANTY

A. Manufacturer: In addition to the Contractor's Standard Guarantee, furnish Owner with manufacturer's warranty for all plumbing valves and accessories against defects in materials and workmanship. Warranty shall cover replacement of all such valves or accessories plus labor to install.

PART 2 - PRODUCTS

2.1 VALVES

A. General:
   1. Similar valves to be by the same manufacturer.
   2. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.
   3. Bronze Valves: 2"Ø and smaller with threaded ends, unless otherwise indicated.
   4. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
   5. Valve Sizes: Same as upstream piping unless otherwise indicated.
   6. Valve Actuator Types:
      a. Handwheel: For valves other than quarter-turn types.
      b. Hand-lever: For quarter-turn valves 6"Ø and smaller, except for plug valves.
      c. Wrench: For plug valves with square heads.
         1) Furnish Owner with 1 wrench for every 5 plug valves, for each size square plug-valve head.
   7. Valve-End Connections:
      a. Flanged: With flanges according to ASME B16.1 for iron valves, ASME B16.5 for steel valves.
      b. Grooved: With grooves according to AWWA C606.
      c. Valve solder-joint connections are common in smaller sizes of plumbing piping. Soldering and brazing methods used to achieve required pressure-temperature ratings may damage internal valve parts. Special installation requirements for soldered valves may make threaded valves more cost-effective.

d. Threaded: With threads according to ASME B1.20.1.
e. Valve Bypass and Drain Connections: MSS SP-45.

B. Acceptable Manufacturers:
1. Ball, gate, butterfly, and check valves:
a. Nibco
b. Apollo
c. Milwaukee
2. Plug Valves:
a. Rockwell
b. Homestead
c. Nordstrom Valves, Inc

C. Ball Valves - $\leq$ 3"Ø:
1. Two-Piece, Full-Port, Lead Free Bronze Ball Valves with Stainless-Steel Trim:
2. NIBCO Model 585-66-LF or equal.
a. Pressure Rating: 600 PSI non-shock cold working pressure
b. Maximum pressure / Temperature: 100 PSI AT 300°F
c. Body Design: Two piece steel with threaded body packnut design (no threaded stem designs allowed) with adjustable stem packing.
d. Body Material: Silicon Bronze ASTM B 584 Alloy C87600.
e. Ends: Threaded or Solder.
f. Seats: PTFE or TFE.
g. Stem: Stainless.
h. Ball: Stainless steel, vented.
i. Port: Full.

D. Gate Valves- $\leq$ 1-1/2"Ø:
1. Screw in Bonnet, Rising Stem, Silicon Bronze Gate Valve
2. NIBCO Model T-111-LF or equal.
a. SWP Rating: 150 psig
b. Maximum Pressure / Temperature: 100 PSI at 300 degree F
c. Body Material: Silicon Bronze ASTM B584
d. Wedge Material: Silicon Bronze ASTM B584
e. Bonnet Material: Silicon Bronze ASTM B584
f. Packing Material: Bronze ASTM B62 or ASTM B584 or Brass ASTM B16
g. Packing nut: Bronze ASTM B62 or ASTM B584 or Brass ASTM B16
h. Handwheel: Malleable Iron ASTM A 47
i. End Connections: Threaded

E. Gas Cock:
1. Gas Ball valve, with lever handle
2. Valve to be rated for 250 psi compressed gas.
3. UL Listed for gas and oil
4. CSA listed
5. Nibco, Model T-FP-600A or equal
a. CWP Rating: 600 psig for 1/4" – 2", 400 PSI for 2-1/2" - 4"
b. Body: Forged Brass ASTM B283
c. Ball: Chrome Plated Brass
d. Ball Seat: PTFE
e. Stem: Brass

2.2 MISCELLANEOUS PIPING PRODUCTS

A. Water Hammer Arrestors
   1. Water Hammer Arrestors to be provided on both hot and cold water branch piping severing ALL plumbing fixtures (not just flush valves).
   2. Provide water branch lines at single fixtures with a manufactured water hammer arrestor. Water hammer arrestors shall be sized per Plumbing Drainage Institute Standard PDI-WH201 “Water Hammer Arrestors.”
   3. Water hammer arrestor to be with nesting type bellows contained within a casing having sufficient displacement volume to dissipate the calculated kinetic energy generated in piping system. Both casing and bellows constructed of Type 304 stainless steel. Arrestor to have a threaded connection.
   4. Where multiple fixtures are located in a row or battery a single or multiple water hammer arrestors, as required, may be used. Multiple fixture installations shall have the arrestor sized and located per standard PDI-WH201 and the manufacturer’s installation instructions.
      a. Provide Access door for water hammer arrestors in restrooms containing more than 1 flush valve type fixture.
   5. All water hammer arrestors shall have male pipe thread connections.
   6. Water hammer arrestor to be a Zurn model Z1700 or equal.
   7. Acceptable Manufacturers:
      a. Zurn
      b. J.R. Smith
      c. Wade
      d. Amtrol Inc.

B. Piping Escutcheons:
   1. Provide chrome plated brass pipe escutcheons with inside diameter closely fitting pipe outside diameter or outside of pipe insulation where pipe is insulated.
   2. Select outside diameter of escutcheon to completely cover pipe penetration hole in floors, walls, ceilings, or pipe sleeve extension, if any.
   3. Furnish pipe escutcheons with nickel or chrome finish and screw or spring clamping device with concealed hinge

C. Pipe Sleeves:
   1. Where pipes pass through concrete floors or walls, install galvanized metal or plastic sleeves having not less than 1/2-inch or more than 1-inch clearance around sides of the pipe or pipe covering for the full thickness of the concrete.
   2. After piping has been installed, fill annular space with fireproof safeing.
   3. Acceptable Manufacturers:
      a. Adjustocrete
      b. Sperzel "Crete-Sleeve"
      c. Or equal

D. Sleeve Seals:
   1. Provide sleeve seals for sleeves located in foundation walls below grade or in exterior walls as follows:
      a. Foundations: Lead and oakum, caulked between sleeve opening and pipe.
      b. Walls Below Grade: Modular-mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between pipe and sleeve, connected with bolts and pressure plates which cause rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.
   2. Acceptable Manufacturers:
      a. Link-Seal Corporation
      b. Or equal

2.3 CLEANOUTS

A. Provide cleanouts of same diameter as pipe shall be installed in all horizontal soil and waste lines where indicated and at all points of change in direction. Cleanouts shall be located a minimum of 18" from building construction so as to provide sufficient space for rodding.

B. Cleanouts shall have cast iron ferrules and bronze plugs.

C. Cleanouts extending to floor level shall be provided with membrane flange and clamping collar, bronze raised head plug, and nonslip scoriated top.

D. Cleanouts to be as follows:
   1. Cleanouts in cast-iron soil or waste lines: Zurn Z-1440A-BP.
   2. Cleanouts in walls: Zurn Z-1446-A-BP with stainless steel access cover.
   3. Cleanouts on exterior of building: Zurn Z-1440.
      a. Provide stainless steel cover and vandal-proof screw where located in wall. Zurn Z-1446-A
      b. Where located at grade, provide 18- by 18- by 6-inch concrete pad and Zurn Z-1474 heavy duty cover. Provide Z-1440-A cleanout.
   4. Cleanouts in floor to be a Zurn ZN-1400 with the following options:
      a. Where located in terrazzo floor, provide –T, square top option.
      b. Where located in carpet, provide –T square top option and –CM carpet marker option.
      c. Where located in vinyl tile, provide –TX square top recessed for tile option.

E. Acceptable Manufacturers:
   1. Zurn
   2. J.R. Smith
   3. MiFab

2.4 FLOOR DRAINS AND FLOOR SINKS

A. Provide floor drains and floor sinks of size as indicated on Drawings, and type, including features, as specified herein. Provide flashing ring and clamp at floors with waterproofing membrane. Set top of drain slightly below floor to insure drainage unless noted otherwise. Install vented P- trap below each drain.

B. Provide with trap primer connections at trap where required.

C. General Service Floor Drains: Zurn Z 415 or equal. Drain to have a dura-coated cast iron body with bottom outlet, combination invertible membrane clamp and adjustable collar with seepage slots.
   1. Provide with "Type B" strainer where installed in concrete.
   2. Provide with "Type S" strainer where installed in tile.
   3. Provide with "Type SL" strainer where installed in composition type floor.
   4. Provide with "Type I" strainer where used at indirect drain locations

D. Floor Sinks in Kitchens: Zurn ZN-1900-K-2 or equal. Floor sink to be a 12"x12"x6" deep floor sink with a cast iron body and square slotted light duty ½ grate with white acid resisting porcelain enamel interior and top. Complete with a white A.R.E anti-splash interior bottom dome strainer.

E. Floor Sinks in Mechanical Room: Zurn Z-566-Y or equal. Floor sink to be a 12”x12” square floor sink with a dura-coated cast iron body with bottom outlet and loose set cast iron secondary strainer. Provide with half grate and sediment bucket.

F. Acceptable Manufacturers:
1. Zurn
2. J.R. Smith
3. Wade
4. MiFab

PART 3 - EXECUTION

3.1 INSTALLATION OF VALVES:

3.2

A. Valve Applications:
1. Domestic Water:
a. Shut off valves above grade: Ball Vales
b. Shut off valves below grade: Gate Valve

B. General:
1. Install valves with stems upright or horizontal. Valves stem position to be arranged to allow access for maintenance.
2. Do not install swing check valves in vertical position.
3. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
4. Operate valves in positions from fully open to fully closed prior to installing within system.
5. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
6. Locate valves for easy access and provide separate support where necessary.
7. Install valves in horizontal piping with stem at or above center of pipe.
8. Install valves in position to allow full stem movement.
9. Install chain-wheels on operators for butterfly and gate valves more than 10’-0” above finished floor. Extend chains to within 60” above finished floor.
10. Install valves where required for proper operation of piping and equipment, including valves in branch lines where necessary to isolate sections of piping. Locate valves so as to be accessible and so that separate support can be provided when necessary.
11. Provide union at each connection to equipment and downstream of each valve. Provide unions at both ends of valves when valves can not be turned due to an obstruction.
12. After piping systems have been tested and put into service, but before final testing, adjusting, and balancing, inspect each valve for possible leaks. Adjust or replace packing to stop leaks; replace valve if leak persists.
13. Tag each valve and provide a complete listing of valve locations and functions.
14. Provide additional tag at each valve noted below. Tag shall be black plastic with white lettering, 3-ply, 125 mil thick, Minimum 3” square.
a. At main domestic water shut off entrance to building, provide tag that reads: MAIN DOMESTIC WATER SHUT OFF”.

b. For multi-floor buildings, at domestic cold water risers, provide take at Riser Shut-off Valve that reads “Riser # CW SHUT-OFF” with number of Riser.
c. For multi-floor buildings, at domestic hot water risers,, provide take at Riser Shut-off Valve that reads “Riser # HW SHUT-OFF” with number of Riser.

15. Provide half scale floorplans highlighting location of all valves. Cross reference valve list with floorplans and valve tags.

3.3 PIPE ESCUTCHEONS:

A. Install pipe escutcheons on each pipe penetration through floors, walls, partitions, and ceilings where penetration is exposed to view and on exterior of building.

B. Tighten escutcheon to pipe or insulation so escutcheon covers penetration hole and is flush with adjoining surface.

3.4 SLEEVES:

A. Secure sleeves to metal or wood forms in such a manner that they will not become displaced during pouring of concrete. Fill sleeves on deck with sand.

B. After forms have been removed from concrete, the sleeves shall be removed from the openings.

C. Core drill properly sized holes in the concrete to replace metal sleeves that are crushed or knocked out of position during pouring of concrete.

D. Provide piping passing through concrete fire walls with sleeves of standard black steel pipe nominally one size larger than pipe enclosed, but in the case of insulated pipe, large enough for insulation to pass through. Caulk space between pipe and sleeve with fire-rated wicking, and provide metal retainer plates at both sides of the wall.

E. Sleeve Seals: Install in accordance with the following:
1. Lead and Oakum: Fill and pack annular space between sleeve opening and pipe with oakum; caulk with lead on both sides.
2. Mechanical Sleeve Seals: Loosely assemble rubber links around pipe with bolts and pressure plates located under each bolt head and nut. Push into sleeve opening and center. Tighten bolts until links have expanded to form watertight seal.

3.5 INSTALLATION OF UNIONS AND FLANGES:

A. Install unions and flanges so that piping can be easily disconnected for removal of tanks, equipment, and valves. Provide a minimum of two unions at each three-way valve.

3.6 CARE AND CLEANING:

A. Repair or replace broken, damaged, or otherwise defective parts, materials, and work.

B. At completion of work, carefully clean and adjust equipment and trim installed as part of this work.

C. Leave systems and equipment in satisfactory operating condition.

3.7 OPERATION TEST:

A. Test each piece of equipment to show that it will operate in accordance with indicated requirements.

END OF SECTION

SECTION 22 07 00 - PLUMBING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes insulation types and thickness for plumbing piping and equipment.

1.2 REFERENCES AND STANDARDS

A. California Code of Regulations – Title 24, Part 4.

B. California Building Code, California Electric code, NFPA, and UL

C. ASTM

D. ASHRAE

E. NAIMA

F. NFPA

G. SMACNA – Sheet Metal and Air Conditioning Contractor’s National Association, Inc.

H. Underwriter’s Laboratories

I. GREENGUARD

J. CAL-GREEN

1.3 ACTION SUBMITTALS

A. Submit complete data of materials proposed.
   1. Indicate individual services for each system.
   2. Indicate proposed insulation thickness for each system.
   3. Indicate proposed R-valves, densities, etc. for each product.

B. Provide Manufacturer’s installation instructions for each product.

1.4 CLOEOUT SUBMITTALS

A. Warranty: Submit executed warranty.

B. Certification: Submit Contractors Certification

1.5 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firm specializing in manufacturing of mechanical insulation products applicable to project whose products has been in satisfactory use in similar services for a minimum of 3 years.

B. Installer's Qualifications: Company specializing in piping insulation application with a minimum of 3 years experience.

C. Flame/Smoke Ratings: Insulation materials, including but not limited to insulation, jackets, coverings, sealers, adhesives, etc., to have flame-spread rating of 25 or less and smoke-developed index of 50 or less when tested in accordance with ASTM E84.

D. Insulating products to be installed in accordance with manufacturer's written instructions and in accordance with recognized industry practices.

1.6 WARRANTY

A. Manufacturer: In addition to the Contractor's Standard Guarantee, furnish Owner with manufacturer's warranty for insulation against defects in materials and workmanship. Warranty shall cover replacement of insulation plus labor to install

PART 2 - PRODUCTS

2.1 GENERAL

A. For purposes of this specification, fittings, joints, strainers, flexible piping, valves, etc. shall be considered as piping and shall be insulated with same material and thickness as adjoining piping unless noted otherwise.

B. Acceptable Manufactures
1. Knauf
2. Johns Manville
3. Certainteed
4. Owens-Corning
5. Armstrong

2.2 MATERIALS

A. Fiberglass Piping Insulation:
1. Insulation to be heavy density fiberglass pipe insulation that complies with ASTM C547.
2. Insulation to have factory-applied self-sealing vapor barrier.
3. Maximum K-Value at 75^{o}F = 0.23 Btu-in/hr-FT^{2}-^{o}F.
4. For pipe sizes 1.5 inches in diameter and larger, provide rigid insulation inserts with galvanized metal shields ("Saddles") at hanger locations.
   a. Shields are not required for pipes 1-1/4" or smaller.
5. Fittings and valves to be insulated with John Manville Zeston 2000 Series 25/50 Smoke-Safe PVC pre-molded insulated covering secured with standard fasteners.
6. Insulation to be Johns Manville Micro-Lok or equal.

B. Flexible Closed Cell Insulation:
1. Flexible elastomeric thermal closed-cell structure insulation.
2. Maximum K-Value at 75^{o}F = 0.27 Btu-in/hr-FT^{2}-^{o}F.
3. Joints to be sealed with Armstrong 520 Adhesive
4. Insulation to be Armstrong Armaflex 22 or equal

2.3 PIPING INSULATION:

A. Domestic Hot Water Supply:
1. Insulate exposed piping with fiberglass piping insulation with thicknesses as follows:
a. Pipes 2"∅ and smaller- 2" thick insulation.
b. Exposed pipes installed within 9'-0" of the finished floor to be provided with ASJ-SSL jacket.
2. Insulate concealed piping with fiberglass piping insulation with thicknesses as follows:
a. Pipes 1"∅ and smaller with 1" of fiberglass piping insulation.
3. Do not insulate unions, valves, and exposed run-outs to fixture.
4. For protective pipe insulation at run-outs to fixtures, reference specification section 22 42 00.

B. Domestic Cold Water:
1. Insulate piping exposed to weather with flexible closed cell insulation.
2. Wrap valves and fittings with mastic and z-tape.
3. Insulation to be a minimum of 3/4" thick.
4. Seal all joints with Armstrong 520 adhesive.
5. Insulation exposed to weather to be provided with metal protective jacket. Metal protective jacket to be as follows:
a. Sheet Aluminum: ASTM B209, 3003 allow, H-14 temper, 0.016" thick.
b. Longitudinal lab to be at least 2" wide.
c. Fitting covers: Factory fabricated die shaped type 3003 sheet aluminum, 0.024" minimum thickness.
d. Provide 3/8 inch wide, 0.016 inch thick aluminum bands spaced at a maximum of 2'-0" on center.

PART 3 - EXECUTION

3.1 GENERAL

A. Insulation to be stored on jobsite in clean / dry location. Any insulation exposed to water must be discarded immediately and removed from jobsite.

3.2 INSTALLATION OF PIPING INSULATION

A. Install piping insulation products in accordance with manufacturer's written instructions and in accordance with recognized industry practices.

B. Installation to be installed after installation of heat tracing, testing, acceptance of testing, and cleaning of pipe.

C. Insulate each continuous run of piping with full-length units of insulation. Cut pieces to size as required. Do not use multiple cut pieces and/or scraps abutting each other.

D. Clean and dry piping surfaces prior to insulating. Butt insulation joints firmly together to ensure complete and type fit over surface to be covered.

E. Install piping insulation without interruption through walls and floors except where otherwise indicated.

F. Taper raw ends of insulation and seal with canvas and sealant as noted for fittings.

G. Install pipe hangers on the outside of the insulation.

3.3 INSULATION REPAIR:

A. Repair damaged sections of existing and/or new mechanical insulation where damaged occurred during this construction period. Use insulation of same thickness as existing insulation. Install new jacket lapping and seal over existing.

3.4 CARE AND CLEANING:

A. Repair and/or replace broken, damaged and or otherwise defective insulation. Work to be completed to the satisfaction of the Architect. At completion of work, clean materials installed as part of this work and leave systems and equipment in satisfactory operating condition.

B. Upon completion of work remove materials, equipment, tools from premises. Leave project area neat, clean and orderly.

END OF SECTION

SECTION 22 11 00 - FACILITY WATER DISTRIBUTION

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes piping for the facility water distribution system.

1.2 REFERENCES AND STANDARDS

A. Requirements of Regulatory Agencies: Contractor to conform to the publications listed below. Requirements of these publications are to be considered as a minimum standard. If details and specifications which require more stringent work are indicated within project, Contractor to provide the more stringent.
   1. California Plumbing Code (CPC) Compliance: Comply with applicable portions of the California Plumbing Code pertaining to selection and installation of plumbing materials and products.

B. Soldering and Brazing materials and labor shall comply with ASME Code and applicable state labor regulations.

C. All plumbing components intended to dispense water for human consumption shall comply with requirements of California Assembly Bill AB1953. Components to include (but not limited to): piping, faucets, angle stops, valves, bubblers, drinking fountains, piping, etc.

1.3 ACTION SUBMITTALS

A. Submit manufacturer's catalog cut sheets, specifications, installation instructions, and dimensioned drawings for each type of pipe, support, anchor, and seal indicated within this section that is applicable to the project. Clearly indicate item being submitted.
   1. Indicate pipe schedules, pressure classes, etc.
   2. Indicate all options being submitted.

B. Provide Brazing Certifications. Submit reports as required for piping work applicable to the project.
   1. Brazers that do not have current Certifications shall not be permitted to braze on the project.

1.4 CLOSEOUT SUBMITTALS

A. Warranty: Submit executed warranty.

B. Certification: Submit Contractors Certification

C. Operation and Maintenance Data: submit the following items in O&M data including:
   1. Domestic Water System Sterilization Report.

1.5 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacturer of plumbing piping systems products, of types, materials, and sizes required whose products have been in satisfactory use in similar service for not less than 5 years.

B. Contractor's Qualifications: Firm with at least 5 years of successful installation experience on projects with piping systems work similar to that required of project.

1.6 WARRANTY

A. Manufacturer: In addition to the Contractor's Standard Guarantee, furnish Owner with manufacturer's warranty for all domestic water piping and accessories against defects in materials and workmanship. Warranty shall cover replacement of piping or accessories plus labor to install.

PART 2 - GENERAL

2.1 GENERAL:

A. Provide piping materials and factory fabricated piping products of sizes, types, pressure and temperature ratings, and capacities as indicated. Materials and products to comply with the California Plumbing Code.

B. Where more than one type of material is indicated, selection is the Contractors option.
1. Contractor to provide submittal information on material which is to be installed.
2. Where more than one material is indicated, the Contractor shall only install one material per system and materials shall not be mixed within the same system.

C. Soldering Materials: Joints in copper tubing for all installations shall be made with brazing alloy sil-fos, or equal. Clean surfaces to be jointed shall be free of oil, grease, rust, and oxides.
1. Harris Stay-Safe 50 solder, or equal, may be permitted on plumbing lines above slab or ground only with prior review for piping sizes 2 inches and smaller only. Solders used shall contain no lead.

D. Comply with SFA-5.8, Section II, ASME Boiler and Pressure Vessel Code for brazing filler metal materials.

2.2 PIPING AND FITTINGS:

A. Domestic Water Piping (cold water, hot water, tempered water, and hot water return):
1. Copper Tube: ASTM B 88, Type L, hard-drawn temper, except as otherwise indicated.
2. Interior Water Piping:
   a. Copper tube, Type L, hard-drawn temper, wrought copper fittings.
   b. Pipe sizes 2" and smaller to have solder joints.
   c. Pipe sizes 2 ½" and larger to have brazed joints.
3. Under Slab Water Piping:
   a. Pipe sizes 1 ½" and smaller: Type K, soft Copper tubing with smoothly formed bends. Runs to be made without joints except where runs are longer than the standard length of tubing role.

b. Pipe sizes 2” and larger: Same as exterior water piping.

4. Exterior Water Piping:
   a. Copper tube, Type L, hard-drawn temper, wrought copper fittings.
   b. All pipe sizes to have brazed joints.
5. Under Slab Water Piping:
   a. Pipe sizes 1 ½” and smaller: Soft Copper tubing with smoothly formed bends. Runs to be made without joints except where runs are longer than the standard length of tubing role.
   b. Pipe sizes 2” and larger: Same as exterior water piping.

PART 3 - EXECUTION

3.1 GENERAL

A. Examine areas and conditions under which plumbing piping systems are to be installed. Do not proceed with Work until unsatisfactory conditions have been corrected in manner acceptable to Contractor.

B. Comply with ANSI B31 Code for Pressure Piping.

C. Install pipes and pipe fittings in accordance with recognized industry practices which will achieve permanently leak-proof piping systems, capable of performing each indicated service without piping failure. Install each run with minimum joints and couplings but with adequate and accessible unions for disassembly and maintenance/replacement of valves and equipment. Reduce sizes where indicated by use of reducing fittings. Align piping accurately at connections, within 1/16-inch misalignment tolerance.

D. Locate piping runs, unless detailed otherwise, vertically, and horizontally (pitched to drain). Install piping parallel and perpendicular to adjacent building walls/structure and avoid diagonal runs wherever possible. Orient horizontal runs parallel with walls and column lines. Locate runs as shown or described by diagrams, details, and notations. Hold piping close to walls, overhead construction, columns, and other structural and permanent-enclosure elements of building; limit clearance to 1/2-inch where furring is shown for enclosure or concealment of piping; locate insulated piping for 1” clearance outside insulation. Wherever possible in finished and occupied spaces, conceal piping from view by locating in column enclosures, in hollow wall construction, or above suspended ceilings; do not encase horizontal runs in solid partitions, except as indicated.

E. Electrical Equipment Spaces: Do not run piping through transformer vaults, elevator equipment rooms, Data closets or other electrical or electronic equipment spaces or enclosures.

F. Should structural difficulties or work of other contractors prevent the running of pipes or the setting of equipment at the points shown, Contractor to make the necessary deviations to the piping system, as determined by the Contractor, with the Architect's review, without additional cost to Owner.

G. Inspect each piece of pipe and each fitting to see that there is no defective workmanship on pipe or obstructions in pipes and fittings.

3.2 INSTALLATION OF WATER PIPING:

A. Run all water piping generally level, free of traps or unnecessary bends, arranged to conform to the building requirements, and to suit clearance for other mechanical work such as ducts, flues, conduits, and other work. No piping shall be installed so as to cause unusual noise from the flow of water therein under normal conditions.

B. Water lines shall not be installed in the same trench with non- metallic sewer lines unless the bottom of the water pipe at all points is at least 12 inches above the top of the sewer line and the water line is placed on a solid shelf excavated at one side of the common trench.

C. Where water and waste piping cross, the pipes shall have no fittings within 10 feet of the crossing, and the water line shall be run above the waste line. Comply with any local codes or requirements.

D. Close open ends of water piping each day to prevent contamination or foreign matter entering pipe during construction. Thoroughly flush out piping to remove any dirt or foreign matter. Remove and clean all aerators at end of project and prior to sterilization.

3.3 DOMESTIC WATER SYSTEM STERILIZATION:

A. Water line disinfections are to be performed by a licensed contractor with training in potable water line disinfections or a D-1 water operator licensed by the state of California and trained in water line disinfections.

B. Water lines shall be cleaned by following guidelines provided by the AWWA standard C-651 for water mains and guidelines provided by DP Disinfection for building water lines.

C. Prior to system sterilization, provide warning signs at all outlets while chlorinating the system. Provide sign at all outlets, which reads “Water Sterilization in Progress – Do not operate”. Remove signs at conclusion of test.

D. Disinfection Procedures / 3 Hour Disinfection (Chemical pump Method / Building side of Double Check Valve Assembly):
   1. Clean and disinfect all hot and cold water systems connected to the domestic water system in accordance with AWWA Standard C-651 for water mains, DP Disinfection guide lines for building water lines, and as prescribed by the local Building and Health department codes. This procedure shall be performed by a Licensed Contractor trained in the disinfection of water systems or by a state certified Water Operator with a minimum of a D-1 license.
   2. Preliminary Preparation:
      a. Locate the injection point. Install an injection hose bib to the system at a point within 10’-0” of its junction with the water supply line. When the project is complete, with all the fixtures connected and operable and ready for use and when, by test, the system is proved to be free from leaks, it shall be thoroughly flushed by fully opening every outlet and operating every fixture until clear water flows from all of them. Take a Sample, test for Free chlorine content and record it on the work sheet.
      b. Use (LR) Low Range Disinfection test strips. A Normally reading will be 2mg/L or less. This is the "Bench Mark" reading.
   3. Disinfecting Agent:

a. The chlorine shall be a registered product with Cal-EPA for use in California in potable water lines, such as Bacticide, Cal-EPA Registration No. 37982-20001. Use liquid Sodium Hypochlorite conforming to ANSI/AWWA B300.

4. Disinfecting Procedure (Chemical Pump Method):
   a. Connect the chemical pump to the injection hose bibb. If the existing pressure exceeds 50psi use a DP Disinfection Backflow / Regulator Injection Assembly.
   b. With system completely full of water and supply valve open, adjust every faucet of system so that a trickle of water flows from each. Find the furthest fixture and trickle at a higher rate until you obtain your first reading. Then work backwards.
   c. Inject disinfectant until a test at each branch outlet shows a chlorine residual concentration of 200 parts per million (ppm).
   d. Close all outlets and valves. Shut down the pump. Close the valve connected to the fresh water supply line. Close the injection hose bib. Maintain condition for 3 hours at 200ppm.
   e. When the above procedure has been completed, flush out entire system with fresh water until a test at any outlet shows a residual of not more than the original "Bench Mark" reading taken in the preliminary preparation.
      1) When flushing, pay attention to any special requirements. Never flush highly chlorinated water into storm drains, creeks, rivers or septic tanks. De-chlorinate the discharge water with Ascorbic Acid.

E. Disinfection Procedures / 24 Hour Disinfection (Chemical pump Method / Building side of Double Check Valve Assembly):
   1. Clean and disinfect all hot and cold water systems connected to the domestic water system in accordance with AWWA Standard C-651 for water mains, DP Disinfection guide lines for building water lines, and as prescribed by the local Building and Health department codes. This procedure shall be performed by a Licensed Contractor trained in the disinfection of water systems or by a state certified Water Operator with a minimum of a D-1 license.
   2. Preliminary Preparation:
      a. Locate the injection point. Install an injection hose bib to the system at a point within 10’-0” of its junction with the water supply line. When project is complete, with all fixtures connected and operable and ready for use and when, by test, the system is proved to be free from leaks, it shall be thoroughly flushed by fully opening every outlet and operating every fixture until clear water flows from all of them. Take a Sample, test for Free chlorine content and record it on the work sheet.
         1) Use a L/R (low range) Disinfection test strip or a chlorine meter. A Normally reading will be 2mg/L or less. This is the "Bench Mark" reading.
   3. Disinfecting Agent:
      a. The chlorine shall be a registered product with Cal-EPA for use in California in potable water lines, such as Bacticide, Cal-EPA Registration No. 37982-20001. Use liquid Sodium Hypochlorite conforming to ANSI/AWWA B300.
   4. Disinfecting Procedure (Chemical Pump Method):
      a. Connect the chemical pump to the injection hose bib. If existing pressure exceeds 50psi use a DP Disinfection Backflow / Regulator Injection Assembly.
      b. With system completely full of water and supply valve open, adjust every faucet of system so that a trickle of water flows from each.. Find the furthest fixture and trickle at a higher rate of speed until you obtain your first reading. Then work backwards.
      c. Inject disinfectant until a test at each branch outlet shows a chlorine residual concentration of 50 parts per million (ppm).
      d. Close all outlets and valves. Close Fresh water hose bib. Shut off pump. Close injection hose bib. Maintain condition for 24 hours and chlorine residual of at least

25 ppm must be retained in system for this 24 hour period. If, after 24 hours, tests indicate that chlorine residual concentration has decreased below 25ppm. The disinfection procedure must be repeated until an approved result is obtained.

e. When the above procedure has been completed, flush out entire system with fresh water until a test at any outlet shows a residual of not more than the original "Bench Mark" readings taken in the preliminary preparation.

1) When flushing, pay attention to any special requirements. Don't flush highly chlorinated water into storm drains, creeks, rivers or septic tanks. De-chlorinate the discharge water with Ascorbic Acid.

F. Chemical and bacteriological tests shall be conducted by a state-certified laboratory and approved by the local authorities having jurisdiction.

G. Submit written report to Health Department as required by State Regulations. Provide a copy of report to Architect prior to completion of project.

3.4 PIPING SYSTEM JOINTS:

A. General: Provide joints of type indicated in each piping system.

B. Cut all steel pipe and hard copper tubing by power hacksaw, a circular cutting machine using an abrasive wheel or in square end vise by means of hand hacksaw. Wheel cutters may be used for steel pipe provided that pipe shall have ends reamed to full inside diameter and beveled before being made up into fittings. Pipe shall have round edges or burrs removed so that a smooth and unobstructed flow will be obtained.

C. Thread pipe in accordance with ANSI B2.1; cut threads full and clean using sharp dies. Ream threaded ends to remove burrs and restore full inside diameter. Apply pipe joint compound, Rector- Seal #5, on male threads at each joint and tighten joint to leave not more than 3 threads exposed. Teflon tape may be used on piping smaller than 2 inches.

D. Braze copper tube-and-fitting joints where indicated, in accordance with ASME B32.

E. Solder copper tube and fitting joints where indicated, in accordance with recognized industry practice. Cut tube ends squarely, ream to full inside diameter, and clean outside of tube ends and inside of fittings. Apply solder flux to joint areas of both tubes and fittings. Insert tube full depth into fitting, and solder in manner which will draw solder full depth and circumference of joint. Solder shall be 95 percent tin, 5 percent antimony and shall be used above grade only. Wipe excess solder from joint before it hardens.

F. Flanged Joints: Match flanges within piping system and at connections with valves and equipment. Clean flange faces and install gaskets. Tighten bolts to provide uniform compression of gaskets.

3.5 TEST OF PIPING:

A. Test piping at completion of roughing in, in accordance with the following schedule. Show no loss in pressure or visible leaks after a minimum duration of 4 hours at the test pressures indicated. Tests to be verified by Inspector of Record.

1. Test Hot, Cold, Tempered, and Hot Water Return system with water at 150 PSI after rough-in and at 100 PSI after equipment connection.

B. Testing equipment, materials, and labor shall be furnished by this Contractor.

C. Repair piping systems sections which fail required piping test, by disassembly and reinstallation, using new materials to extent required to overcome leakage. Do not use chemicals, stop-leak compounds, mastics, or other temporary repair methods.

D. Drain test water from piping systems after testing and repair work has been completed.

3.6 CLEANING UP:

A. Upon completion of Work remove materials, equipment, apparatus, tools, and the like, and leave premises clean, neat, and orderly.

END OF SECTION

SECTION 22 11 23 - DOMESTIC WATER PUMPS

PART 1 - GENERAL

1.1 SUMMARY

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to work within this section.

B. This Section includes pumps and pump accessories, including:
   1. In-Line Recirculation Pumps
   2. Domestic Water Booster Pumps

1.2 REFERENCES AND STANDARDS

A. UL Compliance: Provide electric components for pumps which have been listed by Underwriters Laboratories.

B. All plumbing components intended to dispense water for human consumption shall comply with requirements of California Assembly Bill AB1953. Components to include (but not limited to): piping, faucets, angle stops, valves, bubblers, drinking fountains, piping, etc.

1.3 ACTION SUBMITTALS

A. Product data: submit complete data of materials proposed including:
   1. Manufacturer, model number, and pump specifications
   2. Clearly indicate all options and accessories.
   3. Provide pump curves with selection points indicated.

B. In cases of Substitution, equivalent pump shall not (when compared to basis of design fan):
   1. Increase motor horsepower
   2. Increase bHP by more than 5%
   3. Decrease flow capacity

C. Named non-basis-of-design manufacturer does not guarantee approval of equipment submittals. Manufacturers must comply with all the performance and features as specified within the specifications and as indicated on the design documents.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: submit complete O&M data including:
   1. Maintenance data and parts lists for each type of pump, control, and accessory
   2. Provide "trouble- shooting" maintenance guide
   3. Include this data, product data and Shop Drawings in maintenance manual

1.5 QUALITY ASSURANCE

A. Manufacturer’s Qualifications: Firms regularly engaged in manufacture of pumps, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer’s Qualifications: Company specializing in piping insulation application with a minimum of 3 years’ experience.

1.6 WARRANTY

A. Manufacturer: In addition to the Contractor's Standard Guarantee, furnish Owner with manufacturer's warranty for all pumps and accessories against defects in materials and workmanship. Warranty shall cover replacement of pumps or accessories plus labor to install.

PART 2 - PRODUCTS

2.1 GENERAL:

A. Provide pumps, thoroughly cleaned, and painted with one coat of machinery enamel prior to shipment. Type, size, and capacity of each pump to meet pump schedule.

B. Provide pumps of same type by same manufacturer.

C. Motors to be open drip proof type. Motors to be non-overloading at any point on pump curve and provided with built-in overload protection on single phase motors. Scheduled motor horsepowers are estimated minimums and larger motors must be furnished if necessary to meet non-overloading requirements.

D. Capacities to be as scheduled on plans.

E. Where scheduled, provide variable frequency drive for pump.

F. Acceptable Manufactures
1. ITT Bell and Gossett
2. Grundfos
3. Paco
4. Taco

2.2 IN-LINE DOMESTIC HOT WATER RECIRCULATION PUMPS:

A. Provide in-line recirculation pumps where indicated and of capacities as scheduled.

B. Type: Horizontal, oil-lubricated, designed for 125 PSI working pressure, 225^{O} F continuous water temperature, and specifically designed for quiet operation.

C. Body: Bronze.

D. Shaft: Steel, ground and polished, integral thrust collar with two horizontal sleeve bearings.

E. Seal: Mechanical with carbon-seal face rotating against ceramic seat.

F. Coupling: Self-aligning, flexible coupling.

G. Provide with timer and aquastat.

PART 3 - EXECUTION

3.1 INSPECTION:

A. Examine areas and conditions under which pumps are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF PUMPS:

A. Install pumps in accordance with manufacturer's published instructions, complying with recognized industry practices to ensure that pumps comply with requirements and serve intended purposes.

B. Contractor to provide temporary covers on pump inlet and outlet during construction. Contractor to verify pump is clean of debris prior to connecting to pipe.

C. Provide access space around pumps for service as indicated, but in no case less than that recommended by manufacturer.

D. Install in-line pumps with support from structure on each side of pump, or as indicated on Drawings.

E. Piping shall be supported from the building structure so as to prevent any strain on the pump casings. A final check for perfect alignment of the piping connections shall be made after pump has been secured to its base. Provide valves, accessories, gauges, flexible connections, and supports as indicated.

F. Contractor to verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements of Division-16 sections. Do not proceed with equipment start-up until wiring installation is complete and correct.

G. Check alignment, and where necessary, realign shafts of motors and pumps within recommended tolerances by manufacturer.

H. Lubricate pumps before start-up. Start-up in accordance with manufacturer's instructions.

I. Pumps shall not be connected to piping before piping is thoroughly flushed and cleaned of all debris and dirt. After piping connections have been made, systems shall be filled before starting pumps. Pumps shall not be run dry under any circumstances.

3.3 OPERATION TEST:

A. Test each piece of equipment to show that it will operate in accordance with indicated requirements

3.4 TRAINING:

A. Provide a minimum of 4 hours of training and orientation of Owners operating staff in proper care and operation of Booster pump systems.

3.5 CLEANING UP:

A. Repair and/or replace broken, damaged and or otherwise defective insulation. Work to be completed to that satisfaction of the Architect. At completion of work, clean materials installed as part of this work and leave systems and equipment in satisfactory operating condition.

B. Upon completion of work remove materials, equipment, tools from premises. Leave project area neat, clean and orderly.

END OF SECTION

SECTION 22 13 00 - FACILITY SANITARY SEWERAGE

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes piping required for the Sanitary Sewage system.

1.2 REFERENCES AND STANDARDS

A. Requirements of Regulatory Agencies: Contractor to conform to the publications listed below. Requirements of these publications are to be considered as a minimum standard. If details and specifications which require more stringent work are indicated within project, Contractor to provide the more stringent.
   1. California Plumbing Code (CPC) Compliance: Comply with applicable portions of the California Plumbing Code pertaining to selection and installation of plumbing materials and products.

1.3 ACTION SUBMITTALS

A. Submit manufacturer's catalog cut sheets, specifications, installation instructions, and dimensioned drawings for each type of pipe, support, anchor, and seal indicated within this section that is applicable to the project. Clearly indicate item being submitted.
   1. Indicate pipe schedules, pressure classes, etc.
   2. Indicate all options being submitted

1.4 CLOSEOUT SUBMITTALS

A. Warranty: Submit executed warranty.

B. Certification: Submit Contractors Certification

1.5 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacturer of plumbing piping systems products, of types, materials, and sizes required whose products have been in satisfactory use in similar service for not less than 5 years.

B. Contractor's Qualifications: Firm with at least 5 years of successful installation experience on projects with piping systems work similar to that required of project

1.6 WARRANTY

A. Manufacturer: In addition to the Contractor's Standard Guarantee, furnish Owner with manufacturer's warranty for all sanitary sewage piping and accessories against defects in materials and workmanship. Warranty shall cover replacement of all such piping systems or accessories plus labor to install.

PART 2 - GENERAL

2.1 GENERAL:

A. Provide piping materials and factory fabricated piping products of sizes, types, pressure and temperature ratings, and capacities as indicated. Materials and products to comply with the California Plumbing Code.

B. Where more than one type of material is indicated, selection is the Contractors option.
1. Contractor to provide submittal information on material which is to be installed.
2. Where more than one material is indicated, the Contractor shall only install one material per system and materials shall not be mixed within the same system.

C. Soldering Materials: Joints in copper tubing for all installations shall be made with brazing alloy sil-fos, or equal. Clean surfaces to be jointed shall be free of oil, grease, rust, and oxides.
1. Harris Stay-Safe 50 solder, or equal, may be permitted on plumbing lines above slab or ground only with prior review for piping sizes 2 inches and smaller only. Solders used shall contain no lead.

2.2 PIPING AND FITTINGS:

A. Sanitary Sewer Piping:
1. Cast iron, no-hub soil pipe. Provide with neoprene sleeve gaskets and stainless steel 4 band couplings.
2. Cast Iron Hub and Spigot Soil Pipe and Fittings: CISPI Standard 301 (Latest Edition) and ASTM A 74.
3. Sanitary Sewer couplings to be super-duty type in conformance with Factory Mutual Standard 1680, Class I and/or ASTM C 1540.
    a. Couplings to be as follows: “Husky” SD4000, Orange Shield coupling as manufactured by Husky Technologies, or equal. Minimum Shield thickness to be 0.015”.
    b. No-Hub Cast-Iron Soil Pipe Couplings: Couplings for use in connection with no-hub Cast Iron Soil Pipe and Fittings shall comply with CISPI 310. Shield and clamp assembly shall consist of a 300 series stainless steel corrugated shield, stainless steel bands (4-bands minimum), and sealing sleeve in conformance with ASTM C564.
4. At Contractor's option, Type DWV hard drawn copper tubing with cast bronze solder joint fittings and lead free solder may be used above ground in lieu of cast iron drainage fittings. Provide test tees as specified.
5. Acceptable manufacturer’s
    a. Tyler pipe
    b. AB&I
    c. Or Equal

B. Sanitary Vent Piping:
1. Cast iron, no-hub soil pipe. Provide with neoprene sleeve gaskets and stainless steel 4 band couplings.
2. Vent Couplings to be heavy-duty type in conformance with Factory Mutual Standard 1680, Class I and/or ASTM C 1540.
    a. Couplings to be as follows: “Husky” HD2000, White Shield coupling as manufactured by Husky Technologies, or equal. Minimum Shield thickness to be 0.010”.
    b. No-Hub Cast-Iron Soil Pipe Couplings: Couplings for use in connection with no-hub Cast Iron Soil Pipe and Fittings shall comply with CISPI 310. Shield and

clamp assembly shall consist of a 300 series stainless steel corrugated shield, stainless steel bands (4-bands minimum), and sealing sleeve in conformance with ASTM C564.

3. At Contractor's option, Type DWV hard drawn copper tubing with cast bronze solder joint fittings and lead-free solder may be used above ground in lieu of cast-iron drainage fittings. Provide test tees as specified.

PART 3 - EXECUTION

3.1 GENERAL

A. Examine areas and conditions under which plumbing piping systems are to be installed. Do not proceed with Work until unsatisfactory conditions have been corrected in manner acceptable to Contractor.

B. Install pipes and pipe fittings in accordance with recognized industry practices which will achieve permanently leak-proof piping systems, capable of performing each indicated service without piping failure. Install each run with minimum joints and couplings but with adequate and accessible unions for disassembly and maintenance/replacement of valves and equipment. Reduce sizes where indicated by use of reducing fittings. Align piping accurately at connections, within 1/16-inch misalignment tolerance.

C. Locate piping runs, unless detailed otherwise, vertically and horizontally (pitched to drain). Install piping parallel and perpendicular to adjacent building walls/structure and avoid diagonal runs wherever possible. Orient horizontal runs parallel with walls and column lines. Locate runs as shown or described by diagrams, details and notations. Hold piping close to walls, overhead construction, columns, and other structural and permanent-enclosure elements of building; limit clearance to 1/2-inch where furring is shown for enclosure or concealment of piping; locate insulated piping for 1” clearance outside insulation. Wherever possible in finished and occupied spaces, conceal piping from view by locating in column enclosures, in hollow wall construction, or above suspended ceilings; do not encase horizontal runs in solid partitions, except as indicated.

D. Electrical Equipment Spaces: Do not run piping through transformer vaults, elevator equipment rooms, Data closets or other electrical or electronic equipment spaces or enclosures.

E. Should structural difficulties or work of other contractors prevent the running of pipes or the setting of equipment at the points shown, Contractor to make the necessary deviations to the piping system, as determined by the Contractor, with the Architect's review, without additional cost to Owner.

F. Inspect each piece of pipe and each fitting to see that there is no defective workmanship on pipe or obstructions in pipes and fittings.

3.2 INSTALLATION OF SANITARY DRAINAGE SYSTEMS:

A. Make joints between PVC pipe and cast-iron pipe or fittings using cast iron adapter fittings, installed as recommended by the manufacturer.

B. Sewer Piping: Run all horizontal sanitary drain piping inside of building on a uniform grade of not less than 1/4-inch per foot, unless otherwise noted on the plans. Piping shall have invert elevations as shown and slope uniformly between given elevations.

C. Run all drainage piping as straight as possible and provide easy bends with long turns; make all offsets at an angle of 45 degrees or less.

D. Grade all vent piping so as to free itself quickly of any water condensation.

E. Hubless Cast-Iron Joints: Comply with coupling manufacturer's installation instructions and in accordance with CISPI Pamphlet No. 310, latest edition.

F. Cleanouts: Install in piping as indicated, as required by California Plumbing Code, at each change in direction of piping greater than 45 degrees, at minimum intervals of 50 feet for piping 4 inches and smaller and 100 feet for larger piping, and at base of each conductor.

G. Flashing Flanges: Install flashing flange and clamping device with each cleanout passing through waterproof membrane.

H. Install drains in accordance with manufacturer's written instructions and in locations indicated. Unless detailed otherwise, install floor drains and floor sinks with lip of drain slightly below finished floor to ensure drainage. Coordinate with other Contractors to ensure that floor slopes to drain.

3.3 TEST OF PIPING:

A. Test piping at completion of roughing in, in accordance with the following schedule. Show no loss in pressure or visible leaks after a minimum duration of 4 hours at the test pressures indicated. Tests to be verified by Inspector of Record.
1. Test all soil, Waste Drain and Vent Piping with water. Minimum height of standpipe shall be 10 feet above piping being tested. Fill with water to top of highest vent.

B. Testing equipment, materials, and labor shall be furnished by this Contractor.

C. Repair piping systems sections which fail required piping test, by disassembly and reinstallation, using new materials to extent required to overcome leakage. Do not use chemicals, stop-leak compounds, mastics, or other temporary repair methods.

D. Drain test water from piping systems after testing and repair work has been completed.

3.4 CLEANING UP:

A. Upon completion of Work remove materials, equipment, apparatus, tools, and the like, and leave premises clean, neat, and orderly.

END OF SECTION

SECTION 22 33 00 - ELECTRIC DOMESTIC WATER HEATERS

PART 1 - GENERAL

1.1 SUMMARY

A. This specification section includes plumbing equipment, including:
   1. Tankless Electric Water Heaters

1.2 REFERENCES AND STANDARDS

A. Plumbing Fixture Standards: Comply with applicable portions of the following codes and requirements for all work in this section:
   1. California Plumbing Code – CPC
   2. American National Standards Institute – ANSI
   3. Federal Standards - F.S.

B. UL and NEMA Compliance: Provide electrical components required as part of plumbing equipment, which have been listed and labeled by Underwriters Laboratories and comply with NEMA standards.

C. Water heaters to Comply with ANSI/ASHRAE/IES 90A for energy efficiency.

D. CEC Compliance: Comply with California Electrical Code (ANSI/NFPA 70) as applicable to installation and electrical connections of ancillary electrical components of plumbing equipment.

E. California Energy Commission Compliance: Provide written confirmation of listing of all water heaters in the "Directory of Certified Water Heaters," latest edition.

1.3 ACTION SUBMITTALS

A. Product data: submit complete data of materials proposed including:
   1. Manufacturer and model number
   2. Clearly indicate all options, trim, and accessories.
   3. Cross reference manufacturer’s cut sheet to fixture callout ID on submittal sheet.

1.4 CLOSEOUT SUBMITTALS

A. Warranty: Submit executed warranty.

B. Certification: Submit Contractors Certification

C. Operation and Maintenance Data: submit complete O&M data including:
   1. Maintenance data and parts lists for each type of fixture.
   2. Provide "trouble- shooting" maintenance guide
   3. Include this data within maintenance manual

1.5 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in manufacture of plumbing equipment of type and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Grade or quality of materials desired is indicated by trade names or catalog numbers stated herein.

C. Dimensions, sizes, and capacities shown are minimum and shall not be changed without permission of Architect.

1.6 WARRANTY

A. Manufacturer: In addition to the Contractor’s Standard Guarantee, furnish Owner with manufacturer's warranty for all water heaters and accessories against defects in materials and workmanship. Warranty shall cover replacement of water heater or accessories plus labor to install.

B. Furnish three-year limited warranty on tank leakage.

PART 2 - PRODUCTS

2.1 TANKLESS ELECTRIC WATER HEATERS

A. Acceptable Manufacturers:
1. Eemax
2. Chromomite
3. Or equal

B. General:
1. Water heater to have external digital temperature control.
2. Unit to be rated for a minimum pressure of 25 PSI and a maximum pressure of 150 PSI
3. Unit to have digital micro-pressing temperate control capable of maintaining outlet temperature.
4. Heating element in heater shall be replaceable cartridge insert.
5. Unit shall have replaceable filter in the inlet connector.
6. Heating element shall be Nickel Chrome material.

PART 3 - EXECUTION

3.1 INSTALLATION OF ELECTRIC HOT WATER HEATERS:

A. Install electric water heaters as indicated, in accordance with manufacturer's installation instructions and in compliance with applicable codes.

B. Furnish wiring diagram to Electrical Installer. Refer to Division 26 for wiring of units, not work of this section.

C. Connect hot and cold water piping to units with shutoff valves and dielectric unions. Connect drain and relief piping as noted on Drawings.

D. Start-up, test, and adjust electric water heaters in accordance with manufacturer's start-up instructions. Check and calibrate controls.

3.2 CARE AND CLEANING

A. Repair or replace broken, damaged, or otherwise defective parts, materials, and work. Leave entire work in condition satisfactory to Architect. At completion, carefully clean and adjust equipment, fixtures, and trim that are installed as part of this work. Leave systems and equipment in satisfactory operating condition.

3.3 OPERATION TEST

A. Test each piece of equipment to show that it will operate in accordance with indicated requirements.

3.4 CLEANING UP

A. Upon completion of Work remove materials, equipment, apparatus, tools, and the like, and leave premises clean, neat, and orderly.

END OF SECTION

SECTION 22 34 00 – FUEL FIRED DOMESTIC WATER HEATERS

PART 1 - GENERAL

1.1 SUMMARY

A. This specification section includes plumbing equipment, including:
   1. Gas Fired Water Heater
   2. Potable Water Expansion Tanks

1.2 REFERENCES AND STANDARDS

A. Plumbing Fixture Standards: Comply with applicable portions of the following codes and requirements for all work in this section:
   1. California Plumbing Code – CPC
   2. American National Standards Institute – ANSI
   3. Federal Standards - F.S.

B. UL and NEMA Compliance: Provide electrical components required as part of plumbing equipment, which have been listed and labeled by Underwriters Laboratories and comply with NEMA standards.

C. Water heaters to Comply with ANSI/ASHRAE/IES 90A for energy efficiency.

D. NEC Compliance: Comply with National Electrical Code (ANSI/NFPA 70) as applicable to installation and electrical connections of ancillary electrical components of plumbing equipment.

E. California Energy Commission Compliance: Provide written confirmation of listing of all water heaters in the "Directory of Certified Water Heaters," latest edition.

1.3 ACTION SUBMITTALS

A. Product data: submit complete data of materials proposed including:
   1. Manufacturer and model number
   2. Clearly indicate all options, trim, and accessories.
   3. Cross reference manufacturer’s cut sheet to fixture callout ID on submittal sheet.

1.4 CLOSEOUT SUBMITTALS

A. Warranty: Submit executed warranty.

B. Certification: Submit Contractors Certification

C. Operation and Maintenance Data: submit complete O&M data including:
   1. Maintenance data and parts lists for each type of fixture.
   2. Provide "trouble- shooting" maintenance guide
   3. Include this data within maintenance manual

1.5 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in manufacture of plumbing equipment of type and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years

B. Grade or quality of materials desired is indicated by trade names or catalog numbers stated herein.

C. Dimensions, sizes, and capacities shown are minimum and shall not be changed without permission of Architect.

1.6 WARRANTY

A. Manufacturer: In addition to the Contractor's Standard Guarantee, furnish Owner with manufacturer's warranty for all water heaters valves and accessories against defects in materials and workmanship. Warranty shall cover replacement of all water heaters or accessories plus labor to install.

B. Furnish three-year limited warranty on tank leakage.

PART 2 - PRODUCTS

2.1 GAS FIRED WATER HEATERS

A. General:
1. Provide 94% efficient commercial gas-fired water heater of size, capacity, recovery rate and electrical characteristics as scheduled on Drawings. Provide UL Listing and NSF approval.
2. Heater shall be design certified by A.G.A.
3. Heater(s) shall be provided with an automatic gas shutoff device and safety shutoff in event pilot flame is extinguished; a gas pressure regulator set for the type of gas supplied; an approved draft diverter, and extruded anode rod rigidly supported for cathodic protection.
4. This heater shall be listed by SCAQMD Rule 1146.2 ultra-low-NOx.
5. Heater to have intelligent control system with touch screen display and iCOMM wi-fi connectivity on board.

B. Tank:
1. All internal surfaces of the tank shall be glass-lined with an alkaline borosilicate composition that has been fused-to-steel.
2. Tank shall be catholically protected with adequate extruded magnesium rod.
3. ASME tank construction for 160 psi working pressure.

C. Heater:
1. Modulating gas burner shall automatically adjust the input based on demand.
2. Direct spark ignition spiral heat exchanger.
3. Powered anodes shall be non-sacrificial and maintenance free

D. Safety Controls:

1. Double-pole, manual-reset, high-limit, probe- type electric water flow cutoff; both factory wired.

E. Jacket:
   1. Equip with full-size control compartments with front panel opening.
   2. Insulate tank with vermin-proof glass fiber insulation.
   3. Provide outer steel jacket with bonderized undercoat and baked enamel finish.

F. Accessories:
   1. Provide brass drain valve.
   2. Provide ASTM temperature and pressure relief valve, minimum size =3/4”Ø.
   3. Provide with manufactures condensate neutralization kit.

G. Controls:

   1. The control shall be an integrated solid state temperature and ignition control device with integral diagnostics, LED fault display capability and a digital display of temperature settings.

H. Air Intake and Flue:
   1. Furnish and install schedule 40 PVC air intake and flue
   2. Seal all joints as recommended by the manufacturer for pressure-tight joints.
   3. Provide with manufacture’s concentric vent kit.

I. Warranty:

   1. Furnish three-year limited warranty on tank leakage.

J. Acceptable Manufacturers:
   1. A.O. Smith
   2. State
   3. PVI

2.2 POTABLE WATER EXPANSION TANK

A. Provide potable water expansion tank at domestic hot water heater as detailed within drawings.

B. Potable water expansion tank shall be of drawn steel construction. Tank to have a Butyl diaphragm separating the air chamber from the water containing chamber. Inlet connector shall be brass or stainless steel. Materials of manufacture for the diaphragm shall be FDA approved.

C. Pressure Expansion tank to be as follows:
   1. ASME Section VIII Construction
   2. Carbon Steel Shell
   3. Fixed Butyl Bladder (FDA Approved)
   4. Stainless Steel System Connection
   5. Pre-charged to 40 PSI (Field Adjustable).
   6. Integral bladder integrity monitor

D. The potable water expansion tank shall be a Watts Series DETA5, or equal.

PART 3 - EXECUTION

3.1 INSTALLATION OF GAS-FIRED HOT WATER HEATERS

A. Install power gas-fired heaters as indicated, in accordance with manufacturer's installation instructions and in compliance with applicable codes.

B. Furnish wiring diagram to Electrical Installer. Refer to Division 26 for wiring of units, not work of this section.

C. Connect hot and cold-water piping to units with shutoff valves and dielectric unions. Connect drain and relief piping as noted on Drawings.

D. Start-up, test, and adjust water heaters in accordance with manufacturer's start-up instructions. Check and calibrate controls.

3.2 POTABLE WATER EXPANSION TANK

A. Install potable water expansion tank per manufacturer’s written instructions.

3.3 CARE AND CLEANING

A. Repair or replace broken, damaged, or otherwise defective parts, materials, and work. Leave entire work in condition satisfactory to Architect. At completion, carefully clean and adjust equipment, fixtures, and trim that are installed as part of this work. Leave systems and equipment in satisfactory operating condition.

3.4 OPERATION TEST

A. Test each piece of equipment to show that it will operate in accordance with indicated requirements.

3.5 CLEANING UP

A. Upon completion of Work remove materials, equipment, apparatus, tools, and the like, and leave premises clean, neat, and orderly.

END OF SECTION

SECTION 22 40 00 - PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SUMMARY

A. This submittal section describes plumbing fixtures and trim.

1.2 REFERENCES AND STANDARDS

A. Plumbing Fixture Standards: Comply with applicable portions of the following codes and requirements for all work in this section:
   1. California Plumbing Code – CPC
   2. American National Standards Institute – ANSI
   3. Federal Standards - F.S.

B. All plumbing components within the waterways shall comply with the Safe Drinking Water Act (SDWA) “No-Lead” restrictions of ANSI/NSF Standard 61 Section 9.

C. All plumbing components intended to dispense water for human consumption shall comply with requirements of California Assembly Bill AB1953. Components to include (but not limited to): piping, faucets, angle stops, valves, bubblers, drinking fountains, piping, etc.

1.3 ACTION SUBMITTALS

A. Product data: submit complete data of materials proposed including:
   1. Manufacturer and model number
   2. Clearly indicate all options, trim, and accessories.
   3. Cross reference manufacturer’s cut sheet to fixture callout ID on submittal sheet.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: submit complete O&M data including:
   1. Maintenance data and parts lists for each type of fixture.
   2. Provide "trouble- shooting" maintenance guide
   3. Include this data within maintenance manual

1.5 WARRANTY

A. Manufacturer: In addition to the Contractor’s Standard Guarantee, furnish Owner with manufacturer's warranty for all plumbing valves and accessories against defects in materials and workmanship. Warranty shall cover replacement of all such valves or accessories plus labor to install.

PART 2 - PRODUCTS

2.1 GENERAL

A. All fixtures shall be first class in every respect. Accurately line up finished plumbing. Take special care with the roughing- in and finished plumbing where batteries of fixtures occur.

B. Consult Architectural Drawings, as well as Plumbing Drawings, for locations, dimensions and mounting height of plumbing fixtures.
   1. Take location and mounting heights for roughing-in from Architectural Drawings.

C. Follow Plumbing fixture rough-in schedule on Drawings for roughing-in connections. Set roughing-in for all fixtures exactly as per measurements furnished by the manufacturers of the fixtures used.

D. Roughing-in for sinks and lavatories shall be brought in through the wall under the centerline of the drain from the fixture wherever possible and as close to the fixture as possible.

E. Provide all water supplies to fixtures with compression shut-off stops. Stops to be as follows:
   1. IPS inlets with threaded brass nipples at pipe connection
   2. Lock shield-loose key.
   3. Lead Free
   4. Provide combination fixtures with compression stop on each water supply fitting.
      a. Provide loose key handle for each stop.

F. Provide 1/2 inch rigid risers for all fixtures, unless otherwise noted. Rigid risers to be chrome plated copper tub with brass compression nuts.

G. Riser to have brass barbs, stainless steel Ferrules, Brass nut, and rubber washer.

H. Unless noted otherwise, all finish for exposed metal trim on fixture shall be polished chromium plated.
   1. This also applies to wall flanges, nuts, and washers.
   2. Trim exposed under sinks shall be considered exposed and to be chromium plated.
   3. Handles on all faucets and stops shall be all-metal chromium plated.

I. Make connection between fixtures and flanges on soil pipe gastight and watertight with neoprene-type gaskets (wall-hung fixtures) or bowl wax (floor outlet fixtures).
   1. Rubber gaskets or putty will not be permitted.

J. P-Traps
   1. Provide fixtures not having integral traps with chromium plated P-trap connected to concealed waste within wall and sanitary fittings. Trap to be:
      a. Cast Brass
      b. 17-gauge
   2. Provide ADA fixtures waste offsets.
   3. Acceptable Manufacturers:
      a. McGuire Manufacturing
      b. Dearborn Brass
      c. Or equal

K. Unions on waste pipes on fixture side of traps may be slip or flange joints with soft rubber or lead gaskets.

2.2 PLUMBING FIXTURE HANGERS AND SUPPORTS

A. Install and support plumbing fixtures as required and specified herein.

2.3 PLUMBING FIXTURES

A. Fixtures to be as scheduled on drawings.

B. Provide stops for all concealed supplies.

C. Insulate domestic hot water, cold water, and waste piping below ADA plumbing fixtures with Provide ADA Sinks and Lavatories with protective covers “Truebro” Lav Guard Protective Pipe Covers. Protective covers to be:
   1. Molded closed cell vinyl pipe covers,
   2. Have vandal resistant snap-clip fasteners
   3. ASTM E-84 smoke test rating of 0.

D. Similar fixtures to be by same manufacturer.

E. Acceptable Manufacturers to be as follows:
   1. Stainless Steel Sinks:
      a. Just
      b. Elkay
      c. Or equal
   2. Manual Faucets:
      a. Chicago
      b. Or equal

PART 3 - EXECUTION

3.1 INSPECTION AND PREPARATION

A. Examine roughing-in work of domestic water and waste piping systems to verify actual locations of piping connections prior to installing fixtures. Also examine floors, substrates, and conditions under which fixture work is to be accomplished. Correct any incorrect locations of piping and other unsatisfactory conditions for installation of plumbing fixtures. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install plumbing fixtures of types indicated where shown and at mounting height indicated on Architectural Drawings in accordance with fixture manufacturer's written instructions, roughing-in Drawings, and with recognized industry practices. Ensure that plumbing fixtures comply with requirements and serve intended purposes. Comply with applicable requirements of the Uniform Plumbing Code pertaining to installation of plumbing fixtures.

B. In all cases where plumbing fixtures are mounted on or against building walls of concrete or other materials having relatively rough or non-planar surfaces, it shall be the responsibility of this Contractor to provide any necessary grout or backing materials required to facilitate fixture mounting and eliminate void spaces between fixtures and wall to ensure adequate bearing contact.

C. On completion of installation, provide silicone sealer at all points of fixture contact with walls or floors.

D. Any fixture broken, cracked, or otherwise damaged during installation must be replaced by Contractor at his own expense.

3.3 TRAPPING AND VENTING OF FIXTURES

A. Trap and vent all plumbing fixtures in accordance with Uniform Plumbing Code adopted by the Western Plumbing Officials Association and local plumbing codes, whether or not shown on Drawings. Strictly adhere to any local codes. Only exceptions to above will be those fixtures which are specially noted herein or on Drawings to be provided with special wastes.

B. No vent shall intersect another vent at a point less than 6" above extreme overflow level of highest fixture served.

C. Take vents off top half of horizontal runs and grade so as to free vents quickly of any water or condensation.

3.4 ADJUSTMENT OF PLUMBING PIPING SYSTEM

A. Test and adjust fixtures so that each fixture receives the proper amount of water.
   1. Adjust flush valves so that each fixture receives the proper amount of water.
   2. Regulate all faucets, drinking fountains, etc. to the approval of the Architect so that the entire system is left in first-class condition.
   3. Adjust all slow-off valves to turn off between 12-15 seconds.
   4. Adjust sensitivity of sensor faucets to the satisfaction of the owner.

3.5 CLEAN AND PROTECT

A. Clean plumbing fixtures of dirt and debris upon completion of installation.

B. Protect installed fixtures from damage during the remainder of the construction period.

C. Clean fixtures, equipment, and materials installed under this contract. Remove cement, plaster, paint and/or rust, etc. Also remove all manufacturers' stickers.
   1. Dirt, rubbish, paint spots, or grease on walls or fixtures for which this Contractor is responsible must be removed by him.

D. Fixtures to not be used by Contractors during construction.

3.6 FIELD QUALITY CONTROL

A. Upon completion of installation of plumbing fixtures and after units are water pressurized, test fixtures to demonstrate capability and compliance with requirements.
   1. When possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units and proceed with retesting.

B. Inspect each installed unit for damage to finish. If damaged, cracked, or dented, remove fixture, and replace with new unit.

3.7 OPERATION TEST

A. Test each piece of equipment to show that it will operate in accordance with indicated requirements.

3.8 EXTRA STOCK

A. Furnish special wrenches and other devices necessary for servicing plumbing fixtures and trim to Owner with receipt. Furnish one device for every 10 units.

3.9 TRAINING

A. Train owner on operation and adjustment of all sensor valves.

3.10 CLEANING UP

A. After installation and testing but prior to acceptance, Contractor to clean fixtures with mild detergent and water solution, rinse with clean water, and wipe dry.

B. Upon completion of Work remove materials, equipment, apparatus, tools, and the like, and leave premises clean, neat, and orderly.

END OF SECTION

SECTION 22 61 13 - DENTAL GAS SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes piping, valves, alarms, auxiliary devices, installation and testing requirements for medical gas systems including, but not limited to, the following:
   1. Dental Compressed Air System.
   2. Dental Vacuum System.

1.2 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacturer of plumbing piping systems products, of types, materials, and sizes required whose products have been in satisfactory use in similar service for not less than 5 years.

B. Contractor's Qualifications: Firm with at least 5 years of successful installation experience on projects with piping systems work similar to that required of project.

C. Requirements of Regulatory Agencies: Contractor to conform to the publications listed below. Requirements of these publications are to be considered as a minimum standard. If details and specifications which require more stringent work are indicated within project, Contractor to provide the more stringent.
   1. California Plumbing Code (CPC) Compliance.
   2. NFPA 99, Standard for Health Care Facilities, 2018 Edition.
   3. CGA Pamphlet P-2.1, Medical/Surgical Vacuum Systems.
   4. CGA Pamphlet G-7, Compressed Air for Human Respiration.
   5. CGA Pamphlet G-7.1, Commodity Specification for Air.
   6. ANSI/AWS A5.8, Specification for Filler Metals for Brazing.

1.3 SUBMITTALS

A. Submit manufacturer's catalog cut sheets, specifications, installation instructions, and dimensioned drawings for each type of pipe, support, anchor, and seal indicated within this section that is applicable to the project. Clearly indicate item being submitted.
   1. Indicate pipe schedules, pressure classes, etc.
   2. Indicate all options being submitted.

B. Provide Brazing Certifications. Submit reports as required for piping work applicable to the project.
   1. Brazers that do not have current Certifications shall not be permitted to braze on the project.

C. Provide Medical Gas Testing Reports as required by NFPA 99, 2005 Edition. Submit test reports prior to substantial completion of project.

D. Record Drawings: At project closeout, submit Record Drawings of installed systems piping and piping products, in accordance with requirements of Division 1.

E. Maintenance Data: Submit maintenance data and parts lists for medical gas piping systems materials and products. Include this data, product data, Shop Drawings, and Record Drawings in maintenance manual in accordance with requirements of Division 1.

PART 2 - PRODUCTS

2.1 GENERAL:

A. Provide piping specialties complying with Division-22 Basic Plumbing Materials and Methods section, in accordance with the following listing:
1. Pipe escutcheons
2. Fire barrier penetration seals
3. Pipe sleeves

B. Acceptable Manufacturers
1. SIERRA
2. Midmark

2.2 AIR COMPRESSOR PIPING AND ACCESSORIES

A. Piping:
1. Seamless copper pipe, ASTM B 819. Pipes to be de-burred with a sharp clean de-burring tool to remove all chips from entering tube.
a. For above ground use use Type L hard drawn.
b. For underground use, use Type K annealed.

B. Fittings:
1. Wrought copper joint pressure type per ANSI B16.22, ASTM B 819, suitable for brazing.

C. Certification:
1. Provide piping, valves, and fittings factory cleaned, inspected, tested, packaged and labeled in accordance with CGA Pamphlet G-4.1, certified accordingly in writing.
2. Deliver written certification to the Architect prior to the start of installation.

D. Piping System Joining Processes:
1. As recommended by manufacturer of pipe and fittings.
2. Pass a sufficient continuous flow of dry nitrogen through the piping during the brazing procedure to ensure that oxides of copper do not form anywhere inside the medical gas system.
a. Brazing shall be performed by brazers certified to AWS B2.2.

E. Joints:
1. Joints shall be made using minimum 1000 degree F melting temperature, BCUP brazing filler without flux, and shall comply with AWS A5.8.

F. Check Valves:
1. Cast bronze, straight pattern, positive seal with self-aligning, spring-loaded ball type check valve and cone seat.

G. Single Seat Brass Body Relief Valve:

1. Brass body, preset at 75 psi, with automatic reseating and discharge to atmosphere.

H. Pressure Regulator:
1. Regulator, complete with gauges, cleaned for oxygen service and complying with NFPA 99.

I. Quick-Connect Recessed Wall Outlets:
1. Outlets: Beacon Medeas Diamond Care quick-connect type, provided for vacuum, and medical air service, UL listed conforming with applicable NFPA and CGA Standards. Outlets shall consist of separate rough-in and finish assemblies of modular design.
2. Rough-in Assembly: Corrosion resistant with a secondary check valve and a specific gas pin keying system which shall allow pressure testing without additional labor to remove plug or adapter after testing.
3. Finishing Assembly: Includes a primary check valve, pin key indexing, designed to assure absolutely no gas flow until proper adapter is fully engaged. Color coding and appropriate cover plates shall be provided. Vacuum outlets shall have adjacent slides for bottle support.

2.3 VACUUM PUMP PIPING AND ACCESSORIES

A. Piping:
1. PVC Schedule 40 Type IV, Grade 1 Polyvinyl Chloride (PVC) compound with a cell classification of 23447 per ASTM D2665.
2. Pipe to be manufactured in strict compliance of ASTM D 2665. Pipe to be Spears, PVC Drain, Waste, and Vent (DWV) piping or equal.
3. Piping to be installed with manufacturer's recommended solvent cements.

B. Fittings:
1. Pipes and fittings to have integral wall bell and spigot joints.
2. Fittings and accessories shall be as manufactured and furnished by the pipe supplier.

C. Certification:
1. Provide piping, valves, and fittings factory cleaned, inspected, tested, packaged and labeled in accordance with CGA Pamphlet G-4.1, certified accordingly in writing.
2. Deliver written certification to the Architect prior to the start of installation.

D. Solvents:
1. Solvents to be made in the USA
2. Solvent to be NFS Listed and Certified to Exacting ASTM Standards
3. Solvents to be LOW VOC.
4. Solvent to be Spears PVC-05 or equal.
5. Acceptable manufacturer's:
   a. Spears
   b. Charlotte Pipe
   c. Or Equal

PART 3 - EXECUTION

3.1 GENERAL:

A. Degrease, clean, dehydrate, and cap pipe for medical gas usage, per CGA Pamphlet G-4.1. Piping shall be reamed and deburred at all connections.

B. Daily label piping as to gas service during erection to maintain continuity and system integrity.

C. Confirm final connections to equipment to assure that no cross-connections exist.

3.2 TESTING

A. Provide gases necessary to complete testing procedures through to certification.

B. Complete and test pipe rough-in in accordance with NFPA 99 before any finish work is applied. Covering of work before acceptance is prohibited. Certify system testing completion to Architect.

C. Medical gas systems, including source equipment, valving, alarms, and use point outlets shall be evaluated and certified for mechanical and therapeutic function as defined by NFPA 99, CGA Pamphlet P-2.1, and state and local authorities having jurisdiction thereto.
1. This testing shall be performed by an agency independent of the facility, contractor or their suppliers.
2. The agency shall specialize in medical facilities and shall be able to demonstrate experience and expertise in medical gas installations.
3. The testing agency shall be hired by the Owner and be supported by the Contractor throughout the testing period.

D. The agency shall provide to the facility full documentation of the following:
1. That all medical gas systems as constructed follow guidelines of NFPA 99, regarding placement and applicability of valves, alarms, and source equipment. The agency shall not be responsible for evaluation of plumber's technique in such elements as routing and hangers except as required by paragraphs that follow.
2. That no cross-connections exist in pipelines as constructed. Documentation shall include examination of the outflow of each outlet, following NFPA 99 mechanical cross-connect procedures. Additionally, examine each outlet outflow with an appropriate analyzer and document concentrations. Include oxygen, nitrous oxide, medical air, nitrogen, and vacuum systems in the mechanical examination.
3. all outlets are delivering gas at a pressure and flow consistent with anticipated needs, as defined by responsible authorities within the facility, but in no case less than CGA or NFPA guidelines.
4. That the pipelines are free of debris, including liquid.
5. That all outlets are functional.
    a. That delivered gas purity complies with applicable CGA/USP specifications for breathing gas.
6. Take samples from each station outlet for oxygen, mixed gases containing oxygen, and medical compressed air, and test with an oxygen analyzer to confirm the presence of the desired percentage of oxygen.
    a. Evaluate samples against CGA/USP requirements for human use and compare to one another.
7. That reserve source equipment and its control equipment is in place and operational.
8. That valves are functional. Document the location of control zones without regard to plans. Compare documentation with as-built plans and report discrepancies between the actual installation and the plans to the Owner.
9. That all alarms are set and functioning in accordance with NFPA 99. The surveillance areas of each shall be documented and compared per above.

10. That medical air is dry. The examination shall consist of a dewpoint reading taken at source and most distant outlet of each lateral branch. Document temperatures and pressures affecting dryness.
11. That systems bear appropriate labels in accordance with NFPA 99.

E. Documentation shall be provided by the testing agency to the owner and contain the above information as the certification. These documents become part of the facility's permanent records. Certification shall be provided upon successful completion of tests. The Contractor shall not be released from contractual obligations until certification is obtained.

3.3 TRAINING:

A. Provide a minimum of 4 hours of training and orientation of Owners operating staff in proper care and operation of equipment, systems and controls.

3.4 CARE AND CLEANING:

A. Repair or replace broken, damaged, or otherwise defective parts, materials, and work. Leave entire work in condition satisfactory to Architect. At completion, carefully clean and adjust equipment, fixtures and trim that are installed as part of this work. Leave systems and equipment in satisfactory operating condition.

END OF SECTION

SECTION 23 00 00 MECHANICAL GENERAL CONDITIONS

PART 1 GENERAL

1.1 GENERAL

A. This Section specifies the Division 23 Work coordination requirements with general work provisions.

B. For convenience and reference the Specifications are separated into Divisions and Sections. Such separations shall not operate to make the Engineer an arbitrator to establish subcontract limits between the Prime Contractor and his Subcontractors. In any case, the Prime Contractor is responsible to the owner for a complete job.

C. This section consists of General Requirements and Standard Specifications covering certain parts of work under Division 23 and is supplemented by other Division 23 sections covering additional work, requirements, and materials specifically applicable to the work of each section.

1. Requirements of subsequent sections of the specifications, if in conflict with these General Requirements, shall govern.

D. No material installed as part of this WORK shall contain asbestos in any form.

1.2 CONDITIONS OF THE CONTRACT

A. The Conditions of the Contract (General, Supplementary, and other Conditions) and the General Requirements (Sections of Division 1) are hereby made a part of this Section.

B. This section is a Division-23 Basic Materials and Methods section and is a part of each Division -23 section.

1.3 DESCRIPTION OF REQUIREMENTS

A. Provide finished work, tested and ready for operation including apparatus, appliances, materials, and work. Provide incidental accessories necessary to make the work complete and ready for operation without additional expense to the Owner.

B. Before beginning work or ordering materials, consult Architect for clarification of discrepancies between, or questionable intent, of the Contract Documents.

C. Contractor shall visit the site and field survey the existing site conditions prior to bid. Any site conditions which may cause significant deviation from the design drawings shall be brought to the attention of the Owner’s representative for clarification prior to bid.

1.4 REQUIREMENTS OF REGULATORY AGENCIES:

A. Provide work and materials in full accordance with the latest rules and regulations of the following:
1. California Code of Regulations - Title 24 - Parts 2, 3, 4,5, and 9
2. California Code of Regulations - Title 22 - Chapter 7
3. California Building Code, 2019
4. California Mechanical Code, 2019
5. California Plumbing Code, 2019

6. California Electric Code, 2019
7. California Fire Code, 2019
8. California Building Energy Efficiency Standards 2019
9. California Green Building Standards 2019
10. California Energy Code 2019
11. National Fire Protection Association
12. CAL-OSHA
13. Occupational Safety and Health Administration
14. State Fire Marshal, Title 19 CCR
15. Other applicable state laws

B. Nothing in Drawings or specifications shall be construed to permit work not conforming to these codes.

C. Conform to State of California Energy Conservation Standards for all systems, equipment, and construction.

D. The above Codes and Standards define minimum requirements required for the project. Where Contract Documents differ from governing codes, furnish and install higher standard.

1.5 FEES, PERMITS, AND UTILITY SERVICES

A. Arrange for required inspections and permits required in installation of the work.

B. The Owner will pay charges for permits required.

1.6 SITE EXAMINATION

A. Examine site, verify dimensions and locations against Drawings, and inform self of conditions under which work is to be done before submitting proposal. No allowance will be made for extra expense on account of error.

B. Information shown relative to existing services is based upon available records and data but is approximate only. Make minor deviations found necessary to conform with actual locations and conditions without extra cost. Verify location and elevation of utilities prior to commencement of excavation for new piping or its installation.

C. Exercise care in excavating near existing utilities to avoid any damage thereto. This Contractor is responsible for any damage caused by his operations.

1.7 ACTION SUBMITTALS / MATERIAL LIST AND SUBSTITUTIONS

A. Prior to commencement of work, and within 35 days after award of Contract, submit to Architect for review electronic copies of a complete list of equipment and materials to be furnished, including all substitutions. All submittals to be in electronic format as follows:
   1. Submittals to be in PDF Format.
   2. Individual PDF cut sheets shall be inserted into a single file for review.
   3. All sheets to be “unprotected” and writable.

B. Provide submittal information for all materials proposed for use as part of this project. Provide standard items on specified equipment at no extra cost to the contract regardless of disposition of submittal data. Other material or methods shall not be used unless approved in writing by the Architect. The Architect’s review will be required even though “or equal” or synonymous terms are used.

C. It is the responsibility of the Contractor to assume all costs incurred because of additional work and/or changes required to incorporate the proposed substitute into the project including possible extra compensation due to the Architect. Refer to Division 1 for complete instructions.

D. Contractor to provide complete Submittal packages for each system. At a maximum, submittals to be broken into the following packages:
   1. Mechanical – Dry Side package including: Ductwork, Diffusers/Grilles, and Accessories, etc.
   2. Mechanical – Source Equipment (e.g.: Packaged AC Units, Exhaust Fans, Air Handling Units, etc.)
   3. Mechanical – Duct coordination shop drawing package.
   4. Mechanical – Seismic Shop Drawings
      a. Seismic Shop drawings to show bracing requirements and locations as required by Mason OPM-0043-13.
      b. Seismic shop drawings are submitted whether bracing is required or not. Where bracing is not required, drawings shall be submitted with a statement stating that systems have been reviewed and, no seismic supports are required.
   2. Incomplete submittals or submittals broken down by spec section shall be returned un-reviewed.

E. Identify each item by manufacturer, brand, trade name, model number, size, rating, or whatever other data is necessary to properly identify and review materials and equipment.
   1. Where submittal sheets indicate more than one product, Contractor to clearly identify product being submitted. Contractor to cross-out information not being submitted for review.
   2. Submittals that do not clearly identify submitted item will be returned to the Contractor un-reviewed.

F. Identity each submitted item by reference to specification section number and paragraph in which item is specified. Cross reference submittals by equipment ID where applicable.

G. Quantities are the Contractor's responsibility and will not be reviewed.

H. If Contractor desires to make a substitution, he shall submit complete information or catalog data to show equality of equipment or material offered to that specified.
   1. Only one request for substitution will be considered on each item of material or equipment. No substitutions will be considered thereafter.
   2. Scheduled Products and first named manufacturer/product forms basis of design. All other manufacturers' products are substitutions.
   3. No substitutions will be allowed unless requested and reviewed in writing.
   4. The Architect shall review and take appropriate action on shop Drawings, product data, samples, and other submittals required by the Contract Documents. Such review shall be only for general conformance with the design concept and general compliance with the information given in the Contract Documents. It shall not include review of quantities, dimensions, weights or gauges, fabrication processes, construction methods, coordination with the work of other trades, or construction safety precautions, all of which are the sole responsibility of the Contractor.
   5. Review of a specific item shall not indicate acceptance of an assembly of which the item is a component. The Architect shall not be required to review and shall not be responsible for any deviations from the Contract Documents not clearly noted by the Contractor, nor shall the Architect be required to review partial submissions or those for which submissions for correlated items have not been received. Architect reserves right to require originally specified item.

6. Named non-basis-of-design manufacturer does not guarantee approval of equipment submittals. Manufacturers must comply with all the performance and features as specified within the specifications and as indicated on the design documents.

I. Installation of reviewed substitution is Contractor's responsibility. Any changes required for installation of reviewed substituted equipment must be made without additional cost to the owner. Review by the Architect of the substituted equipment and/or dimensional Drawings do not waive these requirements.

1.8 CLOSEOUT SUBMITTALS / MAINTENANCE AND OPERATING INSTRUCTIONS

A. Instruct the Owners' authorized representatives in the operation, adjustment, and maintenance of all mechanical equipment and systems. Provide PDF copy of certificate signed by Owner's representatives attesting to their having been instructed.

B. Furnish Architect with PDF complete sets of operating and maintenance (O&M) instructions.
   1. O&M manuals to be scanned and provided in an organized PDF file.
   2. O&M manuals to include: descriptive literature, catalog cuts, and diagrams covering all items of operation and maintenance for each and every mechanical system and piece of equipment furnished under these specifications.
   3. Include in each set a copy of the air balance test report specified hereinafter.

C. Contractor must start compiling the above data (including obtaining operating and maintenance instruction data and catalog cuts and diagrams from the manufacturer of the reviewed equipment) immediately upon review of his list of materials, so as not to delay the final installation of the work.

D. Final observation will not be made until booklets are submitted and have been reviewed by the Architect.

E. O&M manuals to incorporate the following:
   1. Complete operating instructions for each item of heating, ventilating and air conditioning equipment and associated piping and ductwork systems.
   2. Test data and system balancing reports as specified.
   3. Temperature control diagrams and literature.
   4. Manufacturer's bulletins with parts numbers, instructions, etc. for each item of equipment. Remove information not applicable to project.
   5. Typewritten maintenance instructions for each item of equipment listing in detail the lubricants to be used, frequency of lubrications, inspections required, adjustment, etc.
   6. A complete list and/or schedule of all major valves giving the valve ID, location of valve, and the rooms or area controlled by the valve.
   7. Provide copies of start-up reports for each piece of mechanical equipment provided as part of this work.
   8. Name, address, and phone number of contractors involved in work under this Division.
   9. Detailed step-by-step instructions for starting, summer operation, winter operation, and shutdown of each system.
   10. Detailed maintenance instructions for starting, summer operation, winter operation, and shutdown of each system.
   11. Spare parts list.
   12. Full size Record as built shop drawings in hard copies and in AutoCAD 2019 CAD files.
      a. Contractor to incorporate field mark-ups into record drawings. Mark-up shop drawings not acceptable.

1.9 COORDINATION SHOP DRAWINGS

A. General:
   1. Prepare and submit for review coordination drawings where work by separate entities requires fabrication of products and materials which must accurately interface or for which space provided is limited.
   2. Coordination drawings shall indicate how the work will interface and installation will be sequenced. It is the intent of this provision to find, bring forth, and resolve potential constructability problems prior to actual construction, thereby allowing for the resolution of issues before construction cost and schedule are impacted.

B. The General Contractor shall oversee preparation of coordination drawings, assign priority space, and bring to the attention of the Architect any conflicts or interferences of an unresolved nature found during preparation of coordination drawings. Expedite conflict or interferences and submit solutions/ recommendations for approval review.

C. Drawings: Shop drawings shall include but are not necessarily limited to the following:
   1. Submit 1/4" = 1'-0" minimum scale, a combined, comprehensive mechanical coordination drawing. Coordination drawing shall include all ductwork, mechanical piping. Drawings to be coordinated with plumbing, sprinkler systems, and ceiling systems overlaid on structural frame and architectural plan. Shop drawings are to be coordinated with all electrical and Telecom systems.
   2. Criteria: Ductwork, mechanical piping, plumbing, and sprinkler system components shall be sized as shown on Drawings. Seismic restraints shall be shown where required. Nonconforming Mechanical work installed within designated coordination areas is subject to removal and replacement by the installing contractor at no additional cost to Owner.
   3. Provide sections for congested areas.
   4. Identify typical areas, start preparation of coordination drawings for such areas first.

D. Where required for coordination purposes, Contractor to modify duct shape to an equivalent flattened size at no additional cost to the owner. Contractor to limit duct aspect ratio to 3:1 unless provided special written permission by the Architect.

E. Coordination drawings shall be signed and dated by individual trade contractors. By act of signature and submittal of singular combined coordination drawing, each trade contractor acknowledges their coordinated portion of the work with all other mechanical, electrical, telecom, architectural, and structural work contractors.

F. After completion of coordination shop drawings signed by individual trade contractors. Submit copies to the architect for review. Once approved, provide copy at the job site for reference. No work shall be performed without the complete coordination shop drawings.

G. No request for information regarding the routing of pipes, ductwork and placement of equipment will be reviewed and responded to without a completed shop drawings.

1.10 SITE CONDITIONS

A. Information of the drawings relative to existing conditions is approximate only. Deviations found necessary during progress of construction to conform to actual conditions as approved by the Architect shall be made without additional cost to the Owner. The Contractor shall be held responsible for any damage caused to existing services. Promptly notify the Architect if services are found which are not shown on the Drawings.

1.11 WARRANTY

A. Be responsible for work done and material installed under these plans and specifications. Repair or replace, as may be necessary, any defective work, material, or part which may show damage to itself or other materials, furnishing, equipment, or premises caused by such defects during this period, if in the opinion of the Architect said defect is due to imperfection of material or workmanship. Provide all such work and materials at no cost to Owner.

B. Be responsible for damage to any part of premises during guarantee period caused by leaks or breaks in work furnished and/or installed under this section. Replace refrigerant, lubricants, or gasses lost as result of defects, breaks, or leaks in work.

C. Provide manufacturer's written warranties covering defects in material and workmanship of products and equipment utilized for the project.

D. Warranties shall be for a period of 2 years from the date of substantial completion unless more stringently specified within individual Sections of this Division.

PART 2 PRODUCTS

2.1 GENERAL

A. Mention herein or on Drawings requires that this Contractor provide each item listed of quality noted or equal. Refer to subsequence division 23000 specification sections for specific equipment and system materials and accessories.

B. All material shall be new, full weight, standard in all respects, and in first- class condition.

C. Provide materials of the same brand or manufacture throughout for each class of material or equipment wherever possible.

D. The grade or quality of materials desired is indicated by the trade names or catalog numbers stated herein.

E. Dimensions, sizes, and capacities shown are a minimum and shall not be changed without permission of the Architect.

F. Conform to the State Energy Conservation Standards for all material and equipment.

2.2 MATERIALS FURNISHED

A. Identify all materials and equipment by manufacturer's name and model number. Remove unidentified materials and equipment from site.

B. Equipment specified by manufacturer's number shall include all accessories, controls, etc. listed in catalog as standard with equipment. Furnish optional or additional accessories as specified.

C. Equipment or material damaged during transportation, installation, or operation is considered as totally damaged. Replace with new equipment. Variance from this permitted only with written consent of the Architect.

D. Deliver, Protection, and Care:

1. Deliver materials or equipment to the Project in the manufacturer's original, unopened, labeled containers.
2. Added costs associated with reordering, expediting orders, or project delays due to rejected materials shall be borne by the Contractor.
3. Protect from damage which may be caused by theft, weather, and building operations. Failure to protect materials and apparatus adequately shall be sufficient cause for rejection of any damaged material or equipment.
4. Close pipe and equipment openings to prevent intrusion of obstructions and damage.
5. Owner or Architect will require removal and replacement of such material or work from the premises which is not in accordance with Contract Documents. Replace unsatisfactory work without delay, at no additional cost to the Owner.
6. All material and equipment shall be protected against moisture, dirt and damage. Protective coverings shall be provided for bearings, open connections to pumps and tanks, coils, ducts, pipes and similar equipment that is vulnerable to grit and dirt.
7. The interior of the pipes and ducts shall be kept clean at all times.

PART 3 EXECUTION

3.1 GENERAL

A. General arrangement and location of piping, ductwork, equipment, etc. are shown on Drawings or herein specified. Carefully examine other work that may conflict with this work. Install this work in harmony with other crafts and at proper time to avoid delay of work. Provide all offsets as required to avoid other trades at no additional cost to the owner.

B. In advance of construction, work out minor changes and relocations to suit actual conditions and work of other trades to avoid conflict therewith. This shall not be cause for additional cost.

C. Execute any work or apparatus shown on the Drawings and not mentioned in the specifications, or vice versa, the same as if specifically mentioned by both. Omission from Drawings or specifications of any minor details of construction, installation, materials, or essential specialties does not relieve this Contractor from furnishing same in place complete.

D. Furnish and install any incidental work not shown or specified which can reasonably be inferred as part of the work and necessary to provide a complete and workable system.

E. Furnish materials and work at proper time to avoid delay of the work.

F. Coordinate with testing and balancing contractor to review drawings for proposed additional balancing components required for proper system testing and balancing.

3.2 ACCESS

A. Continuously check Architectural Drawings for clearance and accessibility of equipment specified herein to be placed. No allowance of any kind will be made for negligence on part of Contractor to foresee means of installing his equipment into proper position.

3.3 CLOSING IN OF UNINSPECTED WORK

A. Do not allow or cause work installed to be covered up or enclosed before it has been inspected and tested. Should work be enclosed or covered up before it has been inspected and tested, uncover work at own expense. After it has been inspected and tested, make

repairs necessary to restore work of other contractors to condition in which it was found at time of cutting.

3.4 PROJECT MODIFICATIONS

A. During the progress of construction, if such conditions arise that require revisions, modifications, or relocations to any mechanical equipment or materials incorporated in this project, such alterations shall be immediately called to the attention of the Architect. Contractor shall then prepare necessary Drawings showing proposed changes. Submit proposed changes for review by the Architect prior to actual revision work in the field.

B. Two sets of Drawings showing all revisions shall be immediately presented to Architect for his records. Maintain additional copies on the project as necessary to comply with "RECORD DRAWINGS" requirement of the General Requirements.

C. Incorporate all revisions into record Drawings.

3.5 FORMING, CUTTING AND PATCHING

A. Coordinate with other contractors as necessary to provide any special forming, recesses, chases, etc., and provide wood blocking, backing, and grounds as necessary for proper installation of mechanical work.

B. If this Contractor fails to coordinate with other contractors at proper time or fails to locate items properly, resulting in extra work, then this Contractor is responsible.

C. This Contractor is responsible for proper placement of pipe sleeves, hangers, inserts, and supports for work.

D. Cutting, patching, and repairing of existing (old) construction to permit installation of piping, etc. is responsibility of this Contractor. Repair or replace damage to existing work with skilled mechanics for each trade involved in first-class manner.

E. Cut existing construction in a neat and workmanlike manner by the use of a concrete saw. Use of pneumatic devices will not be allowed.

F. Core openings through existing construction as required for the passage of new piping and conduits. Cut holes of the minimum diameter to suit size of pipe installed and associated insulation.

3.6 DEMOLITION AND SALVAGE

A. Provide demolition of mechanical work under this SECTION as indicated on Drawings.

B. Removed materials which will not be re-used and which are not claimed by the owner shall become the property of the Contractor and shall be removed from the premises. Consult Owner before removing any material from the premises. Carefully remove materials claimed by the owner to prevent damage. Coordinated delivery of such items to owner.

C. Removed materials which are to be reused are to be removed, cleaned, and stored in a safe location. If such items are lost or damaged by the Contractor, item shall be replaced with new item at no added cost to owner. If item is found to be damaged prior to removal, inform Architect prior to removal so that item may be examined by Architect and owner for further instructions.

3.7 WELDING FOR MECHANICAL WORK

A. All mechanical welding and inspection requirement shall be in accordance with the California Mechanical Code.

B. Qualify welding procedures, welders and operators shall be in accordance with ASME boiler and pressure vessel code, section IX, welding and brazing qualifications. Welding procedures and testing shall comply with ANSI standard B31.9 - standard code for pressure piping, and the American Welding Society (AWS) welding handbook.

C. Soldering and brazing procedures shall conform to ANSI B9.1 standard safety code and NFPA 99.

D. All welders shall be certified by a state approved welding bureau. Fabricator shall have current and valid certificated registration by the building official for the types of welds required by the project. Prior to start of the project, the fabricator shall submit a copy of certificate of registration for approval. Prior to project close out, the fabricator shall submit a certificate of compliance that the work was performed in accordance with the approved plans and specifications to the building official and to the Engineer or Architect of record.

3.8 EXISTING SERVICES

A. Provide and install all required connections to existing systems as required by the Drawings and specifications.

B. Integrate existing systems with all new work to provide a complete working system.

C. Provide minimum 72 hour notice to Owner of service interruptions. All service interruptions shall be kept to the minimum possible time. When requested by Owner service interruptions shall occur outside of normal working hours at no additional cost to owner.

3.9 ASBESTOS ABATEMENT

A. Existing systems within the area of this scope of work may have asbestos-bearing materials. Testing, encapsulation, removal, treatment, or correction of existing asbestos-bearing materials is not a part of this scope of work and is not the responsibility of the mechanical contractors.

3.10 STRUCTURAL DESIGN OF EQUIPMENT AND SEISMIC RESTRAINTS

A. All mechanical equipment supports shall be designed by a licensed Structural Engineer and shall comply with the 2019 California Building Code, Section 1616A.1.18 through 1616A.1.26 and ASCE 7-16. Chapters 13, 26, and 30.

B. Provide seismic sway bracing for all suspended piping in accordance with the OSHPD anchorage pre-approval OPM-0043-13 the “Mason West Inc. Seismic Restraint Guidelines for Suspended Piping, Ductwork, and Electrical Systems”.

3.11 WARRANTY

A. Be responsible for work done and material installed under these plans and specifications. Repair or replace, as may be necessary, any defective work, material, or part which may show damage to itself or other materials, furnishing, equipment, or premises caused by such defects during this period, if in the opinion of the Architect said defect is due to imperfection of material or workmanship. Provide all such work and materials at no cost to Owner.

B. Be responsible for damage to any part of premises during guarantee period caused by leaks or breaks in work furnished and/or installed under this section. Replace refrigerant, lubricants, or gasses lost as result of defects, breaks, or leaks in work.

C. Provide manufacturer's written warranties covering defects in material and workmanship of products and equipment utilized for the project.

D. Warranties shall be for a period of 1 year from the date of substantial completion unless more stringently specified within individual Sections of this Division.

3.12 START-UP PROVISIONS FOR MECHANICAL WORK

A. General: Major equipment (such as air handling units) start-up shall be performed by the equipment manufacturer or authorized representative.

B. Adjusting and Aligning Equipment: Adjust all equipment. Check all motors for proper rotation.

C. Lubrication:
   1. Extend grease fittings on bearings to points of ready and easy accessibility.
   2. Lubricate fan bearings, etc., before operation of any equipment.
   3. Provide a final lubrication to equipment immediately before turning over to Owner.

D. Upon completion of the mechanical work, or at such time prior to completion as may be determined by the Architect, operate and test all mechanical equipment and systems to demonstrate the satisfactory overall operation of the building or project as a complete unit. Commence tests after preliminary balancing and adjustments to equipment have been checked. Immediately before starting tests, install new air filters and lubricate all running equipment. Notify the Architect at least seven calendar days in advance of starting the above tests. Test equipment and systems for a minimum as follows:

   1. Packaged Make-Up air units

E. Provide training and orientation of Owners operating staff in proper care and operation of equipment, systems and controls.

F. Neatly tabulate and deliver to the Architect complete operational data, including air flows, room temperatures, fan speeds, motor currents, plenum and duct static pressures, and other data as required. The Architect reserves the right to spot check results, and if discrepancies or errors are noted, Contractor will be required to redo balancing tests and tabulations entirely.

G. During test period, make final adjustments and balancing of equipment, systems, controls, and circuits so that all are placed in first-class operating condition.

H. Mark final positions of balancing valves after balancing is complete.

I. All areas of building shall receive proper flow of hot and chilled water to assure adequate and uniform temperatures throughout.

J. Final observation will not be made until all of the above have been completed and a preliminary copy of the balance report has been submitted and reviewed.

3.13 MECHANICAL RECORD AS-BUILT DRAWINGS

A. During the course of Project Construction, Mechanical Contractor shall maintain recorded “AS-built” information by distinctively marking up approved shop drawings prints to depict all actual work installed on a daily basis form but not limited to field conditions, addendums, architectural supplemental instructions (ASIs) , instruction bulletins (IBs), change orders (COs), responses to Request For Information (RFIs), and approved product substitutions.

B. The marked-up shop drawings will be made available at the Construction Site to the Architect upon request, at any time.

C. The marked-up shop drawings with the recorded information shall then be used to create Record As-built drawings at the completion of the project. Contractor shall submit the Record As-built drawings in full size hard copies and also in CAD files format using the AutoCAD 2013 or later version.
   1. Hand marked shop drawings are not acceptable.
   2. Provide 2 complete sets of full-size drawings on 20 pound white bond paper.
   3. Provide 1 CD (compact disc) or Thumb Drive with Record drawings in both PDF and AutoCAD, version 2013 or later version.
   4. Record as-built drawings are to be full size drawings (same size as Contract Documents) and all plans are to be to standard engineering scale. The minimum drawing scale to match those provided within the Contract Documents.

3.14 CLEANING UP

A. Remove tools, scaffolding, surplus materials, barricades, temporary walks, debris, and rubbish from the Project promptly upon completion of the work of each Section. Leave the area of operations completely clean and free of these items.

END OF SECTION

SECTION 23 05 00 COMMON WORK FOR HVAC

PART 1 GENERAL

1.1 SUMMARY

A. This section includes general mechanical materials and methods required within the project. Items included within this specification section include:
   1. Access Doors
   2. Equipment Identification
   3. Motors
   4. Motor Starter, Switches, And Wiring
   5. Fireproofing
   6. Concrete
   7. Excavating And Backfill
   8. Electrical Work
   9. Commissioning and preliminary operational tests

1.2 ACTION SUBMITTALS

A. Product data: submit complete data of materials proposed including:
   1. Manufacturer and model number
   2. Clearly indicate all options, trim, and accessories.
   3. Cross reference manufacturer’s cut sheet to specification section on submittal sheet.

1.3 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: where applicable, submit complete O&M data including:
   1. Maintenance data and parts lists for each component.
   2. Provide "trouble- shooting" maintenance guide
   3. Include this data within maintenance manual

1.4 QUALITY ASSURANCE

A. Manufacturer’s Qualifications: Firms regularly engaged in manufacturer of plumbing piping systems products, of types, materials, and sizes required whose products have been in satisfactory use in similar service for not less than 5 years.

B. Contractor’s Qualifications: Firm with at least 5 years of successful installation experience on projects with piping systems work similar to that required of project.

PART 2 PRODUCTS

2.1 ACCESS DOORS

A. Where floors, walls, or ceilings must be penetrated for access to mechanical equipment, provide access doors, 14-inch by 14-inch minimum size in usable opening. Where entrance of a serviceman may be required, provide 18-inch by 24-inch minimum usable opening.
   1. All access doors less than 7’-0” above finished floors and exposed to public access shall have keyed locks.

B. Access doors shall match those supplied in Division 08 3113 in all respects, except as noted herein.

C. Where panels are installed against stainless steel panels, access doors to be stainless steel to match adjacent surfaces.

D. Where panels are located on ducts or plenums, provide neoprene gaskets to prevent air leakage, and use frames to set door out to flush with insulation.

E. Provide insulated doors where located in internally insulated ducts or casings.

F. Where specific information or details relating to access panels different from the above is shown or given on the Drawings or other Divisions of work, then that information shall supersede this specification.

G. Do not locate access doors in highly visible public areas such as lobbies, waiting areas, and primary entrance areas. Coordinate with the architect when access is required within these areas.

H. Available Manufacturers:
   1. Milcor
   2. Karp
   3. Nystrom
   4. Cesco

I. Access doors to be equivalent to the following Milcor access doors:
   1. Style M (plaster)
   2. Style A (A/C tile, gypsum board)
   3. Style M (Masonry)
   4. Style "Fire Rated" where required.

2.2 ROOF FLASHING

A. Flashings in metal deck or membrane type roofing:
   1. Flashing for penetrations of the roof for mechanical items such as flues, ducts, and pipes will be furnished and installed under other sections of these specifications. The work of this section shall include layout, sizing, and coordination of penetrations required for the mechanical work.
   2. Furnish and install counter-flashings above each flashing required in the mechanical work. Flues and ducts shall have 24-gauge galvanized sheet metal storm collar securely clamped to the flue or duct above the flashing.
   3.
   4. plus or minus one of the smallest scale divisions throughout the entire range.
   5. The thermometer scales shall have a minimum of 2 degrees between graduations and a maximum of 20 degrees between figures.
   6. The thermometers shall be located so as to be easily read and shall be furnished with adjustable angle pattern so as to be rotated to any position.
   7. Liquid thermometers for tanks and similar equipment shall have a minimum 5-inch diameter face.
   8. Thermometers for piping shall have a minimum face diameter of 3 inches.
   9. Thermometers installed on insulated tanks or piping shall be provided with an extension neck well to compensate for the thickness of the insulation.
   10. Thermometers shall be provided with stainless steel stems and steel wells.
   11. Thermometers used for air temperature in ductwork, plenum boxes, etc., unless specified or shown otherwise, shall have a minimum scale face of 5 inches and shall have an

adjustable mounting flange so that scale may be set at any angle up to 45 degrees to facilitate reading.
   a. The thermometers shall have a perforated guard over stem suitable for sensing air temperature.
   b. Length of stem shall be a minimum of 8 inches.
12. Thermometer wells with chain and cap shall be provided where wells are indicated on the Drawings.

B. Provide Pete's Plug II, Sisco P/T, or equal test plug with Nordel core where indicated on drawings.

C. Acceptable Manufacturers:
   1. Weston
   2. Marsh
   3. Taylor
   4. Or Equal

2.3 GAUGES

A. General:
   1. Gauges and gauge connections shall be furnished at all locations shown on the Drawings and in accordance with these specifications, whether shown on the Drawings or not.
   2. Accuracy to be within 1 percent in the middle third of the dial range and equipped with front calibration.
   3. Dials to be white with black numerals.
   4. Normal reading to be mid-scale.
   5. Provide a needle valve on each gauge connection.
   6. Gauge to have bronze bushed movement and front recalibration.
   7. Gauges shall have a minimum dial size of 3-1/2 inches.

B. Provide Pete's Plug II, Sisco P/T, or equal test plug with Nordel core where indicated on drawings.

C. Acceptable Manufacturers:
   1. Marsh, Series J
   2. U.S. Gage
   3. Danton 800

2.4 PIPING AND EQUIPMENT IDENTIFICATION

A. Equipment Identification:

   1. Provide white lamacoid plate for each and every piece of equipment installed in this work.
   2. Lettering on plate shall be black, with size of lettering to suit equipment.
   3. Lettering shall be minimum of 3/8-inch in height.
   4. Plates shall be riveted or bolted to equipment.

B. Equipment to include, but not limited to:
   1. Air Handling Units
   2. Exhaust Fans

C. Acceptable Manufacturers:
   1. Marking Services Incorporated, (MSI)
   2. LEM Products
   3. Seton
   4. Craftmark

2.5 ELECTRIC MOTORS

A. General:

1. The following are basic requirements for simple or common motors. For special motors, more detailed and specific requirements are specified in the individual equipment specifications.

B. Electric Motors:

1. All electric motors shall comply with requirements of NEMA, UL, ANSI/IEEE 112 and NEC, suitable for intended load, voltage, phase, frequency, service, and location.
2. Limit maximum motor speeds to 1750 rpm, unless otherwise specified.
3. Motors 1/2 HP and larger shall be 3 phase, 60 Hz, squirrel cage induction motors unless specifically specified to the contrary in subsequent Sections of this Division.
    a. Refer to Drawings for voltage requirements.
    b. Totally enclosed motors rated 3/4 HP, 1200 rpm, or 1 HP and larger, and all drip-proof motors shall have a 1.15 continuous-duty service factor at 40^{o}C ambient temperature.
    c. Insulation system shall be NEMA Class F or better.
    d. Provide double-shielded, grease-lubricated ball bearings with grease pockets on each side for regreasing in service.
    e. Provide inlet and outlet grease connections in 7.5 HP and larger motor housings for each bearing.
    f. Motors 5 HP and smaller and all roof-mounted equipment motors shall be provided with factory sealed, permanently lubricated ball bearings.
4. Motors smaller than 1/2 HP shall be single phase, 110 volt permanent split-capacitor type with integral thermal overload protection. Bearings shall be factory sealed, permanently lubricated ball type.
5. Provide totally enclosed motors, or suitable protection per NEMA Standards, in locations exposed to the weather or dripping water and in air handling units downstream of cooling coils and heat recovery coils. Other motors shall be open drip-proof.
6. Multi-speed motors shall be provided where specifically scheduled.
7. Motors feed by variable frequency drives (VFD) shall be specifically designed by motor manufacturers for variable frequency drive application.
8. Minimum Efficiency and Power Factor: Minimum Power Factor shall be 85 percent minimum, in all sizes, and minimum efficiency shall be as follows, for 1,800 rpm motors as tested in accordance with NEMA Table 12-6D. The minimum efficiencies shall be guaranteed. Minimum efficiencies to be as follows:
    a. <1 HP - 85.5% efficiency
    b. 1-1/2 HP & 2 HP – 86.5% efficiency
    c. 3 HP & 5 HP – 89.5% efficiency
    d. 7.5 HP & 10 HP – 91.0% efficiency
    e. 15 HP – 92.4% efficiency
9. Overload protection: Built-in thermal overload protection and, where indicated, internal sensing device suitable for signaling and stopping motor at starter.
10. Noise rating: Comply with ANSI/NEMA MG 1."Quiet" rating on motors located in occupied spaces of building.
11. Nameplate: Indicate the full identification of manufacturer, ratings, characteristics, construction, special features and similar information.

C. Acceptable Manufacturers:

1. Reliance
2. Baldor

3. US Motors
4. Westinghouse
5. Lincoln
6. General Electric

2.6 MOTOR STARTERS, ELECTRICAL DEVICES, AND WIRING

A. Motor Starters:
   1. Magnetic motor starters for equipment provided under the Mechanical Work shall be furnished by the Mechanical Contractor and turned over to the Electrical Contractor for installation, unless otherwise noted.
      a. Magnetic motor starters shall be provided as part of motor control centers shall be provided and installed by Electrical Contractor
   2. Unless otherwise noted, magnetic motor starters shall be furnished in NEMA 4 enclosure for outside installation and NEMA 1 enclosure for inside installation, with three thermal overloads for three- phase motors and one overload element for single-phase motors. All overloads shall be ambient compensated.
   3. Furnish single phase motors with manual motor starters having integral overload protection.
   4. Furnish 3-phase motors with full voltage, magnetic across-the-line starters unless noted otherwise.
   5. Provide thermal overload protection for all 3-phase legs. Provide motor starters with single phase protection.
   6. Provide fail-open auxiliary contacts, pre-wired to a terminal strip, for future remote alarm wiring and run-time totalization. Refer to Division 26.
   7. Provide equipment starters with an adequate control transformer, complete with fuse protection, to supply 120 volt source for control circuit, regardless of line voltage.
   8. Provide hand-off-automatic selector switches in cover.
   9. Variable Frequency Drive Controllers: Provided under Section 23 29 23 - Variable Frequency Drive Controllers.

B. Manual switches shall have pilot lights and extra positions for multi-speed motors.

C. Overload protection: Melting alloy type thermal overload relays.

D. Magnetic Starters:
   1. Maintained contact push buttons and pilot lights, properly arranged for single speed or multi-speed operation as indicated.
   2. Trip-free thermal overload relays, each phase.
   3. Interlocks, pneumatic switches, electric relays and similar devices as required for coordination with control requirements of Division 15 Controls Sections.
   4. Externally operated manual reset.
   5. Under-voltage release or protection.

E. Motor connections:
   1. Flexible conduit, except where plug-in electrical cords are specifically indicated.

2.7 FIREPROOFING

A. Fireproofing to be installed at all pipe and duct penetrations of rated assemblies.

B. Fireproofing to be UL Rated fire stop material.

C. Acceptable Manufacturers:
   1. Hilti

2. 3M Pro-Set
3. Or Equal

PART 3 EXECUTION

3.1 ACCESS DOORS

A. Access doors shall be furnished and installed wherever valves, balance valves, damper operating mechanisms, air terminal boxes, fans, and similar items normally requiring adjustment or servicing are installed in concealed or inaccessible spaces. Coordinate with access doors shown on architectural Drawings.

B. Comply with manufacturer's instructions for installation of access doors.

C. Where access panels are detailed on architectural or mechanical Drawings, sizes indicated thereon shall be used.

D. Keyed access doors shall be keyed alike.

1. Provide owner with 4 copies of keys for access doors.

3.2 PIPE AND EQUIPMENT IDENTIFICATION

3.3 MOTORS

A. Motors furnished in the Mechanical Work shall be furnished by the Mechanical Contractor, but such equipment shall be delivered to the Electrical Contractor for mounting and connecting to power wiring. Coordinate all motor starter requirements with Electrical Contractor.

3.4 MOTR STARTERS SWITCHES, AND WIRING

A. Starters located in motor control centers will be provided under the Electrical Work. Contractor is referred to electrical drawings for motors served by motor control centers.

B. Starters furnished by the Mechanical Contractor to be delivered to the Electrical Contractor for mounting and connecting to power wiring. Coordinate all motor starter requirements with Electrical Contractor.

3.5 FIREPROOFING

A. Pack the annular space between the pipe sleeves and the pipe and between duct openings and ducts through all floors and walls with UL listed fire stop.

B. Fireproofing system to be installed in strict accordance with manufacturer’s written instructions and details.

3.6 PAINTING

A. Perform all priming and painting on the equipment and materials as specified herein.

B. Exposed piping and unfinished portions of equipment to be painted shall be cleaned of grease, oil, rust, or dirt in preparation for painting.

C. Where applicable, remove pipe clamps prior to painting so that entire pipe is painted. Provide temporary support as required. Re-install clamps after priming/painting is complete.

D. Priming:

1. Contractor to prime all exposed ferrous metals, including piping, which are not galvanized or factory-finished.

a. Black steel pipe exposed to weather shall be cleaned and primed with one coat of Rust-Oleum, or equal, #1069 primer. Color to be Grey.

E. See Painting Section for detailed requirements.

3.7 EXCAVATING AND BACKFILL

A. Perform all excavating required for work of this Section. Do excavating required for installation of piping and service lines and other work that applies as indicated on Drawings. Verify location and elevation of all existing utilities prior to excavation for installation of new piping. Provide the services of a pipe/cable locating service prior to excavating activates to determine location of existing utilities

B. Excavations shall be of open vertical construction of sufficient width to provide free working space at both sides of trench and around pipe as required for caulking, joining, backfilling, and compacting. Unless shown otherwise, provide a minimum of 2’-6” cover above top of pipe to finished grade for all service piping unless otherwise noted. Trim trench bottom by hand or provide a minimum of 4” deep sand bed to provide a uniform grade and firm support throughout entire length of pipe. For PE gas pipe, bed the pipe in a 4” sand bed.

C. Dig trenches straight and true to line and grade with holes for bells for bell-and-spigot pipe. Evenly support piping for its entire length upon outside periphery of lower one-third of pipe. Where rock is encountered, undercut trenches 3 inches and fill with well-tamped, clean sand and pea gravel to correct pipe elevation.

D. After pipe lines in excavation have been installed and tested, backfill excavation to point 6 inches above pipe using sand, fine earth, or other materials free of rocks and large lumps. Proceed evenly on both sides of pipe and continuously tamp. Except as hereinafter noted, backfill above 6 inches above top of pipe shall be made by using earth from excavation placed in layers of 8-inch maximum depth. Compaction of each successive layer will be made with mechanical compactor.

E. Take special care in backfilling over wrapped piping to prevent damage to protective wrapping.

F. This Contractor shall replace sod, concrete, asphalt paving, curbs, pavement, walks, and any other type of existing work or surface disturbed by excavation, using workmen skilled in trade involved.

G. When pipe or underground conduit with a protective wrapping is to be placed in the trench, sand only shall be used for bedding the pipe or conduit. The sand used shall be certified to have a minimum resistance of 5,000 ohms per cubic centimeter when wetted to any moisture content with distilled water and shall consist of clean, natural, washed-sand, hard, and durable particles varying from fine particles to particles of such size that all will pass through a 3/8-inch screen, not less than 90 percent will pass through a 1/4-inch screen, and not more than 25 percent will pass through a No. 50 screen.

H. Any backfill placed under this contract which subsides or settles below the adjacent finished grade or paving level during the guarantee period shall be brought to grade by the Contractor by adding compacted backfill or additional paving in paved areas.

3.8 ELECTRICAL WORK

A. Adequate working space shall be provided around electrical equipment in compliance with the National Electric Code and other applicable codes or ordinances. The mechanical work shall be coordinated with the Electrical Work in order to comply with these requirements. Any work which does not conform to these regulations shall be properly corrected without additional cost to the Owner.

B. Furnish and install all line voltage and low-voltage temperature control wiring in the Mechanical Work by the Temperature Control Sub-Contractor, including all interlock wiring between motor starter coils, interlock relays, and temperature control equipment. Unless noted otherwise, this does not include primary control wiring between starters and push button or other manual starter switch or branch power circuits required for temperature control systems.

C. Temperature control equipment, including relays shown on control diagram, shall be furnished and installed by the Temperature Control Subcontractor.

D. Equipment furnished in this work that is factory wired but requires modification to internal wiring to meet specifications or drawing requirements shall have such internal modifications made at factory before shipment.

E. All electrical work and equipment, including internal wiring, must comply with applicable codes and applicable portions of electrical specifications. Run line and low-voltage control wiring in conduit. Conduit for temperature control wiring shall be responsibility of Mechanical Contractor and shall be of type specified in electrical specifications.

3.9 DEMOLITION

A. Refer to Division 1 sections for general demolition requirements and procedures.

B. Disconnect, dismantle, and remove mechanical systems, equipment, and components indicated to be removed. Coordinate with all other trades
   1. Piping to be removed: Remove portion of piping indicated to be removed. Cap or plug remaining piping with same or compatible piping material.
   2. Piping to be abandoned in Place: Drain piping and cap or plug piping to remain with same or compatible piping material. Refrigerant system to be evacuated per EPA requirements.
   3. Ducts to be removed: Remove portion of duct indicated to be removed. Cap remaining ducts with same or compatible ductwork material and seal cap air-tight.
   4. Ducts to be abandoned in Place: Cap ducts with same or compatible ductwork material.
   5. Equipment to be removed: Drain down and cap remaining services and remove equipment.
   6. Equipment to be removed and re-installed: Disconnect and cap services and remove, clean, and store equipment. When appropriate, re-install, reconnect, and make equipment operational.
      a. If existing equipment which is to be re-installed is damage, contact architect prior to removal. Contractor to take pictures of any damaged equipment prior to its removal and submit pictures to Architect.

b. Equipment damaged during removal, storage, or re-installation shall be the Contractor's responsibility and is to be replaced with new at no additional cost to the owner.

7. Equipment to be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.

C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, removed damaged or unserviceable portions and replace with new products of equal capacity and quality.

D. Non-Destructive Testing Of Existing Concrete Slabs:

1. When drilling or saw cutting existing reinforced concrete, use care and caution to avoid cutting or damaging the existing reinforcing bars, conduit, or tendons. Use a non-destructive method to locate metals poured into the slab prior to doing any work.

3.10 CARE AND CLEANING

A. Repair or replace broken, damaged, or otherwise defective parts, materials, and work. Leave entire work in condition satisfactory to Architect. At completion, carefully clean and adjust equipment, fixtures, and trim that are installed as part of this work. Leave systems and equipment in satisfactory operating condition.

B. Drain and flush piping to remove grease and foreign matter. Thoroughly clean out flush valves, traps, strainers, and pressure-reducing valves.

C. Keep the interior of all ductwork free of dirt, dust, loose insulation, and other foreign materials at all times.

D. Clean out and remove surplus materials and debris resulting from the work, including surplus excavated material.

3.11 OPERATION TEST

A. Test each piece of equipment to show that it will operate in accordance with indicated requirements.

3.12 CLEANING UP

A. Upon completion of Work remove materials, equipment, apparatus, tools, and the like, and leave premises clean, neat, and orderly.

END OF SECTION

SECTION 23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. his section includes total system balance, as defined by AABC, which constitutes the process of testing, adjusting, and balancing each system component so that the entire system produces the results for which it was designed. Testing results of total system balance shall be accepted by the Mechanical Engineer of Record and Owner

1.2 REFERENCES AND STANDARDS

A. Industry Standards: Comply with ASHRAE recommendations pertaining to measurements, instruments and testing, adjusting and balancing, except as otherwise indicated.

B. Reference Standards: Comply with the following Standards:
1. AABC - Associated Air Balance Council - A National Standard Volume 1.
2. ASHRAE - American Society of Heating, Refrigerating, and Air Conditioning Engineers, Inc.
3. AMCA Publication 203, "A Guide to the Measurement of Fan System Performance in the Field."
4. ASHRAE HVAC Applications Handbook, Chapters 34 and 42 as applicable.
5. ADC Test Code No. 1062, "Equipment Test Code."
6. ANSI A1.4, Specification for Sound Level Meters.
7. ANSI S1.11, Specification for Octave, Half-Octave, and Third-Octave Band Filter Sets.

1.3 WORK INCLUDED

A. Test and balance of new air distribution system, and associated equipment.

B. Setting and adjusting speed and volume of systems, recording data, conducting tests, preparing and submitting reports, and recommending modifications to work as required by contract documents.

C. Component types of testing, adjusting, and balancing specified in this section includes the following as applied to mechanical equipment:
1. Fans
2. Air handling units
3. Ductwork systems

D. TAB agency shall perform the following during installation phase of systems:

1. Study design specifications and engineering Drawings and prepare schedule to physically inspect mechanical equipment for air distribution systems to be tested and balanced.

    a. Contractor shall provide TAB agency with one copy of Contract Drawings and specifications, mechanical equipment submittals, and change orders necessary for proper balancing of air distribution systems.

2. TAB agency shall make periodic field inspections prior to closing in portions of systems to be balanced. Agency shall verify to its satisfaction that all work, fittings, dampers, balancing devices, etc. are properly fabricated and installed as shown or specified and that Agency will be able to properly balance system.

3. Prepare test and balancing schedule, test record forms, and necessary technical information about air distribution systems for installed heating-cooling equipment.
4. Recommend adjustments and/or corrections to mechanical equipment and air distribution systems that are necessary for proper balancing of systems.
    a. Corrections required based on TAB Contractor field inspections shall be made at no additional cost to the owner.

1.4 ACTION SUBMITTALS

A. Contractor data:

1. Provide TAB Contractor company information.

1.5 CLOSEOUT SUBMITTALS

A. Duct Leakage Reports:

1. TAB Contractor to provide TAB report for duct leakage tests.

B. Field Inspection Report:

1. TAB Contractor to provide written verification of field inspections.
    a. Include date of inspection and list of all items to be corrected prior to balance.

C. TAB Contractor to provide Test Reports as follows:
1. Submit data on printed report forms published by AABC.
2. Include identification and types of instruments used and their most recent calibration date with submission of final test report.
3. Reports to have computer generated drawings. Drawings to include: general building layout, ductwork and piping layout, HVAC equipment, and air inlet/outlet locations.
    a. Hand drawn/numbered drawings shall not be accepted.
4. Reports to be stamped and signed licensed TAB Contractor.
5. Submit three copies of complete test report prior to final acceptance of project.

D. Balance agency shall submit the results of tests in this SECTION for review by the Architect.

1.6 QUALITY ASSURANCE

A. Obtain the service of an independent test and balance (TAB) agency that specializes in, and whose business is limited to, testing, analysis, and balancing of air distribution systems.

B. Balance agency shall be a member of Associated Air Balance Council.

C. Work shall be done by qualified engineering technicians and trained personnel, using instruments certified accurate to limits used in standard practice for testing and balancing of air distribution for heating-cooling systems. Agency shall field test air flows in accordance with methods set up by Associated Air Balance Council, National Standard Volume 1, latest edition.

D. Approved Balancing Firms: Obtain service from one of the following firms (No others will be considered):
1. RS Analysis
2. Raglen System Balance
3. MESA 3

E. AABC Compliance: Comply with AABC's "National Standards," Volume 1, as applicable to mechanical air distribution systems and associated equipment and apparatus.

1.7 WARRANTY

A. Provide AABC National Performance Guaranty. Guaranty to include:
1. If the building owner or project engineer believes that the test and balance work was not performed properly, a complaint must be submitted, in writing, to AABC National Headquarters
2. Upon receipt of the complaint, AABC will notify the member agency in question and request a written response within 14 days. The AABC Board then reviews both the complaint and the response to determine if an investigation is necessary.
3. If it is determined that an investigation is necessary, the AABC Board will appoint a representative to conduct the investigation and determine a satisfactory resolution. If necessary, the Board may at its discretion provide supervisory personnel, at no cost to the building owner, to help complete the project

B. Guaranty to be valid for one year from the date of submission of a test and balance report.

PART 2 - PRODUCTS

2.1 PATCHING MATERIALS

A. Except as otherwise indicated, use same products as used by original installer for patching holes in insulation, ductwork and housings which have been cut or drilled for test purposes, including access for test instruments, attaching jigs, and similar purposes.

1. At tester's option, plastic plugs with retainers may be used to patch drilled holes in ductwork and housings.

2.2 TEST INSTRUMENTS

A. Utilize test instruments and equipment for test and balance work required, of type, precision, and capacity as recommended in the following test and balance standards:

1. Comply with AABC's Manual "AABC National Standards," Volume 1.

PART 3 - EXECUTION

3.1 BALANCING OF EXISTING AIR HANDLING SYSTEMS

A. Prior to any other Work being started on this project, test all existing air handling systems indicated on the drawings. Provide report indicating fan RPM and CFM, air velocity and air volume for all air inlets and outlets, and any recommended repairs or alterations to the existing system.

B. Prior to completion of the Work, rebalance all existing air inlets and outlets to conditions at start of Work.

3.2 BALANCING

A. Upon completion of air handling systems, balance agency shall complete tests, analysis, and balance of air handling systems for heating-cooling equipment.

B. This report shall include as minimum, but not be limited to, following design and actual information:

1. Air-Moving Equipment Data:
    a. Fan or unit number.
    b. Location.
    c. Area served.
    d. Manufacturer.
    e. Model number and serial number.
    f. Design and actual air-flow measurements:
        1) Total CFM.
        2) Return air CFM
        3) Outdoor air CFM
        4) Relief air CFM
        5) Total/external static pressure in w.g.
        6) Approximate suction static pressure in w.g.
        7) Approximate discharge static pressure in w.g.
        8) Fan rpm
2. Rated and Actual Motor Data:
    a. Horsepower / Break-horsepower
    b. Phase
    c. Voltage.
    d. Amperage.
3. Duct Velocity Traverse Data:
    a. Fan or unit number
    b. Design and actual CFM
    c. Duct division signs and area.
    d. Design and actual average velocity
    e. Duct static pressure average velocity
    f. Traverse location
    g. Traverse measurements in fpm (show grid pattern)
4. Individual Outlet and Inlet Data:
    a. Identify each outlet for location, area, and fan or unit system
    b. Outlet or inlet manufacturer and type
    c. Outlet or inlet size, effective area or A_k factor
    d. Design and actual velocity in feet per minute (FPM)
    e. Design and actual CFM

5. Other information required to establish completely balanced systems.

3.3 BALANCE REQUIREMENTS

A. Make allowance for air filter resistance at time of tests. Balance main air supplies at design air quantities and at an air resistance across filter bank midway between design specifications for clean and dirty filters.

B. Balance work within the following tolerances:
1. Supply, Return, Exhaust inlets/outlets/hoods:
    a. For rooms with less than 500 CFM, balance inlet and outlets within -10% / +10% of design CFM.
    b. For rooms with 500 CFM or greater, or rooms with multiple inlets or outlets in a single room, balance each inlet/outlet to within -10% / +10% of design CFM and overall room CFM within -5% / +5% of design.
2. Outside Air Inlets: balance within -0% / +10% of design CFM.

C. Rooms with positive or negative pressure requirements to maintain a minimum of 15% differential pressure regardless of the above tolerances.

D. Provide a room or building pressure test for each system. Maximum building pressure shall not exceed 0.03” inches of pressure.

E. Test and balance hoods to per AABC National Standards for Total System Balance.

F. HVAC systems shall be balanced at normal "minimum outside air" condition. Where such systems are required to deliver 100-percent return air or a variable amount of outside air, as indicated in specifications for automatic temperature control sequences, total CFM test shall be repeated for 100-percent return air and maximum outside air shall agree with conditions found under maximum outside air operation before system is considered to be in balance. Adjustments of proper dampers shall be made to achieve balance and marked so that control systems contractor may set damper motors accordingly.

G. After final air balance of systems, make adjustments to obtain uniform temperatures as required by actual occupancy.

H. Take static pressure readings with inclined manometer. Take air velocity readings with instruments of recent calibration. Take final velocity readings with Alnor Velometer, Anemotherm or Vane Type Anemometer, calibrated prior to test and recalibrated at end of test. Include certified correction curves for each calibration as part of record. Certify instruments accurate to standards currently used in common practice for system balance work. Use test cones for diffusers.

I. Run tests with supply, return, and exhaust systems operating and doors, windows, etc. closed or under regular traffic. If possible, make final readings with cooling coils under load to ensure that static pressures are at maximum.

J. Adjust deflection of supply outlets to ensure proper and uniform air distribution throughout area served by such outlets.

K. Work with temperature Control Subcontractor in adjustment of automatic dampers, valves, thermostats, etc. required to maintain proper temperatures in all portions of building.

L. Contractor responsible for installing heating, cooling, and ventilating equipment shall make any changes, additions, or modifications to dampers, fan drives and motor sheaves, motors, and other equipment necessary for proper air balance.

M. Balance of systems shall be reviewed by Architect and during this review Mechanical Contractor shall furnish men, materials, ladders, etc. to enable Architect to take all readings as he may direct. If errors are found, Balancing Agency shall readjust system to satisfaction of Architect.

END OF SECTION

SECTION 23 07 00

HVAC INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes insulation types and thickness for mechanical piping, ductwork, and equipment.

1.2 REFERENCES AND STANDARDS

A. California Code of Regulations – Title 24, Part 4.

B. California Building Code, California Electric code, NFPA, and UL

C. ASTM

D. ASHRAE

E. NAIMA

F. NFPA

G. SMACNA – Sheet Metal and Air Conditioning Contractor's National Association, Inc.

H. Underwriter's Laboratories

I. GREENGUARD

1.3 ACTION SUBMITTALS

A. Submit complete data of materials proposed.
   1. Indicate individual services for each system.
   2. Indicate proposed insulation thickness for each system
   3. Indicate proposed R-valves, densities, etc. for each product.

B. Provide Manufacturer's installation instructions for each product.

1.4 CLOSEOUT SUBMITTALS

A. Warranty: Submit executed warranty.

B. Certification: Submit Contractors Certification

1.5 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firm specializing in manufacturing of mechanical insulation products applicable to project whose products has been in satisfactory use in similar services for a minimum of 3 years.

B. Installer's Qualifications: Company specializing in piping insulation application with a minimum of 3 years experience.

C. Flame/Smoke Ratings: Insulation materials, including but not limited to insulation, jackets, coverings, sealers, adhesives, etc., to have flame-spread rating of 25 or less and smoke-developed index of 50 or less when tested in accordance with ASTM E84.

D. Insulating products to be installed in accordance with manufacturer's written instructions and in accordance with recognized industry practices.

1.6 WARRANTY

A. Manufacturer: In addition to the Contractor's Standard Guarantee, furnish Owner with manufacturer's warranty for insulation against defects in materials and workmanship. Warranty shall cover replacement of insulation plus labor to install

PART 2 - PRODUCTS

2.1 GENERAL

A. For purposes of this specification, fittings, joints, strainers, flexible piping, valves, etc. shall be considered as piping and shall be insulated with same material and thickness as adjoining piping unless noted otherwise.

B. Acceptable Manufactures
1. Knauf
2. Johns Manville
3. Certainteed
4. Owens-Corning

2.2 MATERIALS

A. Flexible Closed Cell Insulation:
1. Flexible elastomeric thermal closed-cell structure insulation.
2. Maximum K-Value at 75oF = 0.27 Btu-in/hr-FT2-oF.
3. Joints to be sealed with Armstrong 520 Adhesive
4. Insulation to be Armstrong Armaflex 22 or equal

B. Fiberglass Ductwork Insulation:
1. Duct wrap to be blanket-type thermal and acoustical insulation made from glass fibers, bonded with white formaldehyde-free resin, compliant with ASTM C1290.
2. Labeled K-Value to equal 0.29 Btu-in/hr-FT2-oF.
3. Compressed K-Value to equal 0.27 Btu-in/hr-FT2-oF.
4. Insulation to be Johns Manville Microlite Formaldehyde-Free Faced Duct Wrap or equal or equal.

2.3 DUCTWORK INSULATION

A. Wrap all concealed unlined supply and return ductwork, with duct wrap insulation as follows:
1. Where installed over unconditioned spaces, wrap ductwork with type 75, 3" thick duct wrap. Minimum installed R-value to equal 8.3 (hr-ft$^{2-0}$F)/BTU.
2. Where installed over or within conditioned concealed ceilings, wrap ductwork with type 75, 2" thick duct wrap. Minimum installed R-value to equal 5.6 (hr-ft$^{2-0}$F)/BTU.
3. Duct wrap to have FSK vapor barrier facing.

4. Insulation to be Johns Manville Microlite Formaldehyde-Free Faced Duct Wrap or equal or equal.

2.4 DUCTWORK EXPOSED TO WEATHER

A. Wrap all unlined supply and return ductwork exposed to weather with flexible, closed-cell elastomeric insulation in tubular or sheet form. Armstrong AP Armaflex, or equal.
1. Provide 2-layers of ¾" thick material.

B. Cover insulation with 0.024" thick aluminum jacket of ducting with ½" wide stainless-steel bands at 12" on center.

PART 3 - EXECUTION

3.1 GENERAL

A. Insulation to be stored on jobsite in clean / dry location. Any insulation exposed to water must be discarded immediately and removed from jobsite.

3.2 INSTALLATION OF CONCEALED DUCTWORK INSULATION

A. Install ductwork insulation products in accordance with manufacturer's written instructions and in accordance with recognized industry practices.

B. Prior to applying duct wrap, sheet metal duct shall be clean, dry and tightly sealed at all joints and seams.

C. Wrap insulation around duct with facing to the outside so the 2" flap completely overlaps facing and insulation at the other end of stretch out. Insulation shall be snugly butted. Follow stretch-out dimension recommendations to prevent over-compressing insulation.

D. Secure seams with outward clinching staples on 6" centers.

E. Neatly cut insulation at all volume control dampers.

F. Tape all seams and loose edges with scrim backed foil tape.

G. For ducts which are greater than 24" wide, provide mechanical fasteners at bottom of duct spaced at a maximum of 18" on center.

a. Fasteners to be weld pins or clinch pins. Adhesive type pins shall not be used.

3.3 INSTALLATION OF DUCTWORK INSULATION WHERE EXPOSED TO WEATHER

A. Install ductwork insulation products in accordance with manufacturer's written instructions and in accordance with recognized industry practices.

B. Adhere duct insulation to ductwork with Armstrong 520 Adhesive per manufacturer's recommendations.

C. Armaflex Sheet Insulation shall be adhered directly to clean, oil free surfaces with full coverage of 520 adhesive.

D. The duct insulation shall be constructed for the bottom up, with the top insulation sized to extend over the side insulation. This will for a water shed.

E. Butt-edge seams shall be adhered using 520 Adhesive by the compression fit method to allow for expansion/contraction. Leave a ½" wide uncoated border at the but-edge seams on the duct surface. Overlap the insulation ¼" at the but-edges and compress the edges into place. Apply 520 Adhesive to the butt-edges of the insulation.

F. Standing metal duct seams shall be insulated with the same insulation thickness as installed on the duct surface. Seams may be covered using strips of Armaflex Sheet Insulation or half sections of tubular pipe insulation with miter-cut ends. Standing seams shall be adhered using 520 adhesive.

G. Seams shall be staggered when applying multiple layers of insulation.

H. Duct Insulation Finish:
1. Proved 0.024" thick aluminum jacket over ducting with ½" wide stainless steel bands at 12" on center.
2. Longitudinal seams shall be on the bottom sides of duct only.
3. Seal all seams with duct sealant approved for outdoor use and approved for aluminum.
4. System shall be water-tight.

3.4 INSULATION REPAIR

A. Repair damaged sections of existing and/or new mechanical insulation where damaged occurred during this construction period. Use insulation of same thickness as existing insulation. Install new jacket lapping and seal over existing.

3.5 CARE AND CLEANING

A. Repair and/or replace broken, damaged and or otherwise defective insulation. Work to be completed to the satisfaction of the Architect. At completion of work, clean materials installed as part of this work and leave systems and equipment in satisfactory operating condition.

B. Upon completion of work remove materials, equipment, tools from premises. Leave project area neat, clean and orderly.

END OF SECTION

SECTION 23 31 00 HVAC DUCTWORK

PART 1 GENERAL

1.1 SUMMARY

A. This section includes sheet metal materials, fasteners, supports, and duct construction classifications for:

1. Supply, return, and exhaust systems.
2. Kitchen grease hood exhaust systems

1.2 REFERENCES AND STANDARDS

A. AABC – Associated Air Balance Council Manual: National Standards for Total System Balance

B. ANSI – American National Standard Institute

C. ASHRAE Standards: Comply with American Society of Air Conditioning, Refrigeration, and Air Conditioning Engineers Handbook.

D. NFPA – Compliance. Comply with ANSI/NFPA 90A, *Standard for the Installation of Air Conditioning and Ventilating Systems,* and ANSI/NFPA 90B *Standard for the Installation of Warm Air Heating and Air Conditioning Systems,* latest accepted edition.

E. CBC – California Building Code

F. CFC – California Fire Code

G. CMC – California Mechanical Code

H. Local Codes

I. SMACNA – Sheet Metal and Air Conditioning Contractor's National Association, Inc.
1. Duct Construction Standards
2. Fire damper and heat stop guide.
3. HVAC Systems testing adjusting and balancing.
4. Guidelines for Seismic Restraints of Mechanical Systems and Plumbing Pipe systems.

J. UL – Underwriters' Laboratory Standards for Safety: referred to as UL 181, UL 555, etc.

1.3 ACTION SUBMITTALS

A. Submit typical shop standards and/or SMACNA details for each class of duct specified. Indicate the following for each standard:
1. Gauge sizes and joint details
2. Pressure Class
3. Seam Construction
4. System type (e.g. supply air, return, air, etc.)

B. Shop Drawings: Submit shop drawings for ductwork including elevations and showing all terminal units and air devices connections. Drawings shall be a minimum scale of 1/4”=1’-0” and be coordinated with all other trades.

1.4 CLOSEOUT SUBMITTALS

A. Record Drawings: At project closet-out, submit Record Drawings of installed ductwork, duct accessories, and inlets / outlets in accordance with the requirements of Division 1.

1.5 QUALITY ASSURANCES

A. Contractor to comply with all the above referenced standards.

B. The above referenced standards may be superseded by notes and details on Drawings and in specification.

C. Where two or more references are in conflict, the most stringent, as determined by the Architect, shall take precedence.

D. Flame-Smoke Ratings: All products used in ductwork system to comply with flame-spread index of 25 or less, fuel-contributed index of 50 or less, and smoke-developed index of 50 or less.

E. Installer: A firm with at least three years of successful installation experience on projects similar to that required for this work.

F. Fabricate all ductwork with sheet metal. Fiberglass ductwork will not be accepted.

G. Duct liner to be certified by Greenguard: Greenguard Environmental Institute, independent testing of products for emissions of respirable particles and Volatile Organic Compounds (VOCs), including formaldehyde and other specific product-related pollutants. Provides independent, third-party certification of IAQ performance. Certification is based upon criteria used by EPA, OSHA and WHO

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Manufactured Round and Oval Ductwork:
1. United McGill Sheet Metal
2. Omni Duct
3. Or equal

B. Duct Connection Systems:
1. Ductmate Industries, Inc.
2. Travers Duct Connection (TDC)
3. Or equal

C. Flexible Ductwork:
1. Flexmaster
2. Thermaflex
3. Or equal

D. Duct Sealants:
   1. United McGill Corp.
   2. Ductmate Proseal
   3. Or Equal

E. Duct Liner:
   1. Johns Manville - Linacoustic
   2. Owens Corning Fiberglas Corporation – Aeroflex Plus
   3. Certainteed Corporation - Toughgard

F. Duct adhesives:
   1. Fosters Adhesive – 85-462
   2. Swifts Adhesive – 7336
   3. Or Equal

2.2 DUCT CONSTRUCTION CLASSIFICATIONS

A. General: Construct and seal ductwork in accordance with SMACNA pressure classifications and seal classes listed for ductwork systems involved.
   1. Minimum duct gauge for concealed ductwork to be 26 gauge.
   2. Provide 20 gauge minimum for ductwork exposed within occupied areas.

B. Rectangular or Round Ductwork:
   1. +2” W.G. Class ductwork:
      a. Supply air Ductwork downstream of terminal boxes.
      b. Constant volume supply air ductwork in systems without terminal boxes
   2. -2” W.G. Class ductwork:
      a. General exhaust ductwork.
      b. Return Air Ductwork
   3. +4” W.G. Class ductwork:
      a. Supply air ductwork between source equipment and terminal box
   4. -6” W.G. Class ductwork:
      a. Laboratory exhaust ductwork

2.3 GENERAL

A. All duct sizes listed on drawings are external sizes.

B. Galvanized Sheet Steel to be lock-forming quality, ASTM A924 and ASTM. Coating to be Designation G90. Provide mill phosphatized finish for exposed surfaces of ducts exposed to view.
   1. Provide mill certification for galvanized material at request of IOR, Owner, Architect, or engineer.

C. Tapers to be as follows:
   1. Limit diverging tapers to a maximum of 30 degrees.
   2. Limit expanding tapers to a maximum of 20 degrees.

D. Run ductwork parallel to adjacent walls unless shown otherwise on plans.

E. Ductwork exposed to weather to be cross-broken to shed water.
   1. At contractor’s option, ductwork can be manufactured with a sloped top, with a minimum angle of 5 degrees.

F. Joint Sealing:
   1. Seal all concealed ductwork within the building, all ductwork within mechanical rooms, and all ductwork exposed to weather air tight. Seal all standing seams, transverse joints, manufactured joints and seams with duct sealant. Duct Sealant to be rated for indoor and outdoor use.
   2. Seal punched holes, corner cracks, and all sheet metal screws.
   3. After testing, reseal joints found to be leaking.
   4. At ductmate joints, in addition to ductmate gaskets, seal all bolted corners to eliminate air leakage at corners.
   5. Pressure sensitive tapes shall not be considered.

G. Provide sheet metal angle frame at all duct penetrations to wall, floor, roof, or ceiling.

   1. Ducts to penetrate perpendicular to walls, ceilings and floors.

H. Internal Duct Liner:
   1. Provide internal duct liner as follows:
      a. All Transfer air ducts.
      b. Supply air ductwork downstream of VAV Boxes – minimum length to be 8'-0" unless noted or shown otherwise.
      c. All supply and return air ductwork exposed to weather.
      d. Concealed supply air ductwork downstream of fan, fan casing, or unit casing – minimum length to be 12'-0".
      e. Concealed return air ductwork upstream of fan, fan casing, or unit casing – minimum length to be 12'-0".
      f. Elsewhere as indicated on the drawings.
   2. Internal duct liner within building installed over conditioned spaces to be as follows:
      a. 1" thick, 1.5-pound density (minimum) with matt facing.
      b. Thermal Performance - C Value – 0.24 BTU / (h * FT^2 * ^oF) – minimum
      c. Thermal Performance - R Value – 4.2 (h * FT^2 * ^oF) / BTU – minimum
      d. Minimum Acoustical Performance shall be as follows:
         1) At 125 Hz Octave Band Frequencies, sound absorption of 0.10.
         2) At 250 Hz Octave Band Frequencies, sound absorption of 0.32.
         3) At 500 Hz Octave Band Frequencies, sound absorption of 0.66.
         4) At 1,000 Hz Octave Band Frequencies, sound absorption of 0.84.
         5) At 2,000Hz Octave Band Frequencies, sound absorption of 0.91.
         6) At 4,000 Hz Octave Band Frequencies, sound absorption of 0.91.
         7) NRC sound absorption to be 0.70.
      e. Liner to be CertainTeed, ToughGard R Duct Liner, Type 150, or equal.
   3. Internal duct liner exposed to weather or installed over un-conditioned space to be as follows:
      a. 2" thick, 1.5-pound density (minimum) with matt facing.
      b. Thermal Performance - C Value – 0.14 BTU / (h * FT^2 * ^oF) – minimum
      c. Thermal Performance - R Value – 8.3 (h * FT^2 * ^oF) / BTU – minimum
      d. Minimum Acoustical Performance shall be as follows:
         1) At 125 Hz Octave Band Frequencies, sound absorption of 0.24.
         2) At 250 Hz Octave Band Frequencies, sound absorption of 0.79.
         3) At 500 Hz Octave Band Frequencies, sound absorption of .09.
         4) At 1,000 Hz Octave Band Frequencies, sound absorption of 1.05.
         5) At 2,000Hz Octave Band Frequencies, sound absorption of 1.02.
         6) At 4,000 Hz Octave Band Frequencies, sound absorption of 1.01.
         7) NRC sound absorption to be 1.00.
      e. Liner to be CertainTeed, ToughGard R Duct Liner, Type 150, or equal.
   4. Cement duct liner in place with nonflammable, non-hardening duct adhesive. Seal up all raw edges of insulation inside ductwork with adhesive.

5. Provide sheet metal weld pin fasteners and washers on all duct work on 12-inch intervals with the first row within 3 inches of the leading edge of each piece of insulation and 4 inches from corners. No substitutions on fastening method will be allowed.
6. Duct liner and adhesive shall not exceed flame-spread rating of 25 and smoke-developed rating of 50, all in conformance with NFPA 90A.
7. Provide metal nosing at all locations where liner is preceded by unlined metal.

I. Ductwork Support: Provide hot-dipped galvanized steel fasteners, anchors, rods, straps, trim, and angles for support of ductwork, unless noted otherwise.

J. Miscellaneous Ductwork Materials:

1. Duct Joints: Install duct sealers, pop rivets, or sheet metal screws at each fittings and joint. Use a minimum of #10 galvanized sheet metal screws.

2.4 2” W.G. RECTANGULAR DUCT CONSTRUCTION/FABRICATION

A. Shop fabricate ductwork of gauges and reinforcement complying with the more stringent of the following standards, except as noted herein.

B. California Mechanical Code (CMC).

C. SMACNA HVAC Duct Construction Standards, latest Edition.

D. Fabricate Ducts with minimum gauges and joint reinforcement as follows:
1. Ducts up through 12” to be 26 gauge minimum / no joint reinforcement required.
2. Ducts 13” - 18” to be 24 gauge minimum / no joint reinforcement required.
3. Ducts 19” – 30” to be 24 gauge minimum with C/4 joint reinforcement per CMC.
4. Ducts 31” – 42” to be 22 gauge minimum with E/4 joint reinforcement per CMC.
5. Ducts 43” - 54” to be 22 gauge minimum with F/4 joint reinforcement per CMC.
6. Ducts 55” – 60” to be 20 gauge minimum with G/4 joint reinforcement per CMC.
7. Ducts 61” – 84” to be 20 gauge minimum with I/4 joint reinforcement per CMC.
8. Ducts 85” – 96” to be 20 gauge minimum with J/4 joint reinforcement per CMC.
9. Ducts over 96” to be 18 gauge minimum with K/4 joint reinforcement per CMC.

E. Fabricate duct fittings to match adjoining ducts and to comply with duct requirements as applicable to fittings. Fabricate elbows with center-line radius equal to 1.5 times associated duct width. Fabricate to include single thickness turning vane in elbows where space does not permit the above radius or where square elbows are shown.

F. Fabricate round supply connections at rectangular, plenum type fittings using spin-in type fittings, complete with extractor and volume control damper.

G. Provide drive slip or equivalent flat seams for ducts exposed in the condition space or where necessary due to space limitations. On ducts with flat seams, provide standard reinforcing on inside of duct. Duct connection to outlet on exposed duct shall be full size of outer perimeter of outlet flange.

2.5 4” W.G. RECTANGULAR DUCT CONSTRUCTION/FABRICATION

A. Shop fabricate ductwork of gauges and reinforcement complying with the more stringent of the following standards, except as noted herein.

B. California Mechanical Code (CMC)

C. SMACNA HVAC Duct Construction Standards, latest Edition.

D. Fabricate duct fittings to match adjoining ducts and to comply with duct requirements as applicable to fittings. Fabricate elbows with center-line radius equal to 1.5 times associated duct width. Fabricate to include single thickness turning vane in elbows where space does not permit the above radius or where square elbows are shown.

E. Fabricate round supply connections at rectangular, plenum type fittings using spin-in type fittings, complete with extractor and volume control damper.

F. Provide drive slip or equivalent flat seams for ducts exposed in the condition space or where necessary due to space limitations. On ducts with flat seams, provide standard reinforcing on inside of duct. Duct connection to outlet on exposed duct shall be full size of outer perimeter of outlet flange.

2.6 ROUND/OVAL DUCT CONSTRUCTION

A. Spiral lock seam prefabricated factory-built round and oval duct and fittings shall be used wherever possible. Shop fabricated ducts shall be used only where rectangular shaped ducts are shown on plans or where transitions and special fittings cannot be prefabricated by factory. Provide couplings to join each length of duct.

B. Fabricate duct fittings to match adjoining ducts and comply with duct requirements as applicable to fittings. Except as noted otherwise, fabricate elbows as follows:
   1. Center-line radius to be equal to 1.5 times associated duct width.
   2. Provide two-piece, die stamped, 45 degree to 90 degree elbows for sizes up to 12 inches.
   3. Provide 5 piece 90 degree elbows for sizes 12” and above, conical tees, and conical laterals.
   4. All reducers to be located after tap. Reducers shall be long-taper style. Reducing tees shall not be allowed.

C. Round Ductwork: Construct of galvanized sheet metal complying with ANSI/ASTM A527 by the following methods and in minimum gauges listed.
   1. Ducts 4” - 14” diameter to be 26-gauge minimum spiral lock-seam.
   2. Ducts 15” - 23” diameter to be 24-gauge minimum spiral lock-seam.
   3. Ducts 24” - 36” diameter to be 22-gauge minimum spiral lock-seam.
   4. Ducts 37” - 50” diameter to be 20-gauge minimum spiral lock-seam.
   5. Ducts 51” - 60” diameter to be 18-gauge minimum spiral lock-seam.
   6. Ducts over 60” diameter to be 14-gauge minimum spiral lock-seam.

D. Fittings and Couplings:
   1. Construct of same minimum gauges listed for ductwork.
   2. Provide continuous welds along seams.
      a. At Contractors option, provide spot welded fittings sealed inside and out.

2.7 KITCHEN HOOD EXHAUST DUCTWORK

A. Fabricate kitchen exhaust ducts and supports used for smoke and vapor removal from cooking equipment as follows:

   1. Concealed locations – provide 16 gauge minimum galvanized steel

   2. Exposed locations – provide 18 gauge minimum stainless steel with Number 4 finish and welded joints.

B. All ductwork to be of welded construction in accordance with Section 507 of California Mechanical Code. For duct construction, comply with SMACNA *HVAC Duct Construction Standards* and ANSI/NFPA 96 *Vapor Removal from Commercial Cooking Equipment*.

C. Polish exposed stainless steel ductwork to match adjacent material at all weld locations.

D. Coat galvanized steel with Regalv, or equal, galvanizing repair at all weld locations.

E. Provide cleanouts in ductwork at all changes in direction as required by code.

2.8 FLEXIBLE DUCTWORK

A. Flexible ducts may be used in concealed areas where detailed and as specified.

B. Flexible ducts from rigid run-outs to registers shall be Flexmaster USA, Inc., Type 1M Acoustical Insulated flex duct, or equal.

C. Flexible ducts shall be as follows:
1. Minimum Operating Pressure:
   a. Positive = 10” w.g. for all sizes
   b. Negative = 5” w.g. for sizes thru 16” and 1” w.g. for sizes 18 & 20”
2. Rated Velocity = 5,500 FPM
3. Minimum Burst Pressure = 2 1/2 times working pressure
4. Minimum R Value = 6.0 (h * FT^2 * ^oF) / BTU
5. Duct to be ETL Class 1 Air duct.
6. Flame spread to be less than 25 and smoke developed less than 50.
7. Flex duct to consist of an exterior reinforced metalized vapor barrier, fiberglass insulation, mechanical lock wire helix, and polyethylene inner film. Inner liner to be mechanically locked without adhesives.
8. Minimum Acoustical Performance shall be as follows:
   a. For a 12” diameter straight duct – 3 feet in length:
      1) At 125 Hz Octave Band Frequencies, sound absorption of 3.5.
      2) At 250 Hz Octave Band Frequencies, sound absorption of 5.6.
      3) At 500 Hz Octave Band Frequencies, sound absorption of 5.0.
      4) At 1,000 Hz Octave Band Frequencies, sound absorption of 5.8.
      5) At 2,000Hz Octave Band Frequencies, sound absorption of 5.2.
      6) At 4,000 Hz Octave Band Frequencies, sound absorption of 4.3.
   b. For a 12” diameter straight duct – 6 feet in length:
      1) At 125 Hz Octave Band Frequencies, sound absorption of 8.
      2) At 250 Hz Octave Band Frequencies, sound absorption of 17.
      3) At 500 Hz Octave Band Frequencies, sound absorption of 14.
      4) At 1,000 Hz Octave Band Frequencies, sound absorption of 18.
      5) At 2,000Hz Octave Band Frequencies, sound absorption of 14.
      6) At 4,000 Hz Octave Band Frequencies, sound absorption of 11.
9. Provide acoustical submittal data for 12” diameter ducts within submittal package.

D. A maximum length of five feet to be installed at each air terminal. Flexible duct shall have no bends greater than 45 degrees. Specifications and any applicable drawings or details will be strictly enforced.

E. Make connections to rigid ductwork with Panduit style draw band. Provide one draw-band at inner liner and a second draw band over the outer vapor barrier material.

PART 3 EXECUTION

3.1 INSTALLATION OF DUCTWORK

A. Assemble and install ductwork in accordance with recognized industry practices which will achieve airtight (leakage class 12 for 2-inch pressure class and leakage class 3 for 4-inch pressure class) and noiseless (no objectionable noise) systems capable of performing each indicated service. Install each run with minimum of joints. Align ductwork accurately at connections within 1/8- inch misalignment tolerance and with internal surfaces smooth. Support ducts rigidly with suitable ties, braces, hangers, and anchors of type which will hold ducts true to shape and to prevent buckling.

B. Seal ductwork after installation to seal class required and method prescribed in SMACNA "HVAC Leakage Test Manual," latest edition.

C. Paint inside of duct visible through grille dull black.

D. Duct Supports:
   1. Support ductwork in manner complying with SMACNA "HVAC Duct Construction Standards," latest edition, hangers and supports sections. Where special hanging of ductwork is detailed or shown on Drawings, Drawings shall be followed.
      a. Except where modified in individual paragraphs in this section or detailed on drawings, provide hanger support with minimum 18 gauge straps, 1 inch wide. Fold duct strap under bottom of duct.
      b. Install duct supports to rectangular ducts with sheet metal screws. Provide one screw through strap at top of duct and one screw through strap at bottom of duct.
   2. Upper Connection of support to wood structure shall be with wood screws or lag screws in shear fastened in the upper one half of the wood structural member. Fasteners shall conform to the following schedule:
      a. For duct sizes with P/2 < 30”, use #10 x 1/2” wood screw for fastener.
      b. For duct sizes 31” ≤ P/2 ≤ 72”, use 1/4“x 1-1/2” lag screw for fastener.
      c. For duct sizes P/2 ≥ 73”, use 3/8“x 1-1/2” lag screw for fastener.
   3. Upper connection in tension shall not be used unless absolutely necessary. Where deemed necessary, the Contractor shall submit calculations to show the size fastener and penetration required to support loads in tension from wood in accordance with the following schedule:
      a. For duct sizes with P/2 < 30”, 260 pounds maximum load per hanger.
      b. For duct sizes 31” ≤ P/2 ≤ 72”, 320 pounds maximum per hanger.
      c. For duct sizes 73” ≤ P/2 ≤ 96”, 460 pounds maximum per hanger.
      d. For duct sizes P/2 > 96”, not allowed

E. Where ducts pass through interior partitions and exterior walls, conceal space between construction opening and duct or duct-plus- insulation with sheet metal flanges of same gauge as duct. Overlap opening on four sides by at least 1-1/2 inches.

F. Where ductwork is exposed, Contractor to paint ductwork, supports, and air inlets and outlets to match adjacent architectural surfaces, or as directed by Architect.

3.2 INSTALLATION OF FLEXIBLE DUCTWORK

A. Provide flexible ducts with supports at or near mid-length with 2-inch wide, 26-gauge steel hanger collar attached to the structure with an approved duct hanger. Installation shall minimize sharp radius turns or offsets.

B. Make connections to rigid ductwork with Panduit style draw band. Provide one draw-band at inner liner and a second draw band over the outer vapor barrier material.

C. Bends in flexible ductwork shall be kept to a minimum. When required, the minimum bend radius shall be 1.5 times the duct diameter. Duct offsets to be limited to 45 degree turns.

3.3 INSTALLATION OF KITCHEN HOOD EXHAUST DUCTS

A. Fabricate joints and seams with continuous welds for water-tight construction. Provide for thermal expansion of ductwork through 2,000 degrees F temperature range. Install without dips or traps which may collect residues. Provide access openings at each change in direction located on sides of duct 1-1/2 inches minimum from bottom and fitted with grease- tight covers of same material as duct.

3.4 CLEANING AND PROTECTION

A. Ductwork being stored on site to be covered and protected from elements. Internally lined ductwork to be stored on jobsite in clean / dry location. Any insulation exposed to water must be discarded immediately and removed from jobsite.

B. Clean ductwork internally, unit by unit as it is installed, of dust, dirt, and debris.

C. Clean external surfaces of dirt and foreign substances which might cause corrosive deterioration of metal or where ductwork is to be painted.

D. Strip protective paper from stainless ductwork surfaces, and repair finish wherever it has been damaged.

E. Temporary Closure: At ends of ducts which are not connected to equipment or air distribution devices at time of ductwork installation, provide temporary closure of polyethylene film or other covering which will prevent entrance of dust and debris until time connections are to be completed.

F. If HVAC System is operated prior to the completion of construction, Contractor to provide temporary filters at all return air and exhaust air grilles. Filters to be 2” thick, MERV 8 filters. Contractor to secure filters in place with tape or wiring. Filters to completely cover grille opening.

3.5 OPERATION TEST

A. Test each piece of equipment to show that it will operate in accordance with indicated requirements.

3.6 CLEANING UP

A. Upon completion of Work remove materials, equipment, apparatus, and tools, and leave premises clean, neat, and orderly.

END OF SECTION

SECTION 23 33 00 AIR DUCT ACCESSORIES

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes requirements for the following duct accessories:

1. Volume Control Dampers
2. Turning Vanes
3. Duct Access Doors

1.2 REFERENCES AND STANDARDS

A. SMACNA Compliance: Comply with applicable portions of Sheet Metal and Air Conditioning Contractor's National Association (SMACNA) HVAC Duct Construction Standards (Metal and Flexible), latest edition, for all work in this section.

B. ASHRAE Standards: Comply with American Society of Heating, Refrigerating, and Air Conditioning Engineers, Inc. (ASHRAE) recommendations, latest edition, for all work in this section.

C. NFPA Compliance: Comply with ANSI/NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems," and ANSI/NFPA 90B, "Standard for the Installation of Warm Air Heating and Air Conditioning Systems."

D. Compliance: Construct, test, install and label fire dampers and fire doors in accordance with Underwriters Laboratories (U.L.) Standard 555, "Fire Dampers and Ceiling Dampers."

E. The Diffuser, Register, Grille manufacturer shall provide published performance data for all air inlets/outlets. Performance tests shall be tested in accordance with ANSI/ASHRAE Standard 70-1991.

1.3 ACTION SUBMITTALS

A. Product data: submit complete data of materials proposed including:

1. Manufacturer and model number
2. Clearly indicate all options, trim, and accessories.
3. Cross reference manufacturer’s cut sheet to fixture callout ID on submittal sheet.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: submit complete O&M data including:

1. Maintenance data and parts lists for each type of fixture.
2. Provide "trouble- shooting" maintenance guide
3. Include this data within maintenance manual

1.5 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firm specializing in manufacturing of mechanical insulation products applicable to project whose products has been in satisfactory use in similar services for a minimum of 3 years.

B. Installer's Qualifications: Company specializing in piping insulation application with a minimum of 3 years experience.

PART 2 PRODUCTS

2.1 VOLUME CONTROL DAMPERS

A. General:

1. Provide dampers throughout the duct system where indicated on the drawings to facilitate complete balancing.
2. Provide any dampers not shown on drawings but requested by Test and Balance Contractor add no additional charge to the owner.
3. Locate volume control dampers within 18" of the branch duct take off. Dampers shall not be located at or near the end of the duct branch run.
4. Provide for each damper quadrant lock device on one end of shaft and end-bearing plate on other end.
    a. Quadrant lock device to be Ventlock 641, or equal.
    b. End bearing plate to be Ventlok 607, or equal.
5. Provide extended quadrant locks and extended bearing plates for externally insulated ductwork.

B. Identification:

1. Provide 1" wide identification nylon ribbon for each damper with color as follows:
    a. Supply air – Red
    b. Return Air – Blue
    c. Exhaust Air – Yellow
2. Tie identification ribbon through hole at each end of damper quadrant. Ribbons to have a minimum of 12" of ribbon hanging free. Install ribbon at the time each damper is installed.

C. Inaccessible Ceilings:

1. Where volume control dampers are located in inaccessible ceilings, or where noted otherwise, furnish cable operated remote controlled volume damper. Reference architectural drawings for locations of gypsum board ceilings.
2. Dampers are to be adjustable with standard tools at the ceiling line through a self supporting 2" round Ceiling Cup.
3. Powder painted steel box cover plate shall be fastened with standard countersunk screws providing a secure, unobtrusive appearance flush with the ceiling surface.

4. Galvanized steel, square-shafted damper shall be worm gear actuated via a brass plated rotary cable meeting Mil-spec I-45208 and supported at the damper end by a self-lubricating bearing integral to the worm gear assembly.
5. Additional cable retainer supports shall be factory furnished as required by the cable length. Rotary cable shall have a minimum torque service factor of 200% when installed in accordance with manufacturer furnished instructions.
6. Ceiling Cup, rotary cable, and worm gear shall be furnished as one piece for installation with no linkage adjustment required or small parts to get lost on site. Positive, direct, two-way damper control shall be provided with no sleeves, springs, or screw adjustments.
7. Cable operated dampers shall be Metropolitan Air Technology, or equal Model #RT-250 with model RT-CCR ceiling cup.

D. Rectangular Dampers with either height or width less than 16 inches:
1. Butterfly type damper with 18-gauge steel or duct casing angle reinforced as required.
2. Provide single thickness 16-gauge minimum, galvanized steel blades, welded or permanently bolted to continuous solid 3/8” minimum square shaft. Permanently mark end shaft to indicate blade position and fit with a locking quadrant mounted on outside of frame. Bearings shall be pressed into frame and designed for dynamic requirements

E. Rectangular Dampers with either height or width greater than or equal to 16 inches:
1. Frame with 5” by 1”, 16-gauge galvanized steel channel. Blades to be 8” maximum width, extruded aluminum, airfoil blade, opposed blade, having shafts/bearings designed to meet dynamic requirements, positively locked to shafts.
2. Control shafts to be 3/8” square, plated steel, permanently marked to indicate blade position and fitted with locking quadrant mounted on outside of frame.
3. Provide single thickness 16-gauge minimum, galvanized steel blades, welded or permanently bolted to ½” minimum diameter through shaft. Permanently mark end shaft to indicate blade position and fit with a locking quadrant mounted on outside of frame. Bearings shall be pressed into frame and designed for dynamic requirements

F. Round Dampers:
1. Frame shall be 20 gauge galvanized steel or duct casing reinforced.
2. Provide single thickness 18 gauge galvanized steel blade, welded or permanently bolted to 3/8” minimum diameter through shaft. Permanently mark end shaft to indicate blade position and fit with a locking quadrant mounted on outside of frame. Damper to be provided with end bearing plates.

G. Backdraft Dampers:
1. Provide dampers with parallel blades, constructed of 16-ga. aluminum; provide 1/2-inch diameter ball bearings, 1/2-inch diameter steel axles spaced on 9-inch centers. Construct frame of 2 inches by 1/2-inch by 1/8-inch steel channel for face areas 25 sq. ft. and under; 4 inches by 1-1/4 inches by 16-ga. channel for face areas over 25 sq. ft. Provide galvanized steel finish on frame with aluminum touch-up.

H. Acceptable Manufacturers:
1. Air Balance Inc.
2. Ruskin Manufacturing Company
3. Greenheck

2.2 TURNING VANES

A. Fabricated Turning Vanes: Provide fabricated turning vanes and vane runners, constructed in accordance with SMACNA "HVAC Duct Construction Standards," latest edition.

B. Acceptable Manufacturers:
   1. Duro-Dyne Corporation
   2. Ductmate
   3. Or equal

2.3 DUCT ACCESS DOORS

A. Acceptable Manufacturers:
   1. Nailor
   2. Ductmate
   3. Vent Fabrics

B. General:
   1. Provide airtight access doors in ducts and plenums for cleaning and repairs for volume and fire dampers for control devices within such ductwork and where shown on the Drawings.
   2. Access doors into 2” w.g. pressure class ductwork shall be made of No. 24 gauge galvanized steel minimum, reinforced with angle iron stiffeners. Doors shall be hinged and provided with latches and gasket around entire edge to provide an airtight fit. Reinforce openings for doors with structural steel.
   3. Access doors into ductwork greater than 2” w.g. pressure class shall be side-mounted equal to Nailor Series 0800 for rectangular ducts and Nailor Series 0895 for round ducts. Access doors shall be tested at 8-inch static pressure. Access door height shall not be less than 75% of duct height.
   4. Access doors shall be sandwich-type construction, consisting of three layers of .030” galvanized steel. The inside door shall combine two layers of metal spot welded together at rim and encapsulating high density fiberglass insulation –UL classified FHC 25/50. Doors shall have a minimum R-value of 4.0 total. Access doors shall be pressure rated for 20” WG positive and 10” WG negative with no leakage.
   5. Access doors into ductwork greater than 2” w.g. pressure class shall be side-mounted equal to Nailor Series 0800 for rectangular ducts and Nailor Series 0895 for round ducts. Access doors shall be tested at 8-inch static pressure. Access door height shall not be less than 75% of duct height.
   6. Identification: Access doors shall be permanently identified on the exterior by a label with letters not less than 1/2 inch in height reading: SMOKE/FIRE DAMPER or FIRE DAMPER.

C. 2” w.g. pressure class or less:
   1. Un-insulated round ducts: Nailor model 0890, or equal.
      a. 16-gauge galvanized steel.
      b. Door hinge with Strike and catch, zinc plated steel and gasket.
   2. Insulated round ducts: Nailor model 0890, or equal.
      a. 16-gauge galvanized steel.
      b. Door hinge with Strike and catch, zinc plated steel and gasket.
   3. Rectangular ducts: Nailor model 08SH, or equal.
      a. 16-gauge galvanized steel.
      b. Door hinge with Strike and catch, zinc plated steel and gasket.
      c. Where space does not allow hinged access door, provide Nailor model 08SCL, or equal.

D. Ductwork with pressure class greater than 2” w.g.:
   1. Rectangular Ductwork: Nailor model 0895, or equal.
   2. Round Ductwork: Nailor model 0800, or equal.
   3. Access doors shall be tested at 8-inch static pressure.
   4. Access door height shall not be less than 75% of duct height.

PART 3 EXECUTION

3.1 GENERAL

A. Install duct accessories in accordance with manufacturer's installation instructions with applicable portions of details of construction as shown in SMACNA standards and in accordance with recognized industry practices to ensure that products serve intended function.

3.2 INSTALLATION OF VOLUME CONTROL DAMPERS

A. Provide volume control dampers at all supply, return, and exhaust branch ductwork and elsewhere where shown on the drawings.
   1. Locate volume control dampers at or near branch take off. Volume Control dampers shall not be located at the end of branch duct.

B. Where concealed volume control dampers are used, Contractor to show remote actuator locations on shop drawings for review. Remote Actuators shall be located symmetrically around lights and diffusers/grilles. Locations to be removed with shop drawings.

3.3 INSTALLATION OF TURNING VANES

A. Install turning vanes in square or rectangular 90-degree elbows in supply, return, and exhaust air systems and elsewhere as indicated.

3.4 INSTALLATION OF DUCT ACCESS DOORS

A. Provide for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, smoke dampers, combination fire/smoke dampers, before humidifiers and duct heating coils, and at turning vanes, splitter dampers. In addition, provide access doors at minimum 50 feet on center in duct runs to facilitate cleaning. Review locations prior to fabrication. Doors shall be square, sized to 3/4 of the larger of the duct width or height, but no smaller than 8” x 8” nor no larger than 24” x 24”.

B. Install access doors to open against system air pressure, with latches operable from either side, except outside only where duct is too small for person to enter.

C. Coordinate with other work as necessary to interface installation of duct accessories properly with other work.

D. Field Quality Control: Operate installed duct accessories to demonstrate compliance with requirements. Test for air leakage while system is operating. Repair or replace faulty accessories as required to obtain proper operation and leakproof performance.

3.5 CARE AND CLEANING

A. Repair or replace broken, damaged, or otherwise defective parts, materials, and work. Leave entire work in condition satisfactory to Architect. At completion, carefully clean and adjust

equipment, fixtures, and trim installed as part of this work. Leave systems and equipment in satisfactory operating condition.

3.6 CLEANING UP

A. Upon completion of Work remove materials, equipment, apparatus, tools, and the like, and leave premises clean, neat, and orderly.

END OF SECTION

SECTION 23 34 00 EXHAUST FANS

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes exhaust systems including:
   1. Roof Exhaust Fans
   2. Kitchen exhaust fans
   3. Roof Curbs

1.2 REFERENCES AND STANDARDS

A. AFBMA 9 – Load Ratings and Fatigue Life for Ball Bearings.

B. AFBMA 11 – Load Ratings and Fatigue Life for Roller Bearings.

C. AMCA 99 – Standards Handbook

D. ACMA 210 – Laboratory Methods of Testing Fans for Rating Purposes

E. ACMA 300 – Test Code for Sound Rating Air Moving Devices

F. AMCA 301 – Method of Calculating Fan Sound Ratings form Laboratory Test Data

G. ANSI B3.15

H. California Electrical Code (C.E.C.)

I. SMACNA – HVAC Duct Construction Standards

1.3 ACTION SUBMITTALS

A. Product Data: Submit complete data of materials proposed including the following:
   1. Manufacturer.
   2. Model.
   3. Fan Type
   4. Wheel type
   5. Fan Construction Class
   6. Fan size and arrangement
   7. Dimensional data including bolt hole locations
   8. Fan Weight
      a. Were fans are mounted on vibration isolators, provide corner operating weight data for each fan.
   9. Air flow capacity, fan curves, and efficiency data
   10. Static pressure
   11. Fan motor drive
   12. Motor HP and Fan bHP
   13. Sound Power: discharge and inlet for each octave band.

B. In cases of Substitution, equivalent fan shall not (when compared to basis of design fan):
   1. Increase motor horsepower
   2. Increase bHP by more than 5%
   3. Increase noise level
   4. Increase tip speed by more than 10%

5. Increase air inlet velocity by more than 20%

C. Named non-basis-of-design manufacturer does not guarantee approval of equipment submittals. Manufacturers must comply with all the performance and features as specified within the specifications and as indicated on the design documents.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: Submit operations and maintenance data and parts list for each fan type. Include this data in Maintenance Manual.

1.5 QUALITY ASSURANCE

A. Conform to AMCA bulletins regarding construction and testing. Fans shall bear AMCA certified rating seal.

B. Fans of similar type shall be by the same manufacturer.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURES

A. Roof Kitchen Exhaust fans:
1. CaptiveAire
2. Greenheck
3. Loren Cook

B. Roof Curbs
1. By Fan Manufacturer
2. Or Equal

2.2 GENERAL

A. Provide motors so that they cannot be overloaded above nameplate rating throughout the full speed range of the adjustable pitch driving sheave.

B. Fan wheels shall be balanced statically and dynamically near operating speed.

C. Provide drives and guards conforming to the requirements hereinbefore specified.

D. Fan construction, speed, noise level, tip speeds, outlet velocities and efficiencies will be taken into consideration in approval of fans offered. Fans shall be as scheduled on drawings, or approved equal.

2.3 KITCHEN ROOFTOP CENTRIFUGAL EXHAUST FAN – UPBLAST –DIRECT DRIVE.

A. Roof exhaust fans shall be upblast centrifugal belt driven type. The fan wheel shall be centrifugal backward inclined, constructed of aluminum and shall include a wheel cone carefully matched to the inlet cone for precise running tolerances. Wheels shall be statically and dynamically balanced. The fan housing shall be constructed of heavy gauge aluminum with a rigid internal support structure. Windbands shall have a rolled bead for added strength. Windband shall be welded to curbcaps with a leak proof continuous seam.

B. Motors shall be heavy duty ball bearing type, carefully matched to the fan load, and furnished at the specified voltage, phase and enclosure. Motors and drives shall be mounted on vibration

isolators, out of the airstream. Fresh air for motor cooling shall be drawn into the motor compartment from an area free of discharge contaminants. Motors shall be readily accessible for maintenance. Drive frame assemblies shall be constructed of heavy gauge steel and mounted on vibration isolators.

C. Motor less than 2 HP to be an electronic commutation motor (ECM) specifically designed for fan applications.
   1. AC induction type motors (examples: Shaded pole, permanent split capacitor, split phase, capacitor start and 3 phase induction type motors) are not acceptable.
   2. Motors shall be permanently lubricated with heavy-duty ball bearings to match the fan load and pre-wired to the specific voltage and phase.
   3. Internal motor circuitry shall convert AC power supplied to the fan to DC power to operate the motor.
   4. Motor shall be speed controllable down to 20% of full speed (80% turndown). Speed shall be controlled by either a potentiometer dial mounted on the motor or by a 0-10 VCD signal.
   5. Motor shall be a minimum of 85% efficient at all speeds.

D. Precision ground and polished fan shafts shall be mounted in permanently sealed, lubricated pillow block ball bearings. Bearings shall be selected for a minimum (L50) life in excess of 200,000 hours at maximum cataloged operating speed..

E. All fans shall bear the AMCA Certified Ratings Seal for sound and air performance.

F. Each fan shall bear a permanently affixed manufacturer's nameplate containing the model number and individual serial number for future identification.

G. Provide with the following Options and Accessories:
   1. Aluminum Birdscreen
   2. Gravity backdraft Dampers
   3. UL/cUL 705 Electrical
   4. Drain connection
   5. Speed Controls
   6. NEMA 3R and EXP Disconnect Switches
   7. Vented Curb Extensions
   8. Heat Baffles
   9. UL/cUL 762 Grease
   10. Non-Stick Wheel
   11. Clean Out Port
   12. Grease Trap w/Drain Connection
   13. Hinged Curb Cap Kit w/Cable
   14. High Temp Grease Bearings

2.4 ROOF CURBS

A. Provide manufacturer's standard shop-fabricated units, modified if necessary to comply with project requirements.

B. Fabricate structural framing for units of structural quality sheet steel formed to manufacturer's standard profiles for coordination with roofing, insulation and deck construction. Include 45 degree cant strips and deck flanges with offsets to accommodate roof insulation. Weld corners and seams to form watertight units.

C. Sloping Roof Decks: For deck slopes of 1" per foot and more slope, fabricate support units to form level top edge.

D. Unless scheduled otherwise, curbs height to be 14”.

E. Unless scheduled otherwise, curbs to be fabricated of 14 gauge metal.

F. Provide pressure treated wood nailer, not less than 1-5/8" thick and of not less than width of support wall assembly. Anchor nailer securely to top of metal frame unit.

G. Insulate units inside structural support wall with rigid glass fiber insulation board of approximately 3 lb. density and 1-1/2" minimum thickness, except as otherwise indicated.

PART 3 - EXECUTION

3.1 GENERAL

A. Install fans and ventilators in accordance with equipment manufacturer's installation instructions, and with recognized industry practices, to ensure that equipment complies with requirements and serves intended purposes.

B. Install flexible connections between fan inlet and discharge ductwork. Metal bands of connectors are to be parallel with 1” (minimum) flex between ductwork and fan while running.

C. Flexible connections located outdoors shall be provided with a sheet metal sun shield.

D. Install fan with vibration isolation as indicated. Adjust isolators to prevent tension n flexible connectors when fan is operating.

E. Supply and install sheaves as necessary for final air balancing.

F. Ensure air distribution equipment is wired properly, with rotation in direction indicated and intended for proper performance.

3.2 ROOF CURBS

A. Furnish roof curbs to roofing installer for installation.

3.3 START UP

A. Inspect equipment after installation to verify installation is in accordance with specifications and manufacturers installation guidelines. Verify equipment is lubricated, proper belt tension, and that equipment is otherwise ready to operate.

B. Perform air side test and balance as applicable.

3.4 CLEANING UP

A. Upon completion of Work remove materials, equipment, apparatus, tools, and the like and leave premises clean, neat and orderly.

END OF SECTION

SECTION 23 37 00 AIR OUTLETS AND INLETS

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes requirements for HVAC air inlets and outlets.

1.2 REFERENCES AND STANDARDS

A. SMACNA Compliance: Comply with applicable portions of Sheet Metal and Air Conditioning Contractor's National Association (SMACNA) HVAC Duct Construction Standards (Metal and Flexible), latest edition, for all work in this section.

B. ASHRAE Standards: Comply with American Society of Heating, Refrigerating, and Air Conditioning Engineers, Inc. (ASHRAE) recommendations, latest edition, for all work in this section.

C. NFPA Compliance: Comply with ANSI/NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems," and ANSI/NFPA 90B, "Standard for the Installation of Warm Air Heating and Air Conditioning Systems."

D. Compliance: Construct, test, install and label fire dampers and fire doors in accordance with Underwriters Laboratories (U.L.) Standard 555, "Fire Dampers and Ceiling Dampers."

E. The Diffuser, Register, Grille manufacturer shall provide published performance data for all air inlets/outlets. Performance tests shall be tested in accordance with ANSI/ASHRAE Standard 70-1991.

1.3 ACTION SUBMITTALS

A. Product data: submit complete data of materials proposed including:
   1. Manufacturer and model number
   2. Clearly indicate all options, trim, and accessories.
   3. Cross reference manufacturer’s cut sheet to fixture callout ID on submittal sheet.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: submit complete O&M data including:
   1. Maintenance data and parts lists for each type of fixture.
   2. Provide "trouble- shooting" maintenance guide
   3. Include this data within maintenance manual

1.5 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in manufacture of plumbing equipment of type and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years

B. Grade or quality of materials desired is indicated by trade names or catalog numbers stated herein.

PART 2 PRODUCTS

2.1 AIR INLETS AND OUTLETS

A. Acceptable Manufacturers:
   1. Titus
   2. Price
   3. Nailor
   4. Krueger

B. General:
   1. Provide manufacturer’s standard inlets and outlets where indicated on Contract Drawings. Provide size, shape, capacity, type, and throw patterns as indicated. Construct of materials and components as indicated and as required for complete installation.
   2. All supply diffusers, registers, and grilles located at ceiling shall have factory- applied, bone-white finish unless noted otherwise.
   3. All diffusers, registers, and grilles to be steel construction unless noted otherwise.

C. Reference Diffuser/Grille Schedule of drawings for Manufacturer/model numbers of each inlet/outlet type.

PART 3 EXECUTION

3.1 GENERAL

A. Install duct accessories in accordance with manufacturer's installation instructions with applicable portions of details of construction as shown in SMACNA standards and in accordance with recognized industry practices to ensure that products serve intended function.

3.2 INSTALLATION OF AIR INLETS AND OUTLETS

A. Locate ceiling air diffusers, registers, and grilles as indicated on general construction "Reflected Ceiling Plans." Unless otherwise indicated, locate units in center of acoustical ceiling modules.

B. Install outlets and inlets in accordance with manufacturer's written instructions and in accordance with recognized industry practices to ensure that products serve intended functions.

C. Examine areas and conditions under which outlets and inlets are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

D. Ceiling-mounted air terminals or services shall be positively attached to the ceiling suspension main runners or to cross runners with the same carrying capacity as the main runners.

E. Terminals or services weighing 56 pounds or less shall have two No. 12 gauge hangers connected from the terminal or service to the structure above. These wires may be slack.

F. Terminals or services weighing more than 56 pounds shall be supported directly from the structure above by approved hangers.

G. Paint visible ductwork behind grilles, registers, and diffusers dull black.

3.3 CARE AND CLEANING

A. Repair or replace broken, damaged, or otherwise defective parts, materials, and work. Leave entire work in condition satisfactory to Architect. At completion, carefully clean and adjust equipment, fixtures, and trim installed as part of this work. Leave systems and equipment in satisfactory operating condition.

3.4 CLEANING UP

A. Upon completion of Work remove materials, equipment, apparatus, tools, and the like, and leave premises clean, neat, and orderly.

END OF SECTION

SECTION 26 01 00 - GENERAL REQUIREMENTS OF ELECTRICAL WORK

PART 1 GENERAL

1.01 SUMMARY

A. This Section describes the general requirements for the electric work. These requirements apply to all sections of Division 26.

B. Provide electrical materials, installation and testing for the Woodland JUSD Adult Ed CTE Classroom Conversion project.

1.02 GENERAL REQUIREMENTS

A. No exposed conduit or surface raceway, except in Mechanical yard or equipment rooms, shall be permitted without written approval from the Engineer.

B. Multi-wire branch circuits shall not be permitted. Provide a dedicated neutral for all branch circuits requiring a neutral.

C. Provide shop drawings, materials, labor and testing for all work not explicitly shown or specified in the Constructions Documents but is still required to be completed in order to have a complete and functioning system or facility as specified. Review the bid documents carefully and identify all areas in the constructions documents which require shop drawings and include them in the bid. For example, if an emergency generating system is specified with a remote tank and fuel transfer system and the interconnection wiring of the fuel transfer system was not explicitly included in the Construction Documents, then it is the Contractor's responsibility to provide shop drawings, services (e.g., structural engineer services), materials and labor necessary to complete and test the fuel transfer system so that specified Emergency Generating System meets codes requirements and functions as intended. This also includes but is not limited to mounting details, vendor supplied systems such as UPS, digital lighting, Telecom Systems, Audio Visual, Fire Alarm, etc. Shop drawings shall be submitted to the Engineer for review and approval. Shop drawings will be stamped in accordance with code and plan review requirements.

D. Provide a UL label or evidence of UL listing for all electrical material, unless the material is of a type for which a label or listing service is not provided.

1.03 CODE COMPLIANCE

A. Perform all work in accordance with the following codes:
   1. California Electrical Code 2019
   2. California Building Code 2019
   3. California Fire Code 2019
   4. California Mechanical Code 2019
   5. California Plumbing Code 2019
   6. California Building Standards Administrative Code 2019
   7. California Green Building Standards Code 2019
   8. California Energy Code 2019
   9. All Applicable State and Local Codes and Regulations

1.04 PERMITS, FEES AND INSPECTIONS

A. Obtain all permits that are required for the work.

B. Call for all local building department inspections.

C. Obtain approvals from local building inspector prior to final observation by Engineer.

D. Advise Engineer, one week prior to:

1. Installation of underground work. Obtain Engineer's approval prior to backfill. The Engineer may direct uncovering of any work not so approved.
2. Start of interior rough-in work.
3. Installation of switchboards and motor control centers.

1.05 STANDARDS

A. Comply with the current applicable standards of the listed agencies for electrical materials and installation.

B. Underwriters Laboratories, Inc. (UL): Provide a UL label or evidence of UL listing for all electrical material, unless the material is of a type for which a label or listing service is not provided.

C. National Electrical Manufacturer's Association (NEMA).

D. American National Standards Institute (ANSI).

E. American Society for Testing Materials (ASTM).

F. Insulated Power Cable Engineers Association.

G. Certified Ballast Manufacturer's Association.

H. Institute of Electrical and Electronic Engineers (IEEE).

1.06 SUBMITTALS

A. Provide submittals for items specified in individual sections of Division 26 0000, in accordance with the requirements of Division 1.

B. Procedure: Submit under provisions of Section 01 3000 - Administrative Requirements and Section 01 6000 - Product Requirements.

C. Provide submittals for items listed documenting compliance with specification requirements.
1. Materials and Services
2. Contractor prepared Acceptance Test Procedures for Engineering review and approval.
3. Acceptance Test Results
4. Shop drawings
5. Operation and Maintenance Manual, in accordance with Section 01 7800 - Closeout Submittals.
6. Record Drawings, in accordance with Section 01 7800 - Closeout Submittals.
7. Other- Submittals required elsewhere in the Construction Documents.

1.07 MATERIALS AND SUBSTITUTIONS

A. Provide new material of the quality specified and satisfactory to the Engineer.
1. Provide major equipment which is the product of a manufacturer who has, for a period of not less than five years been in successful manufacture of similar equipment to that specified and who has a catalog covering ratings and specifications of proposed equipment.

1.08 DRAWINGS AND SPECIFICATIONS

A. Data given herein and on the plans are exact as could be secured, but their absolute accuracy is not guaranteed. Plans and specifications are for the assistance and guidance of the Contractor and exact locations, distances, levels and other data will be governed by the structures. The contractor shall provide a layout plan of all electrical equipment showing actual dimensions and working clearances. The contractor is responsible for ensuring that all electrical equipemt will fit and no working clearances are exceeded.

B. Clarification of plans and specifications for the purpose of facilitating construction, but not involving additional labor and materials, may be prepared during construction by the Engineer.

Said revised plans and specifications shall become a part of the contract. The Contractor shall conform to the revised plans and specifications at no additional cost to the Owner.

C. Layouts of equipment, accessories, and wiring systems are diagrammatic but follow these as closely as possible. Examine Architectural, Structural, and Mechanical and other drawings, noting all conditions that may affect this work. Report conflicting conditions to the Engineer for adjustment before proceeding with the work. Should the Contractor proceed with work without so reporting the matter, he does so, on his own responsibility and shall alter work if directed by the Engineer at his own expense.

D. The right is reserved to make minor changes in locations of equipment and wiring systems shown, providing the change is ordered before conduit runs and/or work directly connected to same is installed and no extra materials are required.

1.09 UTILITY COORDINATION

A. Coordinate with the electric utility company and the telephone company whenever necessary, to determine service equipment requirements, conduit and backfill requirements, electric metering requirements and other requirements to provide complete utility services, adequate to supply the electrical and communication system(s) indicated. Provide materials that are specified in Division 26 in addition to conforming to utility company requirements.

B. Include in bid, all work required by the utility companies. All work required for utility services shall be in accord with contract documents, specifications, drawings and as required by the utility companies.

C. Use extreme caution when digging to avoid buried electrical cables.
   1. Before digging, call:
   2. (800) 642-2444

1.10 HOMERUNS AND MAXIMUM NUMBER OF CIRCUITS

A. 120 VAC, 20 A circuit- Maximum of (9) #12 conductors in conduit (assume ambient temp for 120 Deg F, 90 Deg C wire). Homeruns may combine branch circuits by using a maximum of (20) # 10 conductors in 1.25” minimum diameter conduit.

1.11 CUT OVER

A. Prepare, submit and implement the cut over procedure. Provide all necessary materials, equipment, services, and rentals (e.g., generators, UPS, ATS) for the cut over. No disruption in power or any interference with Operations is permitted without Owner's approval. Have cut over coordination meetings with all necessary participants (Owner, Engineers, Vendors, Subcontractors) at least before preparing the cut over procedure and before conducting the approved procedure. Additional meetings may be required (e.g., resolve start up issues).

1.12 SUPERVISION

A. Provide adequate and competent supervision. Maintain complete control of the project execution and complete liability for the materials and work until the job is completed and accepted by the Owner.

1.13 MANUFACTURER'S INSTRUCTION

A. Follow the manufacturer's instructions when specific installation or connection details are not indicated or specified.

B. Notify the Engineer of conflicts between the manufacturer's instructions and installation or connection details prior to the installation of materials.

1.14 WORKMANSHIP

A. Firmly and permanently secure in place all electrical equipment to the structure so that it is level, plumb, and true with the structure and other equipment. Installation methods shall be as recommended by the National Electrical Contractors' Standard of Installation, except when

methods specified or shown on the plans differ. The minimum installation standards shall be as required by the Codes.

1.15 PROTECTION

A. Protect all equipment and materials required for the performance of this work from damage by the elements, vandalism, or work during construction.
   1. Do not subject the work and materials of other trades to damage during execution of the work in this division of the specifications.

1.16 COORDINATION WITH OTHER TRADES

A. Coordinate with other trades and promptly transmit all information required by them. Coordinate the sequence of construction with other trades to ensure that all work proceeds with a minimum of interference and delay. Perform all work that requires relocation due to negligence or absence of regard for the work of other trades.

1.17 EXAMINATION OF SITE

A. Examine the site prior to bid to determine existing site conditions that may affect the work. No allowance will be allowed for any extra work required due to a failure to recognize, or negligence to discover conditions prior to bid.

1.18 STRUCTURAL REQUIREMENTS

A. Secure all anchors for electrical equipment in a manner that will not decrease the structural value of any structure to an unsafe level. Inform the Engineer of any proposed modifications to the structure that involves cutting or patching of concrete, masonry, steel, or wood in the project.

1.19 IDENTIFICATION

A. Install nameplates on electrical equipment including:
   1. Individual circuit breakers on switchboards, distribution panelboards and motor control centers.
   2. Motor starters.
   3. Pilot lights, selector switches, overload resets, timers and other pilot control devices.
   4. Panelboards, switchboards, transformers, control cabinets and other major equipment.
   5. Disconnect switches, time switches, contactors, relays and other miscellaneous equipment enclosures.
   6. Light switches for which the control functions are not evident.
   7. Provide labeling on receptacles and light switches which describe the source panel and circuit number. Use clear adhesive label with typed text. Example, "EH-3", that is panel "EH" circuit 3.

B. Describe item, control function of sequence or operation on each nameplate, as applicable.

C. Fabricate nameplates of laminated phenolic plastic, black front and back with white core. Bevel edges. Engrave through outer layer to produce white letters and numerals. For control pilot devices, engraved metallic plates, filled with enamel, are acceptable. Fasten nameplates to equipment with No. 4 Phillips, round head, cadmium steel, self-tapping screws.

1.20 TESTS AND REPORTS

A. Perform routine insulation-resistance, continuity, equipment settings and rotation tests for all affected distribution and utilization equipment prior to and in addition to tests performed by the testing firm specified herein. Prepare inspection and test reports for all equipment as specified herein and submit to the Electrical Engineer for review and approval. Submit at least two weeks before the planned testing. Perform these inspections and test prior to or as part of system Acceptance Testing. Examples include:

1. Grounding systems, for resistance to earth. Provide additional grounding electrodes if main service or separately derived system ground resistance exceed 5 ohms.
2. Motor circuits with motor disconnected, for resistance to ground.
3. Control circuits for resistance to ground.
4. Lighting circuits, for resistance to ground.
5. Power feeders, for resistance to ground.
6. Switchboards, Motor Control Centers for resistance to ground.:
7. Main bus, power and control circuits, for resistance to ground.
    a. Check connection; tighten if necessary.
    b. Operation of each device.
    c. Set relays and trip settings in accord with the Engineer's directions.
    d. Check thermal overload heaters for size and reset operation.
8. Prior to energization of equipment, check the insulation resistance of listed circuits, with a 500-volt "Megger".
9. Set circuit protective devices to provide proper long-time, short-time and ground-fault tripping coordination
10. Coordinate phase rotation of all motors with installer to ensure proper direction of rotation. List motor data:
    a. Item of equipment.
    b. Nameplate data.
    c. Overload heater catalog number and rating.

1.21 DEMONSTRATIONS:

A. After testing and final inspection, demonstrate operation of all affected systems and equipment to Engineer and Owner.

B. Arrange date of test with Owner.

C. Advise the manufacturers' representative to be present when required.

D. Instruct Owner's personnel in operation, adjustment and maintenance of equipment and systems, using the operation and maintenance data as the basis of instruction.

1.22 GUARANTEE:

A. Guarantee the electrical work against defects in work or materials for one year after filing of Notice of Completion.

B. Undertake repairs within 24 hours after notice from the Owner.

C. If the operation of the electrical system fails to conform to Division 26 requirements, approved submittals, or operation and maintenance manuals, the Owner may operate the electrical system without liability to Owner. Repair or replace defective or unsatisfactory equipment or systems.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 EQUIPMENT MOUNTING SEISMIC CRITERIA

A. Brace or anchor all electrical equipment to resist a horizontal force acting in any direction using the criteria of Section 1613A and 1615A, 2019 California Building Code, Title 24, Part 2.

B. Where anchorage details are not shown on the drawings, the field installation shall be subject to the approval of the electrical and structural engineers.

END OF SECTION

SECTION 26 05 02 - SUPPORTING FROM BUILDING STRUCTURE

PART 1 GENERAL

1.01 DESCRIPTION

A. This specification defines the seismic design criteria to be used for the design of equipment anchorage and seismic bracing for electrical equipment/components. This section provides guidelines and limitations for supporting all electrical items from the building structure, and for seismic bracing for all such items.

B. The Contractor is responsible for engaging the services of a qualified licensed professional engineer in the state of California with a minimum 5 years of experience in structural seismic design to provide the analysis, calculations, seismic bracing, and installation details for equipment and equipment anchorage, skids and frames in accordance with specified criteria and applicable codes. The Contractor's engineer is to provide construction support during the equipment installation for any field problem that may arise during construction. The Contractor is required to design support and bracing for items for which the contract documents do not provide specific attachment, support, and bracing.

C. Unless the item is classified by the owner as essential, seismic bracing and restraint may be waived for the following.
   1. Anchorage for equipment with operating weighs less than 400 pounds and is supported at 4 feet or less above the floor.
   2. Temporary or movable equipment when rolling/sliding is prevented and is not subject to tipping.
   3. Equipment weighing less than 20 pounds supported on vibration isolators.
   4. Equipment weighing less than 20 pounds suspended from the floor or roof or mounted to walls.
   5. Verification and investigation on Item C.2, whether the equipment will be tipped over under the code required seismic forces using R=1.0 and 60% of the operating weight, shall be performed by a qualified engineer per Paragraph 1.01B.

D. Seismic bracing is not required for the following items:
   1. All electrical conduits less than 2.5 inches inside diameter, unless racked together.
   2. All conduits mounted less than 12" from hanger anchorage.

E. Design and install all support and bracing systems except as noted. Provide for attachment to portions of the building structure capable of bearing the loads imposed. Design systems to not overstress the building structure

1.02 RELATED REQUIREMENTS

A. Section 26 0100: General Requirements for Electrical Work.

1.03 REFERENCES

A. California Building Code (CBC), with local amendments where the project is located.

B. American Society of Civil Engineers (ASCE), ASCE 7, Minimum Design Loads for Buildings and Other Structures,

C. American Society of Heating and Ventilating and Air Conditioning (ASHRAE), HVAC Applications, Latest Edition, Seismic and Wind Restrain Design
   1. The lateral force equations in ASCE 7, as appropriate, should be used to determine the lateral seismic force. The force calculations found in these standards are based on a previous code provision that may not comply with the latest ASCE 7.

D. American Society of Mechanical Engineers (ASME), including addendum through the latest edition

E. Structural Engineers Association of California, Recommended Lateral Force Requirements and Commentary, Latest Edition

F. Seismic Restraint Manual Guidelines for Mechanical Systems, Latest Edition (SMACNA)

1.04 SYSTEM DESCRIPTION

A. Site Criteria: Obtain the required parameters from the Structural Specifications/Structural Engineer of Record.

B. Design Requirements
   1. All electrical equipment/devices, attachments and supports shall be designed to withstand the specified seismic loads and comply with the latest ASCE 7 seismic design detailed requirement for strength and displacement.
   2. Equipment design is solely the responsibility of the equipment supplier. The equipment shall be designed so the strength and anchorage of the internal and external components or equipment piping exceed that of the forces used to restrain and to anchor the equipment to the supporting structure. Guidance as to which pieces of equipment and parts require seismic design can be found in the commentary section of SEAOC Recommended Lateral Force Requirements and Commentary, specifically Section C107. Equipment with flexible and /or cantilevered lateral system shall be avoided.
   3. Seismic design parameters as defined by the latest ASCE 7.
      a. Rp for anchorage shall consider the ductility and the embedment depth of the anchor.
      b. Additional factor for anchorage to cracked concrete and masonry structure shall be applied as required by codes.
   4. Components and Equipment Supported by Structures
      a. The lateral force is to be applied at the center of mass of the component and can act in any lateral direction.
   5. Seismic restraint for electrical system is to be designed per the latest ASCE 7 - seismic design requirements.

C. Connection Requirements
   1. Component attachments are to be welded, bolted, or otherwise positively connected without consideration of frictional resistance resulting from gravity loads. Do not weld on any joists or beams without written approval from Structural Engineer.
   2. Attachments to concrete shall be made with anchors suitable for cyclical loads. Expansion or chemical anchors not rated for Seismic Design Category “D”, “E” & “F” shall not be used for seismic anchorage.
   3. Powder driven fasteners shall not be used for tension load applications.
   4. Friction clips shall not be used for anchorage.
   5. Welded plate washers with standard holes shall be used at bolted connections with oversized holes on the base plate.
   6. Unless the base sheet metal is reinforced with stiffeners and is designed to take the bending from the uplift forces, oversized plate washers shall be used at bolted connection through the base sheet metal
   7. Isolators must be designed to withstand the seismic loads. Provide snubbers if the isolator cannot withstand the specified load and see below for the design force.
   8. Components mounted on vibration isolator system shall have a bumper restraint or a snubber in each horizontal direction. The design force is to be taken as 2Fp unless the nominal clearance (air gap) between the frame and restraint is equal or less than 0.25”.

D. Refer to structural drawings for material specifications of structure. If no structural drawings are available, assume 3000 psi concrete and ASTM A36 steel for attachment design and confirm these values with Structural Engineer before proceeding with the design

1.05 SUBMITTALS

A. Calculations and Drawings.
   1. Submit structural calculations and a separate drawing stamped and signed by the California Licensed Professional Engineer in good standing. The calculations and drawings shall include the following information as minimum:.
      a. Empty weight
      b. Operating weight
      c. Center of mass in plan
      d. Center of mass in elevation
      e. Seismic vertical, lateral, and overturning loads
      f. Load combinations in accordance with applicable codes
      g. Anchor bolt brand, type, size, embedment depth in concrete, grip distance, and locations, including specific drilling and special inspection requirement
      h. Installation sequence if it requires specific sequence to fasten the anchorage
   2. Coordination drawings to demonstrate interface with adjacent systems including location and space required for seismic bracing and anchorage.
   3. Furnish certification letter in the calculations stating the design of the equipment components and anchorage comply with the seismic design requirement per ASCE 7 13.2.2.a. and applicable local building codes.

B. Installing contractor to submit following reports to Structural Engineer and Building Official
   1. Bolt inspection reports for field installed bolts for structural components including the location of the test, date of the test, bolt diameter, and recorded torque.
   2. Reports covering other structural activities requiring inspection in accordance with the applicable local building codes.

PART 2 PRODUCTS

2.01 MATERIALS

A. Furnish all substructures and fasteners required to comply with the limitations given below. Use materials as specified in the various sections and as appropriate to the use.

B. All exterior materials: Hot dipped galvanized or stainless steel.

PART 3 EXECUTION

3.01 GUIDELINES & LIMITATIONS

A. Coordinate with the Structural Engineer of Record for criteria.

END OF SECTION

SECTION 26 05 19 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.01 SUMMARY

A. Provide electrical materials, installation and testing for the Woodland JUSD Adult Ed CTE Classroom Conversion project.

1.02 DESCRIPTION

A. This section describes requirements for wire and cable.

1.03 RELATED WORK

A. Section 26 0100: General Requirements for Electrical Work.

1.04 REFERENCE STANDARDS

A. NETA STD ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems; International Electrical Testing Association; 2009.

1.05 SUBMITTALS

A. Provide submittals for items listed documenting compliance with specification requirements.

B. Product Data:

1. Electrical Materials: Manufacturer’s current published catalog sheets, and samples of product as required.

PART 2 PRODUCTS

2.01 CONDUCTOR AND CABLE GENERAL REQUIREMENTS

A. Provide products that comply with requirements of CEC.

B. Provide products listed and classified by Underwriters Laboratories Inc. as suitable for the purpose indicated.

C. Provide conductors and cables with lead content less than 300 parts per million.

D. Provide new conductors and cables manufactured not more than one year prior to installation.

E. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, etc. as required for a complete operating system.

F. Comply with NEMA WC 70.

G. Thermoplastic-Insulated Conductors and Cables: Listed and labeled as complying with UL 83.

H. Thermoset-Insulated Conductors and Cables: Listed and labeled as complying with UL 44.

I. Conductors and Cables Installed Exposed in accessible above ceiling space (only where specifically permitted): Plenum rated, listed and labeled as suitable for use in return air plenums.

J. Conductor Material:

1. Provide copper conductors only. Aluminum conductors are not acceptable for this project. Conductor sizes indicated are based on copper.
2. Copper Conductors: Soft drawn annealed, 98 percent conductivity, uncoated copper conductors complying with ASTM B3, ASTM B8, or ASTM B787/B 787M unless otherwise indicated.
3. Tinned Copper Conductors: Comply with ASTM B33.

K. Minimum Conductor Size:

1. Branch Circuits: 12 AWG. Compensate size for voltage drop as required by governing codes.
2. Control Circuits: 14 AWG.

L. Conductor Color Coding:
1. Color code conductors as indicated unless otherwise required by the authority having jurisdiction. Maintain consistent color coding throughout project.
2. Color Coding Method: Integrally colored insulation.
3. Color Code:
   a. 480Y/277 V, 3 Phase, 4 Wire System:
      1) Phase A: Brown.
      2) Phase B: Orange.
      3) Phase C: Yellow.
      4) Neutral/Grounded: Gray.
   b. 208Y/120 V, 3 Phase, 4 Wire System:
      1) Phase A: Black.
      2) Phase B: Red.
      3) Phase C: Blue.
      4) Neutral/Grounded: White.
   c. Equipment Ground, All Systems: Green.

2.02 WIRE AND CABLE

A. Conductor: Insulated copper, individual conductors, 98 percent conductivity, stranded.
1. Power conductors, #12 AWG, minimum to 750 MCM, stranded.
2. Control conductors #14 AWG, minimum to #10 AWG, stranded.

B. Insulation:
1. Rated 600 volts as follows:
2. THHN/THWN-2

Item	Size (AWG)	Insulation Type
Branch Circuits (except wet locations)	#12 to #4/0	THHN/THWN-2
Underground Branch Circuits	#12 to #4/0	XHHW-2 or THWN-2
Fixture Taps	#12	XHHW-2 or THHN/THWN-2
Feeders (except wet locations)	#12 to #4/0	THHN/THWN-2
	to #750 MCM	USE-2,or XHHW-2
Underground Feeders	#12 to #750 MCM	XHHW-2
Grounding	All	THHN/THWN-2
Control Interconnect	#14 to #10	THHN/THWN-2
Control Cabinets	#14	THHN/THWN-2

2.03 WIRE CONNECTIONS

A. Connect wire to binding post screw, stud, bolt or bus as follows:
1. #10 AWG and smaller conductors, compression type, nylon, self-insulated grip spade lugs, T & B "Sta-Kon", Buchanan "Termend", Panduit "Pan-Term", or equal.
2. #8 AWG to #750 MCM copper conductors, solderless lug type connectors, with hex-head or allen type compression set screws with configuration to suit application, T & B "Locktite", Burndy "QA", OZ Type "XL" or "XLH", or equal.

B. Conductor Taps: #8 through #4 copper conductors, split-bolt, Kearney.

C. Splice wire as follows:
   1. #10 AWG and smaller conductors, twist-on solder-less, insulated spring connectors, 3M "Scotchloks", T & B "Piggys" or equal.
   2. #8 AWG to #750 MCM copper conductors, two-way connectors, OZ type "XW", Burndy or equal.
   3. In underground pull-boxes, cast resin epoxy, Scotch.

D. Size, install and tighten wire terminal and splice connectors in accordance with manufacturer's recommendations.

2.04 TAPE

A. Wire Splices: Vinyl plastic electrical tape, 8.5-mil and 4.0-mil, Scotch 33.

B. Conduit Wrapping: 10-mil vinyl wrapping tape, Manville, Minnesota Mining and Manufacturing Company.

2.05 WIRING ACCESSORIES

A. Identify conductors with self-adhesive vinyl cloth markers, sized to fit the conductor insulation, with machine printed black marking, W.H. Brady, Thomas and Betts, or equal.

PART 3 EXECUTION

3.01 INSULATED CONDUCTORS AND CABLE

A. Exercise extreme care when pulling conductors and cable into conduits to avoid kinking, twisting, nicking or scratching of the insulation or the placement of extreme stress on the conductors or cable. When required, utilize UL approved pulling compounds to assist in pulling conductors.

B. Color code conductors by phase sequence A-B-C when looking into the front of the equipment from left-to-right, top-to-bottom or front-to-back. Provide conductors with the appropriate phase color or mark conductors with a minimum of 6 inches of phase tape on ends connected to terminals. Phase code conductors as listed:

Voltage	Phase A	Phase B	Phase C	Neutral	Ground
120/208	Black	Red	Blue	White	Green

C. Identify all conductors with their respective circuit numbers at all boxes and terminals.

D. For medium voltage cables, do not exceed manufacturer's recommendations for maximum allowable pulling force. Where wire and cable-pulling compound is used, use UL listed compounds only. In all cases, limit pulling tension to the following:
   1. Applied to Conductors: 0.008 pounds per circular mil of conductor cross sectional area.
   2. Applied to Nonmetallic Jacket: 1,000 pounds, but not exceeding pulling force specified above for conductor.

E. Connections:
   1. Use twist-on solder-less connectors for splicing receptacle and lighting circuits #10 AWG wire size and smaller.
   2. Splice #12 and #10 AWG stranded conductors with compression connectors.
   3. Terminate conductors at motors with bolted connections, insulated with plastic tape.
   4. For conductor taps #8 through #4 AWG, provide split bolt service connectors.

5. For splices larger than #10 AWG, insulate and smooth the splice with insulation putty, tape with one half-lapped layer of 8.5-mil vinyl plastic electrical tape and two half-lapped layers of 7.0-mil vinyl plastic electrical tape.
6. Use cast resin epoxy splices for splices in underground pullboxes.

END OF SECTION

SECTION 26 05 26 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 RELATED REQUIREMENTS

A. Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables: Additional requirements for conductors for grounding and bonding, including conductor color coding.

B. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

1.02 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction; National Electrical Contractors Association; 2016.

B. NETA STD ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems; International Electrical Testing Association; 2009.

C. CEC - California Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

D. UL 467 - Grounding and Bonding Equipment; Current Edition, Including All Revisions.

1.03 SUMMARY

A. This section describes requirements for grounding of the power and communications systems.

1.04 DESCRIPTION

A. Provide all equipment and materials for a complete grounding system.
   1. Power System Grounding.
   2. Communications System Grounding.
   3. Electrical Equipment and Raceway Grounding and bonding.

1.05 RELATE REQUIREMENTS

A. Section 26 0100: General Requirements for Electrical Work.

1.06 REFERENCE STANDARDS

A. National Electrical Manufacturers Association (NEMA).

B. American National Standards Institute (ANSI).

1.07 SUBMITTALS

A. Submit a complete set of marked-up record drawings to indicate installed location of system grounding electrode connections, and routing of grounding electrode conductor.

B. Submit certified test results stating ground resistance from service neutral at service entrance and separately derived systems.

PART 2 PRODUCTS

2.01 GROUNDING AND BONDING REQUIREMENTS

A. Existing Work: Where existing grounding and bonding system components are indicated to be reused, they may be reused only where they are free from corrosion, integrity and continuity are verified, and where acceptable to the authority having jurisdiction.

B. Do not use products for applications other than as permitted by NFPA 70 and product listing.

C. Unless specifically indicated to be excluded, provide all required components, conductors, connectors, conduit, boxes, fittings, supports, accessories, etc. as necessary for a complete grounding and bonding system.

D. Where conductor size is not indicated, size to comply with CEC but not less than applicable minimum size requirements specified.

2.02 GROUNDING AND BONDING COMPONENTS

A. General Requirements:
   1. Provide products listed, classified, and labeled by Underwriter's Laboratories Inc. (UL) or testing firm acceptable to authority having jurisdiction as suitable for the purpose indicated.
   2. Provide products listed and labeled as complying with UL 467 where applicable.

B. Conductors for Grounding and Bonding, in addition to requirements of Section 26 0519:
   1. Use insulated copper conductors unless otherwise indicated.
      a. Exceptions:
         1) Use bare copper conductors where installed underground in direct contact with earth.
         2) Use bare copper conductors where directly encased in concrete (not in raceway).

C. Connectors for Grounding and Bonding:
   1. Description: Connectors appropriate for the application and suitable for the conductors and items to be connected; listed and labeled as complying with UL 467.
   2. Unless otherwise indicated, use exothermic welded connections for underground, concealed and other inaccessible connections.
   3. Unless otherwise indicated, use mechanical connectors, compression connectors, or exothermic welded connections for accessible connections.

2.03 ACCEPTABLE MANUFACTURERS

A. Thomas and Betts Appleton, Raco, Oz Gedney, Blackburn, or approved equal.

2.04 MATERIALS

A. Ground Rods: Copper encased steel, 5/8 inch diameter, minimum length - 8 feet.

B. Ground Clamp: Water pipe connection, bronze two piece with serrated jaws, lug sized for grounding electrode conductor.

C. Connectors, Compression Type: Bronze or Copper, pretreated with conductive paste, sized for conductor to which applied.

D. Connectors, Exothermic Weld Type: Powder actuated weld. Bond made through exothermic reaction producing molten copper from premixed copper oxide and aluminum powder. Form bond in mold or crucible.

2.05 COMMUNICATIONS GROUNDING SYSTEM

A. All intermediate distribution frame (IDF) and main distribution frame (MDF) rooms shall have a Telecommunication Ground Bus Bar installed. Refer to drawings for specific size and assembly.

B. The telecommunication service entrance MDF, shall have a minimum of a #2 AWG conductor with green outer sheath installed to the Telecommunication Ground Bus Bar located in the room.

C. Except where specifically indicated otherwise, all facility MDFs shall have a minimum of a #4 AWG conductor with green outer sheath installed to the Telecommunication Ground Bus Bar located in each room.

D. Except where specifically indicated otherwise, all facility IDFs shall have a minimum of a #6 AWG conductor with green outer sheath installed to the Telecommunication Ground Bus Bar located in each room.

2.06 GENERAL BRANCH CIRCUITS GROUNDING

A. All grounding conductor wire shall be insulated green copper conductors.

B. All conduit bushings shall be grounding type.

C. All grounding connections shall be made with solderless lugs and nonferrous hardware.

2.07 CONDUIT BANK GROUNDING

A. Provide a size 4/0 AWG bare copper grounding conductor for each of the campus utility distribution conduit banks shown on drawings. Install this grounding conductor within the ground floor slab and parallel to the respective conduit bank.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that work likely to damage grounding and bonding system components has been completed.

B. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install grounding and bonding system components in a neat and workmanlike manner in accordance with NECA 1.

C. Ground Rod Electrodes: Unless otherwise indicated, install ground rod electrodes vertically. Where encountered rock prohibits vertical installation, install at 45 degree angle or bury horizontally in trench at least 30 inches (750 mm) deep in accordance with CEC or provide ground plates.
   1. Outdoor Installations: Unless otherwise indicated, install with top of rod 6 inches (150 mm) below finished grade.
   2. Indoor Installations: Unless otherwise indicated, install with 4 inches (100 mm) of top of rod exposed.

D. Ground Plate Electrodes: Unless otherwise indicated, install ground plate electrodes at a depth of not less than 30 inches (750 mm).

E. Make grounding and bonding connections using specified connectors.
   1. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors. Do not remove conductor strands to facilitate insertion into connector.
   2. Remove nonconductive paint, enamel, or similar coating at threads, contact points, and contact surfaces.
   3. Exothermic Welds: Make connections using molds and weld material suitable for the items to be connected in accordance with manufacturer's recommendations.
   4. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
   5. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.

F. Identify grounding and bonding system components in accordance with Section 26 0553.

3.03 FIELD QUALITY CONTROL

A. Perform inspection in accordance with Section 01 4000.

B. Inspect and test in accordance with NETA STD ATS except Section 4.

C. Perform inspections and tests listed in NETA STD ATS, Section 7.13.

D. Perform ground electrode resistance tests under normally dry conditions. Precipitation within the previous 48 hours does not constitute normally dry conditions.

E. Investigate and correct deficiencies where measured ground resistances do not comply with specified requirements.

F. Submit detailed reports indicating inspection and testing results and corrective actions taken.

3.04 EXISTING GROUND SYSTEM

A. Test and inspect existing building ground. Replace damaged and corroded parts and pieces. Also replace parts wich do not confirm to this specifications.

B. Provide additional ground rod(s) it existing ground test exceed 5 ohms.

3.05 GENERAL BRANCH CIRCUITS AND FEEDERS

A. All conduit systems, equipment housings, material housings, junction boxes, cabinets, motors, ducts, wireways, cable trays, light fixtures, portable equipment and all other conductive surfaces shall be solidly grounded in accordance with the California Electrical Code to form a continuous, permanent and effective grounding system.

B. Install a separate green grounding conductor in all conduits, including feeder, branch circuit, and flexible; both metallic and non-metallic. The conduit systems shall not be used as the system equipment grounds. Size all grounding conductors per CEC Article 250 unless a larger ground is indicated on the drawings.

C. All panelboards, junction boxes, pullboxes, wireways and equipment enclosures shall be bonded to the conduit systems.

D. All building expansion joints shall be bonded.

E. Isolated ground receptacles shall have both an isolated ground conductor and a separate equipment grounding conductor.

3.06 MOTOR CIRCUITS

A. All motor circuits shall have a ground wire pulled with the phase conductors. The ground wire shall be extended from the panel ground bus and shall be bonded at all junction boxes, pullboxes, disconnect switches, controllers, motor connection boxes, and motor frames. Each motor with a Variable Frequency Drive (VFD) controller shall have a dedicated grounding conductor. Ground these motors back through the VFD controller as recommended by the drive manufacturer to eliminate radio frequency interference. Also, the wiring between the VFD controller and the motor shall be in a dedicated conduit.

3.07 SEPARATELY DERIVED SOURCES

A. All secondary neutrals for the 120/208 volt wye services of dry type transformers shall be grounded to building steel. Connection shall be made with cable sized according to Table 250-94(a) of the California Electrical Code. Extend separately derived insulated ground to the transformer in rigid steel conduit.

3.08 EQUIPMENT ROOM GROUND TERMINAL BAR

A. Mount bar by anchors and bolts using 1-1/2 inch long segments of 1/2 inch rigid conduit as spacer between bar and wall. Use a minimum of two supports, 18 inches on center. Connect all grounding electrode system conductors, system enclosure ground bus, and other indicated electrode systems to the terminal bar. Each telecom/his room shall have a ground bar with a minimum of six lugs or screws. Interconnect telecom/his ground bars to building steel with No. 6 AWG insulated copper conductor.

3.09 FLEXIBLE RACEWAY GROUNDING

A. Install a ground conductor inside all flexible raceways (e.g. flexible steel, liquid tight). Bond the conductor to the enclosure or ground bus in the nearest box or access on either side of the flexible section. Size conductor as specified, indicated or required by code, whichever is larger.

3.10 GENERAL GROUNDING REQUIREMENTS

A. All ground connectors shall be bronze of the clamp type. All clamp accessories such as bolts, nuts, and washers shall also bronze to assure a permanent corrosion-resistant assembly. Connector shall be as manufactured by Burndy Engineering Company, Ilsco Corporation, or equal. Make connections easily accessible for inspection, underground or concealed in floors or walls.

B. All ground cable splices, joints, and connections to ground rods shall be made with an exothermic welding process which shall provide a weld with current-carrying capacity not less than that of the conductors welded. Soldered connections shall not be used.

C. All ground wire shall be insulated, unless otherwise indicated on the Drawings, extra flexible stranded copper cables. Grounding cables installed in earth shall be laid slack.

D. Neutrals throughout the system shall be solidly grounded.

E. Lighting and power panelboards shall be grounded by connecting a grounding conductor to the grounding stud and to the incoming and outgoing feeder conduits grounding bushings. Each grounding-type bushing shall have the maximum ground wire accommodation available in standard manufacturer for the particular conduit size. Connection to the bushing shall be with wire of this maximum size.

F. The equipment for the fire protection alarm system shall have its grounding terminal connected to the ground lug on the panelboard serving the system by means of a #6 green coded insulated conductor, run in 3/4 inch steel conduit, utilizing a ground clamp.

END OF SECTION

SECTION 26 05 34 - CONDUIT

PART 1 GENERAL

1.01 SUMMARY

A. This section describes requirements for conduit raceways.

1.02 RELATED WORK

A. Section 26 0100: General Requirements for Electrical Work.

B. Section 26 0526: Grounding and Bonding.

C. Section 26 0502: Supporting from Building Structure

1.03 REFERENCE STANDARDS

A. American National Standards Institute (ANSI):
   1. C80.1Specification for Rigid Steel Conduit, Zinc Coated
   2. C80.3Specification for Electrical Metallic Tubing, Zinc Coated

B. National Electrical Manufacturers Association (NEMA):
   1. TC 2 Electrical Plastic Tubing (EPT), Conduit (EPC-40 and EPC-80) and Fittings

C. Underwriters Laboratories, Inc. (UL):
   1. 1242 Intermediate Metal Conduit

D. Federal Specifications:
   1. WW-C-581E Conduit, Metal Electrical Conduit. Steel, Zinc Coated

1.04 SUBMITTALS

A. Procedure: Submit under provisions of Section 01 3000 - Administrative Requirements and Section 01 6000 - Product Requirements.

B. Provide submittals for items listed documenting compliance with specification requirements.
   1. Product Data:
   2. Electrical Materials: Manufacturer’s current published catalog sheets.

PART 2 PRODUCTS

2.01 RACEWAYS

A. Rigid Steel Conduit:
   1. ANSI C80.1, minimum size 3/4 inch.
   2. Threaded fittings, galvanized.
   3. Locknuts, 3/4 inch to 1-1/2 inch, heavy nut steel.
   4. Locknuts, 1-1/2 inch and larger, malleable iron.
   5. Insulated bushings, malleable iron, plastic or nylon insert, OZ "IBC" series, Efcor "56" series, Appleton "GIB" series or equal.
   6. Three-piece conduit couplings, malleable iron, T & B "Erickson", Appleton "EC" series, OZ "4" series, or equal.

B. Intermediate Metal Conduit (IMC):
   1. Conform to UL 1242 and Federal Specification WW-C-581E, minimum size 3/4 inch.
   2. Fittings: As specified for rigid steel conduit.

C. Electrical Metallic Tubing (EMT):
   1. Galvanized rolled steel ANSI C80.3.
   2. Fittings to 2 inch, rain-tight compression gland, steel, plated with zinc or cadmium, for wet locations and setscrew steel for dry locations.
   3. Couplings, to 2 inch:

a. Compression type: OZ "6050S" series, T & B "5120" series, Efcor "760" series, or equal.
b. Setscrew type: OZ "5050S" series, Steel City "TK121" series, Efcor "730" series, or equal.

4. Connectors, insulated throat:
   a. Compression type: OZ "7050 ST" series, T & B "5123" series, Efcor "750B" Series, or equal.
   b. Setscrew type: OZ "4050 ST" series, Steel City "TC721" series, Efcor "720B" Series, or equal.
5. Couplings, 2-1/2 inch to 4 inch, set-screw, four screw, steel plated with zinc or cadmium, OZ "5250S" series, T & B "5042" series, Efcor "736" series, or equal.
6. Connectors, 2-1/2 inch to 4 inch, insulated throat, set-screw, two screw, plated with zinc or cadmium, Appleton "TW250 SI" series, Efcor "726B" series, or equal.
7. Adapter, EMT to rigid steel, zinc or cadmium plated malleable iron, OZ, T & B, Efcor, or equal.
8. Maximum size, 2 inch, except for Telephone, 4 inch.

D. Flexible Metal Conduit:
1. Fabricate from galvanized steel strip, minimum size 1/2 inch.
2. Connectors, T & B "Tite Bite", with insulated throat, or equal.
3. Length, no greater than 6 feet. Allow slack for movement of connected equipment.

E. Liquid-tight Flexible Metal Conduit:
1. Fabricate from galvanized steel strip, jacketed with PVC, minimum size 1/2 inch.
2. Straight connectors, cadmium plated steel or malleable iron, insulated throat and neoprene sealing ring, OZ "4Q-IT" series, T & B "5330" series, Efcor "11-B" series, or equal.
3. Angle connectors, cadmium plated steel or malleable iron, insulated throat and neoprene sealing ring, OZ, T & B, Efcor, or equal, comparable to straight connectors.
4. Hardware, cadmium plated steel.
5. Length, no greater than 6 feet. Allow slack for movement of connected equipment.

F. PVC Conduit:
1. Schedule 40, NEMA TC2, Type II underground installation.
   a. Minimum size, 1 inch.
   b. Elbows, Schedule 40, encased in concrete for sizes 2-inch and larger.
   c. Extensions above grade, rigid steel (exposed), EMT (concealed indoors).
   d. Adapters, PVC to rigid steel, threaded plastic.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install conduit in a neat and workmanlike manner in accordance with NECA 1.

C. Conduit Support:
1. Secure and support conduits in accordance with CEC and Section 26 0529 using suitable supports and methods approved by the authority having jurisdiction.
2. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.

D. Connections and Terminations:
1. Use suitable adapters where required to transition from one type of conduit to another.
2. Provide insulating bushings or insulated throats at all conduit terminations to protect conductors.

3. Secure joints and connections to provide maximum mechanical strength and electrical continuity.

E. Penetrations:
1. Do not penetrate or otherwise notch or cut structural members, including footings and grade beams, without approval of Structural Engineer.
2. Make penetrations perpendicular to surfaces unless otherwise indicated.
3. Provide sleeves for penetrations as indicated or as required to facilitate installation. Set sleeves flush with exposed surfaces unless otherwise indicated or required.
4. Conceal bends for conduit risers emerging above ground.
5. Seal interior of conduits entering the building from underground at first accessible point to prevent entry of moisture and gases.
6. Where conduits penetrate waterproof membrane, seal as required to maintain integrity of membrane.
7. Make penetrations for roof-mounted equipment within associated equipment openings and curbs where possible to minimize roofing system penetrations. Where penetrations are necessary, seal as indicated or as required to preserve integrity of roofing system and maintain roof warranty. Include proposed locations of penetrations and methods for sealing with submittals.
8. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 8400.

F. Conduit Movement Provisions: Where conduits are subject to thermal expansion, provide expansion and expansion/deflection fittings to prevent damage to enclosed conductors or connected equipment. Where conduits are subject to seismic movement, provide 6 feet max. flex conduit with grounding fittings on each end bonded with #6 green wire. This includes, but is not limited to:
1. Where conduits cross structural joints intended for expansion, contraction, or deflection (seismic expansion joint).

G. Condensation Prevention: Where conduits cross barriers between areas of potential substantial temperature differential, provide sealing fitting or approved sealing compound at an accessible point near the penetration to prevent condensation. This includes, but is not limited to:
1. Where conduits pass from outdoors into conditioned interior spaces.
2. Where conduits pass from unconditioned interior spaces into conditioned interior spaces.

H. Provide grounding and bonding in accordance with Section 26 0526.

I. Hazardous (Classified) Locations: Where conduits cross boundaries of hazardous (classified) locations, provide sealing fittings located as indicated or in accordance with CEC.

3.02 ABOVE GROUND RACEWAY SYSTEMS

A. Install all wiring in raceways. Install raceway systems, including conduits, hangers and support channels parallel or perpendicular to structural members in accordance with Section 260529 Hangers and 260502 Support. Coordinate location of raceway systems with other Divisions prior to commencing installation.

B. Rigid Steel Conduit: Suitable for use in all locations.

C. Intermediate Metal Conduit: As specified for rigid steel.

D. Electrical Metallic Tubing: Suitable for use in concealed dry locations, not in concrete, masonry, or underground, and suitable exposed, minimum 8 feet above finished floor.

E. Flexible Metal Conduit: Suitable for connection of recessed lighting fixtures, motors or other devices requiring flexible connections in dry locations.

F. Liquid-Tight Flexible Metal Conduit: Suitable for connection of motors and equipment in damp or wet locations.

G. Conduit Supports:
   1. Support all conduits at intervals per Chapter 3 of the CEC for the selected raceway type (not to exceed 10-feet).
   2. Support individual conduits with conduit hangers or clamp back and nest back, if required for entrance into the equipment.
   3. Support multiple conduits, 2 or more in parallel, with framing channel and pipe clamps.
   4. Spring steel fasteners may be used to fasten electrical metallic tubing to individual hanger wires, minimum #12 AWG, specifically used for hanging conduit, nothing else.

H. Conduit Bends:
   1. Provide no more than (3) 90-degree conduit bends or the equivalent number of smaller radius bends in any conduit run between boxes or equipment.
   2. Length of run: 400-feet maximum less 100-feet for each equivalent 90 degree bend.
   3. Fabricate bends and offsets with a hickey or conduit bender designed specifically for use with the type of conduit to be bent, or use factory made bend.
   4. Radius of Bends: Conduits 2" inside diameter or less the inside bend radius shall be at least 6 times the diameter. Conduits greater than 2" diameter the inside bend radius shall be at least 10 times the conduit diameter.

I. Cap conduits during construction to prevent entrance of foreign material.

J. Provide conduit-sealing bushings at conduit penetrations through exterior walls to seal against fluid and gas pressure around the conduit.

K. Fit all conduits that enter the enclosure of a switchboard, distribution panel, or motor control center with an insulated grounding bushing.

L. Install pull ropes in all empty conduits, #12 AWG in conduits 1 inch and smaller and 3/16 inch polypropylene rope in conduits 1-1/4 inch and larger.

3.03 UNDERGROUND RACEWAY SYSTEMS

A. Install all wiring in raceways. Coordinate location of raceway systems with other Divisions prior to commencing installation. Provide excavation, clearances from other utilities, encasing, trenching, boring, backfill, compaction, patching, per Division 31 Site Preparation. Provide conduits per drawings.

B. EXCAVATING AND BACKFILLING
   1. Excavate and backfill as required for installation of electrical work. Maintain all warning signs, barricades, flares and lanterns as required by the Safety Orders and local ordinances.
   2. Excavation: Dig trenches straight and true to line and grade, with bottom clear of any rock points. Support conduit for entire length on undisturbed original earth. Backfill: All backfill material shall be local material free of rubble, rubbish or vegetation. Trenches shall be backfilled and compacted to 90% of maximum dry density at optimum moisture content in layers not to exceed 6" when compacted.
   3. Minimum Coverage (depth) - Per CEC Table 300.5
   4. Area of Influence- Do not install conduits parallel to building footings in the area of influence. See structural drawings and specifications for the area of influence and the methods that conduits can cross a footing.
   5. Drain Slope- Underground conduit shall be installed such that a .125" per foot min. slope exists at all points of the run to allow drainange and prevent the accumulation of water. Provide a drain slope of greater than .125" per foot when extending conduit away from a building.
   6. Provide underground warning tape along entire conduit length.

C. CUTTING AND PATCHING
   1. Provide necessary cutting and patching required to accomplish the work of Division underground 26. Restore all surfaces, roadways, sod, walks, curbs, walls, existing underground installation, etc., cut by installations to original condition in an acceptable manner.

D. Conduit Bends:
   1. Provide no more than (3) 90-degree conduit bends or the equivalent number of smaller radius bends in any conduit run between boxes or equipment.
   2. Length of run: 400-feet maximum less 100-feet for each equivalent 90 degree bend.
   3. Fabricate bends and offsets with a hickey or conduit bender designed specifically for use with the type of conduit to be bent, or use factory made bend.
   4. Radius of Bends: Conduits 2" inside diameter or less the inside bend radius shall be at least 6 times the diameter. Conduits greater than 2" diameter the inside bend radius shall be at least 10 times the conduit diameter.

E. Rigid Steel Conduit: Suitable for use in all locations. Where used underground, wrap with no less than 2 layers of half-lapped 10 mil vinyl pipe wrapping tape, Manville, Minnesota Mining

F. PVC Conduit: Suitable for use underground, with a minimum of 18 inches of cover. Also suitable for use in concrete slabs (for healthcare facilities, use Schedule 80 PVC). Fabricate field bends with an approved thermal bender and jig. Maintain separation between conduits using plastic spacers specifically designed for the purpose.

G. Provide conduit-sealing bushings at conduit penetrations through exterior walls to seal against fluid and gas pressure around the conduit. Ducts shall be sealed to resist liguid and gas infiltration at all maintenance holes and building entrances.

H. Install pull ropes in all empty conduits, #12 AWG in conduits 1 inch and smaller and 3/16 inch polypropylene rope in conduits 1-1/4 inch and larger.

I. Fit PVC conduits that enter pullboxes and junction boxes with belled ends.

END OF SECTION

SECTION 26 05 37 – BOXES

PART 1 GENERAL

1.01 RELATED REQUIREMENTS

A. Section 26 2726 - Wiring Devices:
   1. Wall plates.

1.02 REFERENCE STANDARDS

A. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; National Electrical Manufacturers Association; 2012 (ANSI/NEMA FB 1).

B. NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports; National Electrical Manufacturers Association; 2008 (Revised 2010) (ANSI/NEMA OS 1).

C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); National Electrical Manufacturers Association; 2008.

D. CEC - California Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

E. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.

F. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.

G. UL 508A - Industrial Control Panels; Current Edition, Including All Revisions.

H. UL 514A - Metallic Outlet Boxes; Current Edition, Including All Revisions.

1.03 SUMMARY

A. Provide electrical materials, installation and testing for the interior improvements in Relocatable Building Houston Middle School.

1.04 DESCRIPTION

A. This section describes requirements for outlet boxes.

1.05 RELATED WORK

A. Section 26 0100: General Requirements for Electrical Work.

1.06 REFERENCE STANDARDS

A. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; National Electrical Manufacturers Association; 2007.

B. NEMA OS 1 - Sheet Steel Outlet Boxes, Device Boxes, Covers, and Box Supports; National Electrical Manufacturers Association; 2008.

C. NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports; National Electrical Manufacturers Association; 2008.

D. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); National Electrical Manufacturers Association; 2008.

1.07 SUBMITTALS

A. Procedure: Submit under provisions of Section 01 3000 - Administrative Requirements and Section 01 6000 - Product Requirements.

B. Provide submittals for items listed documenting compliance with specification requirements.

C. Product Data:

1. Electrical Materials: Manufacturer’s current published catalog sheets.

PART 2 PRODUCTS

2.01 BOXES

A. General Requirements:
   1. Do not use boxes and associated accessories for applications other than as permitted by CEC and product listing.
   2. Provide all boxes, fittings, supports, and accessories required for a complete raceway system and to accommodate devices and equipment to be installed.
   3. Provide products listed, classified, and labeled by Underwriter's Laboratories Inc. (UL) or testing firm acceptable to authority having jurisdiction as suitable for the purpose indicated.
   4. Where box size is not indicated, size to comply with CEC but not less than applicable minimum size requirements specified.
   5. Provide grounding terminals within boxes where equipment grounding conductors terminate.

B. Outlet and Device Boxes Up to 100 cubic inches (1,650 cu cm), Including Those Used as Junction and Pull Boxes:
   1. Use sheet-steel boxes for dry locations unless otherwise indicated or required.
   2. Use cast iron boxes or cast aluminum boxes for damp or wet locations unless otherwise indicated or required; furnish with compatible weatherproof gasketed covers.
   3. Use suitable concrete type boxes where flush-mounted in concrete.
   4. Use suitable masonry type boxes where flush-mounted in masonry walls.
   5. Use raised covers suitable for the type of wall construction and device configuration where required.
   6. Use shallow boxes where required by the type of wall construction.
   7. Do not use "through-wall" boxes designed for access from both sides of wall.
   8. Sheet-Steel Boxes: Comply with NEMA OS 1, and list and label as complying with UL 514A.
   9. Cast Metal Boxes: Comply with NEMA FB 1, and list and label as complying with UL 514A; furnish with threaded hubs.
   10. Boxes for Supporting Luminaires and Ceiling Fans: Listed as suitable for the type and weight of load to be supported; furnished with fixture stud to accommodate mounting of luminaire where required.
   11. Boxes for Ganged Devices: Use multigang boxes of single-piece construction. Do not use field-connected gangable boxes.
   12. Wall Plates: Comply with Section 26 2726.

C. Cabinets and Enclosures, Including Junction and Pull Boxes Larger Than 100 cubic inches (1,650 cu cm):
   1. Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E, or UL 508A.
   2. NEMA 250 Environment Type, Unless Otherwise Indicated:
   3. Junction and Pull Boxes Larger Than 100 cubic inches (1,650 cu cm):
      a. Provide screw-cover or hinged-cover enclosures unless otherwise indicated.

D. Cast Boxes: NEMA FB 1, Type FD, cast feralloy. Provide gasketed cover by box manufacturer. Provide threaded hubs.

2.02 OUTLET BOXES

A. Construction: Deep drawn or fabricated interlocked flat pieces with welded tabs, electro-galvanized sheet steel with electro-galvanized hardware. Do not use sectional boxes.

B. Size: To accommodate the required number and sizes of conduits, wires, splices and devices but not smaller than the size indicated or specified.

C. Plaster Ring: Provide flush with wall or ceiling finish, except where otherwise indicated or specified.

D. Device Boxes: For single switches and receptacles, provide boxes not less than 4 inches square by 1-1/2 inches deep. For 2 devices, provide boxes not less than 4-11/16 inches square by 1-1/2 inches deep.

E. Telecommunications Boxes: No less than 4-11/16 inches square by 2 inches deep.

F. Special Mounting: In cabinets, tile, concrete block, brick, stone, wood or similar material, provide rectangular boxes with square corners and straight sides. For single devices, provide boxes 4 inches high by 2-1/2 inches wide by 3-3/8 inches deep. For 2 or more devices, provide multi-gang, non-sectional box with tile or masonry ring.

G. Lighting Fixtures: 4-inch octagon by 2-1/8 inch deep, minimum. Fit boxes for surface or pendant mounted fixtures with 3/8-inch malleable iron fixture stud.

H. Attach device boxes with adjustable bar type hangers screw fastened to two stud/ceiling joists on both sides of box.

2.03 PULL AND JUNCTION BOXES

A. General: For all pull and junction boxes over 300 cubic inches, provide code gauge, sheet steel boxes which meet NEMA 1 standards for panelboard and terminal cabinet box construction, with screw type covers.

B. Ground Lug: Weld, before finish is applied, a grounding pad drilled for two bolted grounding lugs or two ground studs on the box interior.

C. Finish: Apply rust inhibiting prime coat and 2 coats of baked enamel, standard factory gray.

D. Hardware: Cadmium plated steel screws.

PART 3 EXECUTION

3.01 BOXES AND CABINETS

A. Place outlet boxes in a location as close to that shown on the plans as possible. Coordinate location of boxes with other Divisions.

B. Install wall mounted outlet boxes so that the distance from the centerline of the box to finished floor is as listed or indicated:
   1. Receptacles, + 1 foot-6 inches
   2. Telephone, + 1 foot-6 inches
   3. Data, + 1 foot-6 inches
   4. Switches, + 4 feet-0 inches

C. Install junction boxes with covers in concealed areas accessible after installation. Do not install junction boxes flush with finish walls or ceilings unless specifically approved by the Engineer.

D. Attach surface boxes with:
   1. Steel or malleable iron expansion anchors in concrete or solid masonry.
   2. Wood screws in wood.
   3. Toggle bolts in hollow walls or masonry.
   4. Machine screws, bolts or welded studs in steel.

E. Attach flush boxes with adjustable bar type hangers screw fastened to studs on both sides of the box.

END OF SECTION

SECTION 26 05 53 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 RELATED REQUIREMENTS

A. Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables: Color coding for power conductors and cables 600 V and less; vinyl color coding electrical tape.

1.02 REFERENCE STANDARDS

A. ANSI Z535.2 - American National Standard for Environmental and Facility Safety Signs; 2007.

B. ANSI Z535.4 - American National Standard for Product Safety Signs and Labels; 2007.

C. NFPA 70E - Standard for Electrical Safety in the Workplace; National Fire Protection Association; 2018.

D. UL 969 - Marking and Labeling Systems; Current Edition, Including All Revisions.

1.03 DESCRIPTION

A. Extent of electrical identification work is as outlined by this specification.

B. Types of electrical identification work specified in this section include the following:
   1. Buried cable warnings.
   2. Electrical power, control and communication conductors.
   3. Operational instructions and warnings.
   4. Danger signs.
   5. Equipment/system identification signs.

1.04 RELATED REQUIREMENTS

A. Section 26 0100: General Requirements for Electrical Work.

1.05 QUALITY ASSURANCE

A. California Electrical Code (CEC) Compliance: Comply with CEC as applicable to installation of identifying labels and markers for wiring and equipment.

B. Underwriters Laboratories, Inc. (UL) Compliance: Comply with applicable requirements of UL Standard 969, "Marking and Labeling Systems", pertaining to electrical identification systems.

C. American National Standards Institute (ANSI) Compliance: Comply with applicable requirements of ANSI Standard A13.1, "Scheme for the Identification of Piping Systems".

D. National Electrical Manufacturer's Association (NEMA) Compliance: Comply with applicable requirements of NEMA Standard No's WC-1 and WC-2 pertaining to identification of power and control conductors.

1.06 SUBMITTALS

A. Product Data: Submit manufacturer's data on electrical identification materials and products.

B. Samples: Submit samples of each color, lettering style and other graphic representation required for each identification material or system.

PART 2 PRODUCTS

2.01 IDENTIFICATION REQUIREMENTS

A. Identification for Equipment:
   1. Use identification nameplate to identify each piece of electrical distribution and control equipment and associated sections, compartments, and components.
      a. Switchgear:

1) Use identification nameplate to identify load(s) served for each branch device.

b. Panelboards:
1) Identify ampere rating.
2) Identify voltage and phase.
3) Identify power source and circuit number. Include location when not within sight of equipment.
4) Identify main overcurrent protective device. Use identification label for panelboards with a door. For power distribution panelboards without a door, use identification nameplate.
5) Use typewritten circuit directory to identify load(s) served for panelboards with a door. Identify spares and spaces using pencil.
6) For power panelboards without a door, use identification nameplate to identify load(s) served for each branch device. Do not identify spares and spaces.

c. Enclosed switches, circuit breakers, and motor controllers:
1) Identify voltage and phase.
2) Identify power source and circuit number. Include location when not within sight of equipment.
3) Identify load(s) served. Include location when not within sight of equipment.

d. Enclosed Contactors:
1) Identify ampere rating.
2) Identify voltage and phase.
3) Identify configuration, e.g., E.O.E.H. (electrically operated, electrically held) or E.O.M.H. (electrically operated, mechanically held).
4) Identify coil voltage.
5) Identify load(s) and associated circuits controlled. Include location.

2. Service Equipment:
a. Use identification nameplate to identify each service disconnecting means.
b. Use identification nameplate at each piece of service equipment to identify the available fault current and the date calculations were performed.

3. Use identification nameplate to identify disconnect location for equipment with remote disconnecting means.

4. Use identification label to identify overcurrent protective devices for branch circuits serving fire alarm circuits. Identify with text "FIRE ALARM CIRCUIT".

5. Use field-painted floor markings, floor marking tape, or warning labels to identify required equipment working clearances where indicated or where required by the authority having jurisdiction.
a. Field-Painted Floor Markings: Alternating black and white stripes, 3 inches (76 mm) wide, painted in accordance with Section 09 9123 and 09 9113.

6. Arc Flash Hazard Warning Labels: Use warning labels to identify arc flash hazards for electrical equipment, such as switchboards, panelboards, industrial control panels, meter socket enclosures, and motor control centers that are likely to require examination, adjustment, servicing, or maintenance while energized.
a. Minimum Size: 3.5 by 5 inches (89 mm by 127 mm).
b. Legend: Include orange header that reads "WARNING", followed by the word message "Arc Flash and Shock Hazard; Appropriate PPE Required; Do not operate controls or open covers without appropriate personal protection equipment; Failure to comply may result in injury or death; Refer to NFPA 70E for minimum PPE requirements" or approved equivalent.

7. Use warning signs to identify electrical hazards for entrances to all rooms and other guarded locations that contain exposed live parts operating at 600 V nominal or less with the word message "DANGER; Electrical hazard; Authorized personnel only" or approved equivalent.

B. Identification for Conductors and Cables:
   1. Color Coding for Power Conductors 600 V and Less: Comply with Section 26 0519.
   2. Identification for Communications Conductors and Cables: Comply with Section 27 1005.
   3. Use identification nameplate or identification label to identify color code for ungrounded and grounded power conductors inside door or enclosure at each piece of feeder or branch-circuit distribution equipment when premises has feeders or branch circuits served by more than one nominal voltage system.
   4. Use wire and cable markers to identify connected grounding electrode system components for grounding electrode conductors.

C. Identification for Raceways:
   1. Use voltage markers or color-coded bands to identify systems other than normal power system for accessible conduits at maximum intervals of 20 feet (6.1 m).
      a. Color-Coded Bands: Use field-painting or vinyl color coding electrical tape to mark bands 3 inches (76 mm) wide.
         1) Color Code:
            (a) Fire Alarm System: Red.
         2) Field-Painting: Comply with Section 09 9123 and 09 9113.
         3) Vinyl Color Coding Electrical Tape: Comply with Section 26 0519.

D. Identification for Boxes:
   1. Use voltage markers to identify highest voltage present.
   2. Use voltage markers or color coded boxes to identify systems other than normal power system.
      a. Color-Coded Boxes: Field-painted in accordance with Section 09 9123 and 09 9113 per the same color code used for raceways.
         1) Fire Alarm System: Red.

2.02 IDENTIFICATION NAMEPLATES AND LABELS

A. Identification Nameplates:
   1. Materials:
      a. Indoor Clean, Dry Locations: Use plastic nameplates.
      b. Outdoor Locations: Use plastic, stainless steel, or aluminum nameplates suitable for exterior use.
   2. Plastic Nameplates: Two-layer or three-layer laminated acrylic or electrically non-conductive phenolic with beveled edges; minimum thickness of 1/16 inch (1.6 mm); engraved text.
   3. Stainless Steel Nameplates: Minimum thickness of 1/32 inch (0.8 mm); engraved or laser-etched text.
   4. Aluminum Nameplates: Anodized; minimum thickness of 1/32 inch (0.8 mm); engraved or laser-etched text.

B. Identification Labels:
   1. Materials: Use self-adhesive laminated plastic labels; UV, chemical, water, heat, and abrasion resistant.
      a. Use only for indoor locations.
   2. Text: Use factory pre-printed or machine-printed text. Do not use handwritten text unless otherwise indicated.

C. Format for Equipment Identification:
   1. Minimum Size: 1 inch (25 mm) by 2.5 inches (64 mm).
   2. Legend:
      a. System designation where applicable:
         1) Fire Alarm System: Identify with text "FIRE ALARM".

b. Equipment designation or other approved description.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height:
   a. System Designation: 1 inch (25 mm).
   b. Equipment Designation: 1/2 inch (13 mm).
5. Color:
   a. Normal Power System: White text on black background.
   b. Fire Alarm System: White text on red background.

D. Format for Control Device Identification:
1. Minimum Size: 3/8 inch (10 mm) by 1.5 inches (38 mm).
2. Legend: Load controlled or other designation indicated.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height: 3/16 inch (5 mm).
5. Color: Black text on clear background.

E. Format for Fire Alarm Device Identification:
1. Minimum Size: 3/8 inch (10 mm) by 1.5 inches (38 mm).
2. Legend: Designation indicated and device zone or address.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height: 3/16 inch (5 mm).
5. Color: Red text on white background.

2.03 WIRE AND CABLE MARKERS

A. Markers for Conductors and Cables: Use wrap-around self-adhesive vinyl cloth, wrap-around self-adhesive vinyl self-laminating, heat-shrink sleeve, plastic sleeve, plastic clip-on, or vinyl split sleeve type markers suitable for the conductor or cable to be identified.

B. Markers for Conductor and Cable Bundles: Use plastic marker tags secured by nylon cable ties.

C. Legend: Power source and circuit number or other designation indicated.

D. Text: Use factory pre-printed or machine-printed text, all capitalized unless otherwise indicated.

E. Minimum Text Height: 1/8 inch (3 mm).

F. Color: Black text on white background unless otherwise indicated.

2.04 VOLTAGE MARKERS

A. Markers for Conduits: Use factory pre-printed self-adhesive vinyl, self-adhesive vinyl cloth, or vinyl snap-around type markers.

B. Markers for Boxes and Equipment Enclosures: Use factory pre-printed self-adhesive vinyl or self-adhesive vinyl cloth type markers.

C. Minimum Size:
1. Markers for Conduits: As recommended by manufacturer for conduit size to be identified.
2. Markers for Pull Boxes: 1 1/8 by 4 1/2 inches (29 by 110 mm).
3. Markers for Junction Boxes: 1/2 by 2 1/4 inches (13 by 57 mm).

D. Legend:
1. Markers for Voltage Identification: Highest voltage present.
2. Markers for System Identification:

E. Color: Black text on orange background unless otherwise indicated.

2.05 NOT USED

2.06 FLOOR MARKING TAPE

A. Floor Marking Tape for Equipment Working Clearance Identification: Self-adhesive vinyl or polyester tape with overlaminate, 3 inches (76 mm) wide, with alternating black and white stripes.

2.07 WARNING SIGNS AND LABELS

A. Comply with ANSI Z535.2 or ANSI Z535.4 as applicable.

B. Warning Signs:
   1. Materials:
   2. Minimum Size: 7 by 10 inches (178 by 254 mm) unless otherwise indicated.

C. Warning Labels:
   1. Materials: Use factory pre-printed or machine-printed self-adhesive polyester or self-adhesive vinyl labels; UV, chemical, water, heat, and abrasion resistant; produced using materials recognized to UL 969.
   2. Machine-Printed Labels: Use thermal transfer process printing machines and accessories recommended by label manufacturer.
   3. Minimum Size: 2 by 4 inches (51 mm by 102 mm) unless otherwise indicated.

2.08 ACCEPTABLE MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide electrical identification products of one of the following (for each type marker):
   1. Almetek,
   2. Brady, W.H. Company,
   3. Calipico Inc.,
   4. Cole-Flex Corporation,
   5. Direct Safety Company,
   6. George-Ingraham Corporation,
   7. Griffolyn Company,
   8. Ideal Industries, Inc.,
   9. LEM Products, Inc.,
   10. Markal Company,
   11. National Band and Tag Company,
   12. Panduit Corporation,
   13. Seton Name Plate Company,
   14. Tesa Corporation,
   15. Or equal.

2.09 ELECTRICAL IDENTIFICATION MATERIALS

A. Except as otherwise indicated, provide manufacturer's standard products of categories and types required for each application. Where more than single type is specified for an application, provide single selection for each application.

B. Color-Coded Plastic Tape:
   1. Provide manufacturer's standard self-adhesive vinyl tape not less than 3 mils thick by 1-1/2 inches wide.
      a. Colors: Unless otherwise indicated or required by governing regulations, provide orange tape.

C. Underground-Type Plastic Line Marker:
   1. Manufacturer's standard permanent, bright-colored, continuous-printed plastic tape, intended for direct-burial service; not less than 6 inches wide x 4 mils thick. Provide tape with printing which most accurately indicates type of service of buried cable.

D. Cable/Conductor Identification Bands:
   1. Provide manufacturer's standard vinyl-cloth self-adhesive cable/conductor markers of wrap-around type, either pre-numbered plastic coated type, or write-on type with clear plastic self-adhesive cover flap; numbered to show circuit identification.

E. Plasticized Tags:
   1. Manufacturer's standard pre-printed or partially pre-printed accident-prevention and operational tags, of plasticized card stock with matte finish suitable for writing, approximately 3-1/4 x 5-5/8 inches, with brass grommets and wire fasteners, and with appropriate pre-printed wording including large-size primary wording, e.g., DANGER, CAUTION, DO NOT OPERATE.

F. Self-Adhesive Plastic Signs:
   1. Provide manufacturer's standard, self-adhesive or pressure-sensitive, pre-printed, flexible vinyl signs for operational instructions or warnings; of sizes suitable for application areas and adequate for visibility, with proper wording for each application, e.g., 208V, EXHAUST FAN, RECTIFIER.

G. Colors: Unless otherwise indicated, or required by governing regulations, provide white signs with black lettering.

H. Baked Enamel Danger Signs:
   1. General: Provide manufacturer's standard DANGER signs of baked enamel finish on 20-gauge steel; of standard red, black and white graphics; 14 x 10 inches size except where 10 x 7 inches is the largest size which can be applied where needed, and except where larger size is needed for adequate vision; with recognized standard explanation wording, e.g., HIGH VOLTAGE, KEEP AWAY, BURIED CABLE, DO NOT TOUCH SWITCH.

I. Engraved Plastic-Laminate Signs:
   1. Provide engraving stock melamine plastic laminate, complying with FS L-P-387, in sizes and thicknesses indicated, engraved with engraver's standard letter style of sizes and wording indicated, black face and white core plies (letter color) except as otherwise indicated, punched for mechanical fastening except where adhesive mounting is necessary because of substrate.
   2. Thickness: 1/8 inch, except as otherwise indicated.
   3. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate substrate.

2.10 LETTERING AND GRAPHICS

A. General: Coordinate names, abbreviations and other designations used in electrical identification work, with corresponding designations shown, specified or scheduled. Provide numbers, lettering and wording as indicated or, if not otherwise indicated, as recommended by manufacturer or as required for proper identification and operation/maintenance of electrical systems and equipment. Comply with ANSI A13.1 pertaining to minimum sizes for letters and numbers.

PART 3 EXECUTION

3.01 APPLICATION AND INSTALLATION

A. General Installation Requirements:
   1. Install electrical identification products as indicated, in accordance with manufacturer's written instructions, and requirements of CEC and OSHA.
   2. Coordination: Where identification is to be applied to surfaces which require finish, install identification after completion of painting.
   3. Regulations: Comply with governing regulations and requests of governing authorities for identification of electrical work.

B. Conduit Identification:
   1. Where electrical conduit is exposed in spaces with exposed mechanical piping which is identified by color-coded method, apply color-coded identification on electrical conduit in manner similar to piping identification. Except as otherwise indicated use white as coded color for conduit.

C. Box Identification:
   1. After completion, using an indelible wide tip marker, indicate on the cover of each junction and pull box the designation of the circuits contained therein, i.e., A-1, 3, 5. Use a black marker for normal power circuits a red marker for critical circuits, an orange marker for life safety circuits, and a green marker for equipment circuits.
   2. All junction and pull boxes for wiring systems above 600V shall be identified with high voltage warning labels installed every 20 linear feet in accordance with OSHA standards. All boxes shall also be painted red, see Section 09900 of the specifications.
   3. All junction and pull boxes for the fire alarm system shall be painted red. All raceway for the fire alarm system shall be labeled "Fire Alarm" in red letters on intervals not to exceed ten feet.

D. Underground Cable Identification:
   1. During back-filling/top-soiling of each exterior underground electrical, signal or communication conduits, install continuous underground-type plastic line marker, located directly over buried line at 6 to 8 inches below finished grade. Where multiple small lines are buried in a common trench and do not exceed an overall width of 16 inches, install a single line marker.
   2. Install line marker for every buried conduit.

E. Cable/Conductor Identification:
   1. Apply cable/conductor identification, including voltage, phase and feeder number, on each cable/conductor in each box/enclosure/cabinet where wires of more than one circuit or communication/signal system are present, except where another form of identification (such as color-coded conductors) is provided. Match identification with marking system used in panelboards, shop drawings, contract documents, and similar previously established identification for project's electrical work. Refer to Section 16100 - Basic Materials and Methods of these specifications for color coding requirements.

F. Operational Identification and Warnings:
   1. Wherever directed by the Owner’s Representative, to ensure safe and efficient operation and maintenance of electrical systems, including prevention of misuse of electrical facilities equipment by unauthorized personnel, install self-adhesive plastic signs or similar equivalent identification, instruction or warnings on switches, outlets and other controls, devices and covers of electrical enclosures. Where detailed instructions or explanations are needed, provide plasticized tags with clearly written messages adequate for intended purposed. Request a meeting with the Owner’s Representative prior to substantial completion to coordinate warning requirements.

G. Danger Signs:
   1. In addition to installation of danger signs required by governing regulations and authorities, install appropriate danger signs at locations identified by the Owner’s Representative as constituting similar dangers for persons in or about project. Request a meeting with the Owner’s Representative prior to substantial completion to coordinate danger sign requirements.
      a. High Voltage: Install danger signs wherever it is possible, under any circumstances, for persons to come into contact with electrical power of voltages higher than 110-120 volts.
      b. Critical Switches/Controls: Install danger signs on switches and similar controls, regardless of whether concealed or locked up, where untimely or inadvertent

operation (by anyone) could result in significant danger to persons, or damage to or loss of property.

H. Equipment/System Identification:
   1. Install engraved plastic-laminate sign on each major unit of electrical equipment in building; including central or master unit of each electrical system including communication/control/signal systems, unless unit is specified with its own self-explanatory identification or signal system. Except as otherwise indicated, provide single line of text, 1/2 inch high lettering, on 1-1/2 inch high sign (2 inch high where 2 lines are required), white lettering in black field. Provide text matching terminology and numbering of the contract documents and shop drawings. Provide signs for each unit of the following categories of electrical work:
      a. Electrical cabinets and enclosures.
      b. Access panel/doors to electrical facilities.
      c. Transformers.
      d. Fire alarm control panel, battery cabinets, voice alarm system cabinets, and transponders.
   2. Install signs at locations indicated or, where not otherwise indicated, at location for best convenience of viewing without interference with operation and maintenance of equipment. Secure to substrate with fasteners, except use adhesive where fasteners should not or cannot penetrate substrate. Identification of flush mounted cabinets and panelboards shall be on the inside of the device.
   3. Panelboards, individually mounted circuit breakers, and each breaker in the switchboards, secondary unit substations, and distribution panels shall be identified with an engraved plastic laminate sign. Plastic nameplates shall be multicolored laminated plastic with faceplate and core as scheduled. Lettering shall be engraved minimum 1/4 inch high letters.
      .
      a. 208/120 volt normal power equipment shall be identified with green faceplate with white core.
      b. 208/120 volt equipment branch power equipment shall be identified with blue faceplate with white core.
      c. Equipment identification is to indicate the following:
         1) Equipment ID abbreviation.
         2) Voltage, phase, wires and frequency.
         3) Emergency or other system.
         4) Power source origination.
         5) Example:
            (a) Panel GLSH1
            (b) 208/120V, 3 phase, 4 wire
            (c) Fed by GLSD1
      d. Submit complete schedule with the shop drawings listing all nameplates and information contained thereon.

END OF SECTION

SECTION 26 08 01 - ELECTRICAL ACCEPTANCE TESTING

PART 1 GENERAL

1.01 DESCRIPTION

A. The work required under this section of the specifications consists of the electrical acceptance testing and inspections for all electrical systems and equipment installed or affected by this project. The Contractor shall prepare and submit to the Engineer for review and approval acceptance test procedures and inspection forms in accordance with this specification. A complete functional acceptance test shall be performed on all electrical systems and equipment to prove they perform as intended under all modes of operation. Testing specified in other sections is in addition to testing specified herein. Also the testing will demonstrate the electrical system and equipment operation to the Owner. All labor, materials, rentals, permits and testing equipment or other which is required shall be provided by the Contractor.

1.02 GENERAL

A. The Contractor shall prepare and submit to the Engineer for review and approval acceptance test procedures and inspection forms in accordance with this specification. Testing shall be performed by the Contractor, the manufacturer's representative, and/or a International Electrical Testing Association (NETA) testing company depending on the type of equipment or system being tested as follows:
   1. CONTRACTOR
      a. Cables, Low-Voltage, 600-Volt Maximum
      b. Switches and Circuit Breakers, Air, Low-Voltage
      c. Fiber Optic Cable
      d. Lighting System
      e. Clock System
      f. Telecommunications System
      g. Grounding System
      h. Low Voltage (600 VAC maximum) Power Distribution System
      i. Instrument and Control System
   2. MANUFACTURER'S REPRESENTATIVE
      a. Fire Alarm System
   3. NETA
      a. Switchgear and Switchboard Assemblies (480VAC, 1000A or greater)
      b. Ground Fault Protection System
      c. Circuit Breakers
      d. Metering Devices

B. The Contractor shall prepare the test procedures and inspection forms and perform the specified testing and inspections, for the assigned equipment and systems above, as applicable to the equipment and systems installed or affected by the project. If the Contractor (including sub contractors) does not have the ability or qualifications to conduct the required tests then the Contractor will sub contract with a testing organization who does.

C. The Contractor shall engage in and pay for the services of the Manufacturer's Representative approved testing organizations to provide testing and inspection of the applicable electrical equipment and systems as listed above and specified in this section. The testing organizations may be an independent division or authorized representative of the manufacturer of the assembled products being tested. The Manufacturer's Representative will conduct startup testing and will be part of integrated system testing. If an outside testing organization is approved, a representative of the manufacturer shall be under contract by the testing company.

The representative shall be present during all testing to insure that the testing is performed properly and that any deficiencies discovered are promptly corrected. The Manufacturer's Representative will assist in the preparation and performance of other test procedures and inspections such as integrated system testing (e.g., loss of power/ generator/ats/ups/annunciator integrated system test)

D. The Contractor shall engage in and pay for the services of a NETA Accredited Testing Company to provide testing and inspection applicable electrical equipment and systems as listed above and specified in this section. Also, the NETA testing contractor will conduct integrated system testing or other testing as required. NETA testing will be conducted per the current Standard for NETA Acceptance Testing Specification including test report preparation and submittals. Technicians performing these electrical tests and inspections shall be trained and experienced concerning the apparatus and systems being evaluated. These individuals shall be capable of conducting the tests in a safe manner and with complete knowledge of the hazards involved. They must evaluate the test data and make a judgment on the serviceability of the specific equipment. Technicians shall be certified in accordance with the current ANSI/NETA ETT, Standard for Certification of Electrical Testing Personnel. Each on-site crew leader shall hold a current certification, Level III or higher, in electrical testing. The testing organization shall provide the following: A written record of all tests and a final report; All field technical services, tooling, equipment, instrumentation, and technical supervision to perform such tests and inspections; Specific power requirements for test equipment; Notification to the owner's representative prior to commencement of any testing; A written record of all tests and a final report and a timely notification of any system, material, or workmanship that is found deficient based on the results of the acceptance tests. The NETA contractor will assist in the preparation and performance of other test procedures and inspections such as an acceptance testing of the integrated system (e.g., loss of power/generator/ATS/UPS/annunciator integrated system test)

E. Submit all test reports to the Owners Representative at least two weeks prior to the project final inspection for review.

1.03 SAFETY AND PRECAUTIONS

A. All parties involved must be cognizant of industry-standard safety procedures. This document does not contain any procedures including specific safety procedures. It is recognized that an overwhelming majority of the tests and inspections recommended in these specifications are potentially hazardous. Individuals performing these tests shall be qualified and capable of conducting the tests in a safe manner and with complete knowledge of the hazards involved.

B. Safety practices shall include, but are not limited to, the following requirements:
   1. All applicable provisions of the Occupational Safety and Health Act, particularly OSHA 29 CFR Part 1910 and 29 CFR Part 1926 including OSHA lockout procedures.
   2. ANSI/NFPA 70E, Standard for Electrical Safety in the Workplace.
   3. Applicable state and local safety operating procedures.
   4. Owner's safety practices.
   5. A safety lead person shall be identified prior to the commencement of work.
   6. A safety briefing shall be conducted prior to the commencement of work.
   7. All tests shall be performed with the apparatus de-energized and grounded except where otherwise specifically required to be ungrounded or energized for certain tests.
   8. The testing organization shall have a designated safety representative on the project to supervise operations with respect to safety.

1.04 QUALITY ASSURANCE

A. The testing and inspection shall comply with all applicable sections of the following codes and standards:
   1. American National Standards Institute - ANSI

2. American Society for Testing and Materials - ASTM
3. Association of Edison Illuminating Companies - AEIC
4. Institute of Electrical and Electronics Engineers - IEEE
5. Insulated Power Cable Engineers Association - IPCEA
6. International Electrical Testing Association - NETA Acceptance Testing Specifications
7. California Electrical Code - CEC
8. National Electrical Manufacturers Association - NEMA
9. National Fire Protection Association - NFPA
10. State and Local Codes and Ordinances

B. The inspection and testing shall comply with the project plans and specifications as well as with the manufacturer's drawings, instruction manuals, and other applicable data for the apparatus tested.

C. Review and Approval- All test reports, deficiencies and corrections, test results, shall be reviewed by the Engineer of Record.

1.05 DIVISION OF RESPONSIBILITY

A. Perform routine insulation-resistance, continuity, and rotation tests for all distribution and utilization equipment prior to and in addition to tests performed by the testing firm specified herein.

B. Supply a suitable and stable source of electrical power to each test site. The testing firm shall specify the specific power requirements.

C. Notify the testing firm when equipment becomes available for acceptance tests. Work shall be coordinated to expedite project scheduling.

D. Supply a complete set of electrical plans, specifications, and any pertinent change orders to the testing firm prior to commencement of testing.

E. Notify the Engineer and Owner's Representative prior to commencement of any testing.

F. Any system, material or installation which is found defective on the basis of acceptance tests shall be reported to the Owner's Representative.

G. The testing firm shall maintain a written record of all tests and, upon completion of project, shall assemble and certify a final test report for review and approval by the Engineer of Record.

1.06 ACCEPTANCE TEST PROCEDURES

A. The Acceptance Test Procedure shall include the following sections:
1. Purpose of Test
2. References
3. Test Participants- Name/Company/Telephone Number and hand signed Initials
4. Equipment and Systems tested.
5. Description of test.
6. Acceptance Criteria
7. Initial Conditions/Prerequisites
8. Test Equipment and Calibration date
9. Test Procedure and Date of Test
10. Test Results-verification of passing acceptance criteria.
11. Deficiencies, Corrections and Re-test
12. Verification Systems and Equipment are returned to Operational Status
13. Conclusions and recommendations.
14. Appendix, including test forms.

B. Each piece of equipment shall be recorded in the test procedure listing the condition of the equipment as found and as left. Included shall be recommendations for any necessary repair

or replacement parts. The test procedures shall indicate the name of the engineer who tested the equipment and the date of the test completion.

C. Inspection Reports may be in situ test reports prepared by manufacturer representatives such as startup test reports by, for example the UPS or Generator manufacturers' startup representative. The inspection reports shall indicate the name of the person who inspected the equipment and the date of completion.

D. The Acceptance Test Procedure shall be a step by step procedure to be followed verbatin and initialed after each step's performance. The test shall include the listed sections above. The procedure shall be prepared on 8.5" x 11" paper. See Attachment 1 as an example.

1.07 TESTING INSTRUMENT TRACEABILITY

A. All applicable test instrumentation shall be currently calibrated within rated accuracy.

B. The accuracy shall be traceable to the National Bureau of Standards in an unbroken chain.

C. Instruments shall be calibrated in accordance with the following frequency schedule:
   1. Field instruments: 6 months maximum.
   2. Laboratory instruments: 12 months.
   3. Leased specialty equipment: 12 months

D. Dated calibration labels shall be visible on all test equipment.

1.08 FINAL SETTINGS

A. The Contractor shall be responsible for implementing all final settings and adjustments of equipment in accordance with manufacturer's and/or Engineer's specified values. The Contractor shall be responsible to request any required setting values from the Engineer.

1.09 SUBMITTALS

A. At least two weeks prior to conducting testing, submit Acceptance Test Procedures and Inspection Reports for review and approval by the Electrical Engineer of Record. This includes the prepared test report outlined above including all systems and equipment to be tested (with the test results, deficiencies, and conclusions sections blank). The Contractor shall be responsible to integrate the testing by the Contractor, Manufacturing Representatives, and NETA testing organization. The NETA testing organization shall prepare the Testing Documents per the current NETA Acceptance Testing Specification and assist the Contractor in preparing an Integrated System Test. The Manufacturing Representative testing organization shall prepare their regular start up test plan and assist the Contractor in preparing an Integrated System Test. After review and approval the test report shall be executed.

B. At least two week prior to conduction testing, submit for review and approval by the Engineer the list of test participants and prove of their qualifications and demonstrate they have the necessary testing experience and training to conduct the test.

C. Record copies of the completed test report shall be submitted no more than 30 days after completion of the testing and inspection.

1.10 FAILURE TO MEET TEST

A. Any found defective on the basis of acceptance test shall be reported directly to the Engineer.

B. Contractor shall replace the defective material or equipment and have test repeated until test proves satisfactory without additional cost to the Owner.

PART 2 - PRODUCTS-NOT USED

PART 3 - EXECUTION

3.01 EQUIPMENT TO BE TESTED AN INSPECTED

A. The following equipment shall be tested in accordance with the scopes of work which follow and additional participation in other acceptance testing such as integrated system and

functional testing. Acceptance test procedures and inspection reports shall be prepared, submitted and approved prior to performance of testing and inspections. The party responsible is identified in accordance with the following key: C = Contractor/Installer; M = Manufacturer; T = Testing Agency.

1. Molded Case Circuit Breakers - C
2. Fire Alarm System - M
3. Grounding System - C
4. Cables, Low Voltage, 600 Volts Maximum - C
5. Ground Fault Systems - C
6. Low Voltage Switchgear and Switchboards - T
7. Low Voltage Power Circuit Breakers and Insulated Case Circuit Breakers - T
8. Lighting Control System - C
9. Telecommunications Systems-C or M
10. Other Systems-C, M, T

3.02 INSPECTIONS

A. DRY TYPE TRANSFORMERS

1. Visual and Mechanical Inspection:
   a. With case covers removed, inspect transformer core and coil assembly and enclosure interior. Cloth wipe and brush major insulating surfaces.
   b. Check primary, secondary, and ground connections.
   c. Check tap connections and tap changer.
   d. Inspect all bolted connections. Torque wrench tighten or remake any questionable connections.
   e. Inspect insulators, spacers, and windings.
   f. Inspect for adequate electrical clearance.
   g. Check base or support insulators, including vibration isolation supports.
   h. Check accessory devices for condition and proper operation.
   i. Verify that the transformers have been provided with adequate spacing for ventilation.

B. MOLDED CASE CIRCUIT BREAKERS

1. Visual and Mechanical Inspection:
   a. Inspect cover and case, and check for broken or loose terminals.
   b. Operate breaker to check operation.
   c. Verify proper reporting of the events on the project equipment monitoring system
2. Electrical Tests (400 ampere frame and larger):
   a. Insulation Resistance Test: Megger main poles of breaker pole-to-pole, from each pole to ground, and across the open contacts of each pole.
   b. Contact Resistance Test: Ductor across main pole contacts with breaker closed and latched to check for good, low resistance contact.
   c. Test overcurrent trip device and calibrate. Where primary injection testing is specified, test each pole of the breaker individually. Data shall be compared with manufacturer's published data.
      1) All trip units shall be tested by primary injection.
      2) Static overcurrent trip devices shall be tested per manufacturer's instructions.
      3) Test for minimum pick-up current.
      4) Apply 300% of pick-up current and measure time necessary to trip breaker (long time delay).
      5) Where short time delay characteristics are provided, test short time pick-up and delay.
      6) Test instantaneous trip by passing current sufficiently high to trip breaker instantaneously.

7) Where ground fault protection is provided, test ground fault pick-up and delay.
8) Check reset characteristics of trip unit.
9) Electrically test any auxiliary devices such as shunt trips, undervoltage trips, alarm switches, and auxiliary switches.

C. FIRE ALARM SYSTEM
1. Visual and Mechanical Inspection:
   a. Inspect each device for physical damage.
   b. Check for proper labeling of conductors.
   c. Inspect all test switches for proper operation.
   d. Inspect all system lamps and LED's for proper operation. Replace all non-operational equipment.
   e. Check all cabinet doors latches and hinges for proper operation. Adjust, lubricate, and repair as required.
   f. Verify proper reporting of the events on the project equipment monitoring system.
2. Electrical Tests: Test each individual circuit at panel with equipment connected for proper operation. Entire system shall test free from opens, grounds, and short circuits. Verify control circuit integrity: Field tests to verify component compliance with specifications, adjusting, calibrating, and setting circuit breaker, relays, timers, etc. Testing will include, but not be limited to the following:
   a. Before energizing the cables and wires, check for correct connections and test for short circuits, ground faults, continuity, and insulation.
   b. Close each sprinkler system control valve and verify proper supervisory alarm at the FACP.
   c. Verify activation of all flow switches.
   d. Open initiating device circuits and verify that the trouble signal actuates.
   e. Open and short signaling line circuits and verify that the trouble signal actuates.
   f. Open and short indicating appliance circuits and verify that trouble signal actuates.
   g. Ground all circuits and verify response of trouble signals.
   h. Check presence and audibility of all alarm notification devices.
   i. Check installation, supervision, and operation of all intelligent smoke detectors.
   j. Each of the alarm conditions that the system is required to detect should 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.
   k. When the system is equipped with optional features, the manufacturer's manual should be consulted to determine the proper testing procedures. This is intended to address such items as verifying controls performed by individually addressed or grouped devices, sensitivity monitoring, verification functionality and similar.
   l. Check the integrity of the software program with the system in complete operation. Verify that each message reported is correct with respect to the signal received. All possible operating conditions and system troubles shall be tested. Rewrite software as required.
   m. Before energizing the cables and wires, check for correct connections and test for short circuits, ground faults, continuity, and insulation.
   n. Close each sprinkler system control valve and verify proper supervisory alarm at the FACP.
   o. Verify activation of all flow switches.
   p. Open initiating device circuits and verify that the trouble signal actuates.
   q. Open and short signaling line circuits and verify that the trouble signal actuates.
   r. Open and short indicating appliance circuits and verify that trouble signal actuates.
   s. Ground all circuits and verify response of trouble signals.
   t. Check presence and audibility of all alarm notification devices.

u. Check installation, supervision, and operation of all intelligent smoke detectors.
v. Each of the alarm conditions that the system is required to detect should 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.
w. When the system is equipped with optional features, the manufacturer's manual should be consulted to determine the proper testing procedures. This is intended to address such items as verifying controls performed by individually addressed or grouped devices, sensitivity monitoring, verification functionality and similar.
x. Check the integrity of the software program with the system in complete operation. Verify that each message reported is correct with respect to the signal received. All possible operating conditions and system troubles shall be tested. Rewrite software as required.

D. GROUNDING SYSTEM
1. Visual and Mechanical Inspection:
a. Inspect wiring system outlet and junction boxes for proper grounding. Green grounding conductor shall be connected to outlet and junction boxes. Inspect a minimum of 5% of project boxes.
b. Verify connections of grounds for the secondary of separately derived grounding systems, i.e. at dry type transformers. Note type of connection, i.e. mechanical or exothermic.
c. Verify proper connection to all components of building service entrance grounding system. Note all system components which are interconnected and type of connection either mechanical or exothermic. Note depth of driven ground rods.
2. Electrical Tests (Small Systems):
a. Perform ground-impedance measurements utilizing the fall-of-potential method per ANSI/IEEE Standard 81 "IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System". Instrumentation utilized shall be specifically designed for ground impedance testing. Provide sufficient spacing so that plotted curves flatten in the 62% area of the distance between the item under test and the current electrode.
b. Equipment Grounds:
1) Utilize two-point method of IEEE Std. 81. Measure between equipment ground being tested and known low-impedance grounding electrode or system.
3. Electrical Tests (Large Systems):
a. When sufficient spacing of electrodes described above is impractical, perform ground-impedance measurements utilizing either the intersecting curves method or the slope method. (Ref. Nos. 40 and 41 in IEEE Std. 81.)
b. Test Values:
1) The main ground electrode system impedance-to-ground should be no greater than five (5) ohms. Equipment grounds, depending on size and length of grounding conductor, should be only fractionally higher than system ground.

E. CABLES - LOW-VOLTAGE - 600V MAXIMUM
1. Visual and Mechanical Inspection:
a. Inspect cables for physical damage and proper connection in accordance with single-line diagram.
b. Test cable mechanical connections to manufacturer's recommended values using a calibrated torque wrench.
c. Check cable color-coding with applicable specifications and National Electrical Code standards.
2. Electrical Tests:

a. Perform insulation-resistance test on each feeder on the riser diagram with respect to ground and adjacent conductors. Applied potential shall be 1000 volts dc for 1 minute.
b. Perform continuity test to insure proper cable connection.
c. Test Values:
    1) Evaluate results by comparison with cables of same length and type. Investigate any values less than 50 megohms.
    2) Provide a test report for each feeder which indicates the manufacturer's target values and actual test reading. Report shall indicated pass/fail for each feeder. Submit report to Owner's Representative for approval. Include test report in project maintenance manual.
d. Feeder Cables:
    1) 600-volt feeder cables in the building and secondary service cables to the building shall be tested using a megohmmeter, to measure the insulation resistance of each conductor in the circuit.
    2) Disconnect all equipment switches, relays, buswork, transformers, etc.) from the cable being tested.
    3) Tests to be performed in a dry area.
    4) Clean and dry cable ends with a cloth moistened with a suitable solvent.
e. e.Cable Values: Cable values shall be established and provided by the cable manufacturer. Provide target value insulation resistance (IR) in megohms, based on 1000 ft. at 60 Deg F.
f. Temperature Correction Factor: For temperatures above or below 60ºF, a correction factor may have to be applied to determine the true IR value. However, if the measured IR of the system is equal to or greater than the calculated value, a correction factor is not needed.
g. Correct insulation deficiencies which show and insulation resistance of less than one megohm.
h. Test conductors with power off and impress a voltage of not less than 500 volts D.C.
i. Perform continuity tests on all conductors.

F. GROUND-FAULT SYSTEMS (CEC 230-95)
1. Visual and Mechanical Inspection:
    a. Inspect for physical damage and compliance with drawings and specifications.
    b. Inspect neutral main bonding connection to assure:
        1) Zero-sequence sensing system is grounded.
        2) Ground-strap sensing systems are grounded through sensing device.
        3) Ground connection is made ahead of neutral disconnect link on zero-sequence sensing systems.
        4) Grounded conductor (neutral) is solidly grounded.
    c. c.Inspect control power transformer to ensure adequate capacity for system.
    d. Manually operate monitor panels (if present) for:
        1) Trip test.
        2) No trip test.
        3) Nonautomatic reset.
    e. Record proper operation and test sequence.
    f. Set pickup and time-delay settings in accordance with the settings provided by the University's Representative.
    g. Verify proper reporting of the events on the project equipment monitoring system.
2. Electrical Tests:

a. Measure system neutral insulation to ensure no shunt ground paths exist. Remove neutral-ground disconnect link. Measure neutral insulation resistance and replace link.
b. Determine the relay pickup current by current injection at the sensor and operate the circuit interrupting device.
c. Test the relay timing by injecting three hundred percent (300%) of pickup current, or as specified by manufacturer.
d. Test the system operation at fifty-seven percent (57%) rated control voltage, if applicable.
e. Test zone interlock systems by simultaneous sensor current injection and monitoring zone blocking function.
f. On multiple source, tie breaker, etc., systems, devise a simulation scheme that fully proves correct operation.
g. Test Parameters:
    1) System neutral insulation shall be a minimum of one hundred (100) ohms, preferably one (1) megohm or greater.
    2) Relay timing shall be in accordance with manufacturer's published time-current characteristic curves but in no case longer than one (1) second for fault currents equal to or greater than 3,000 amperes.
    3) Relay pickup value shall be within +10% of setting and in no case greater than 1200A.

G. LOW VOLTAGE SWITCHBOARDS
1. Visual and Mechanical Inspection:
    a. Verify that the enclosure interiors have been cleaned of accumulated dust, dirt, oil films, and other foreign materials.
    b. Inspect all electrical and mechanical components for condition and any evidence of defects or failure.
    c. Check for proper travel and alignment of any drawout or plug-in circuit breakers.
    d. Check breaker connections to bus.
    e. Inspect bolted connections. Torque wrench tighten or remake any questionable connections.
    f. Inspect for missing or loose hardware or accessories.
    g. Inspect ground bus connections.
    h. Operate key and door interlock devices to assure proper operation.
    i. Verify proper reporting of the events on the project equipment monitoring system.
2. Electrical Tests:
    a. Insulation Resistance Test: Megger main secondary bus and feeder circuits phase-to-phase and phase-to-ground.
    b. Energize any space heater circuits to insure proper operations.
    c. Check phase rotation with a Biddle phase rotation meter.
    d. Instruments and Meter Tests:
        1) Inspect panel mounted instruments and meters. Clean and check for calibration accuracy. Make minor adjustments as necessary.

H. LOW VOLTAGE POWER CIRCUIT BREAKERS AND INSULATED CASE CIRCUIT BREAKERS
1. Visual and Mechanical Inspection:
    a. Remove each draw-out type circuit breaker.
    b. Inspect arc chutes of power circuit breakers.
    c. Inspect circuit breaker for defects or damage.
    d. Inspect and check contacts. Check alignment, over-travel, and pressure. Adjust if necessary.

e. Inspect finger clusters on line and load stabs of draw-out circuit breakers.
f. Check for proper mechanical operation. Lubricate where necessary.
g. Check auxiliary devices for proper operation.
h. Check breaker racking device (if applicable) for alignment and friction-free operation. Lubricate if necessary.
i. Verify proper reporting of the events on the project equipment monitoring system.

2. Electrical Tests:
   a. Insulation Resistance Test: Megger main poles of breaker pole-to-pole, from each pole to ground, and across the open contacts of each pole.
   b. Contact Resistance Test: Ductor across main pole contacts with breaker closed and latched to check for good, low resistance contact.
   c. Test overcurrent trip device by primary injection and calibrate to settings provided. Static overcurrent trip devices shall be tested per the manufacturer's instructions. Test each pole of the breaker individually. Data shall be compared with manufacturer's published data.
      1) Test for minimum pick-up current.
      2) Apply 300% of pick-up current and measure time necessary to trip breaker (long time delay).
      3) Where short time delay characteristics are provided, test short time pick-up and delay.
      4) Test instantaneous trip by passing current sufficiently high to trip breaker instantaneously.
      5) Where ground fault protection is provided, test ground fault pick-up and delay.
      6) Check reset characteristic of trip unit.
   d. Electrically test any auxiliary devices such as shunt trips, undervoltage trips, alarm contacts, and auxiliary contacts.

END OF SECTION

SECTION 26 22 00 – LOW VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.01 REFERENCE STANDARDS

A. IEEE C57.96 - Guide for Loading Dry-Type Distribution and Power Transformers; 2014.

B. NEMA ST 20 - Dry-Type Transformers for General Applications; National Electrical Manufacturers Association; 2014.

1.02 REQUIREMENTS INCLUDED

A. The General Conditions, Supplementary General Conditions, Special Conditions and Division 1 General Requirements apply to the work of this section.

B. This section describes requirements for dry type transformer.

C. This section describes requirements for dry type transformer K-rated.

1.03 RELATED WORK

A. Section 26 0100: General Requirements for Electrical Work.

1.04 REFERENCE STANDARDS

A. The Underwriters Laboratory, Inc. (UL).

B. National Electrical Manufacturers Association (NEMA).

1.05 QUALIFICATIONS

A. The equipment manufacturer shall be ISO 9000, 9001 or 9002 certified.

B. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

C. The transformers shall be suitable for and certified to meet all applicable seismic requirements of the International Building Code (IBC) for zone 4 application. Guidelines for the installation consistent with these requirements shall be provided by the transformer manufacturer and be based upon testing of representative equipment.

D. The test response spectrum shall be based upon a 5 percent minimum damping factor, IBC: a peak of 0.75g, and a ZPA (zero period acceleration) of 0.38g. The tests shall fully envelope this response spectrum for all equipment natural frequencies up to at least 35Hz.

1.06 SUBMITTALS

A. Submit manufacturers' data and shop drawings in accordance with Section 01 3000 - Administrative Requirements and Section 01 6000 - Product Requirements for items listed.

B. Manufacturers Data:
   1. Dimension drawing and weight.
   2. Technical certification sheet.
   3. Conduit entry/exit locations.
   4. Transformer ratings including:
      a. Primary and secondary kVA.
      b. Voltage.
      c. Taps.
      d. Primary and secondary continuous current.
      e. Basic Impulse level for equipment over 600-volts.

f. Impedance.
g. Insulation class and temperature rise.
h. Sound level.

PART 2 - PRODUCTS

2.01 ALL TRANSFORMERS

A. Description: Factory-assembled, dry type transformers for 60 Hz operation designed and manufactured in accordance with NEMA ST 20 and listed and labeled by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

B. Unless noted otherwise, transformer ratings indicated are for continuous loading according to IEEE C57.96 under the following service conditions:
1. Altitude: Less than 3,300 feet (1,000 m).
2. Ambient Temperature: Not exceeding 86 degrees F (30 degrees C) average or 104 degrees F (40 degrees C) maximum measured during any 24 hour period.

C. Core: High grade, non-aging silicon steel with high magnetic permeability and low hysteresis and eddy current losses. Keep magnetic flux densities substantially below saturation point, even at 10 percent primary overvoltage. Tightly clamp core laminations to prevent plate movement and maintain consistent pressure throughout core length.

D. Impregnate core and coil assembly with non-hydroscopic thermo-setting varnish to effectively seal out moisture and other contaminants.

E. Basic Impulse Level: 10 kV.

F. Ground core and coil assembly to enclosure by means of a visible flexible copper grounding strap.

G. Isolate core and coil from enclosure using vibration-absorbing mounts.

H. Nameplate: Include transformer connection data, ratings, wiring diagrams, and overload capacity based on rated winding temperature rise.

2.02 DRY TYPE POWER TRANSFORMERS

A. General: Provide dry type power transformers, for lighting and general power applications, rated as indicated.

B. Transformers shall be designed for continuous operation at rated kVA, for 24 hours a day, yearly operation, with normal life expectancy as defined in American National Standards Institute (ANSI) C57.96.

C. Shipping: Provide lifting holes, accessible without removal of any of the enclosure components.

D. Insulation, as listed:

Insulation Size	Temperature Class	Rating	Hot Spot Allowance
E. 2kVA & below	NEMA B or better	80 degress C rise	30 degrees C
F. 3kVA thru 15 kVA	NEMA F or better	115 degress C rise	30 degrees C
G. 15kVA and above	NEMA H	150 degress C rise	30 degrees C

H. Base temperature rating and hot spot allowances in the above table on a 40 degrees C maximum ambient temperature and 30 degrees C average ambient temperature.

I. Overload Capacity: 10 percent above full load rating continuously in an ambient not exceeding 40 degrees C.

J. Case Temperature: Maintain no more than a 35 degrees C rise above a 40 degrees C ambient.

K. Taps, as listed:

Transformer Rating	Phase	Taps
L. Through 10kVA	Single	None
M. 15kVA thru 2kVA	Single	(2) 5 percent FCBN
N. 6kVA thru 15 kVA	Three	(2) 5 percent FCBN
O. 30kVA and larger	Single and Three	(2) 2-1/2 percent FCAN and
P. (4) 2-1/2 percent FCBN		

where FCBN - Full Capacity Below Normal.

Q. Sound levels, not to exceed listed values, as determined by NEMA standards:

Size	Sound Level in dB
Through 9kVA	40
10 through 50kVA	45
51 through 150kVA	50

R. Provide vibration isolating mounts to isolate the enclosure from the core and coil assembly.

S. Mounting, suitable as listed:
   1. Single Phase Transformers: Wall
   2. Three Phase Transformers, through15kVA: Wall.
   3. Three Phase Transformers, 15kVA and above: Floor or ceiling hung channel.

T. Provide conduit knockouts for line and load conduit entrance.

U. Enclosure:
   1. Units rated 30kVA and below, the encapsulated enclosure construction shall be totally enclosed, non-ventilated, NEMA 3R, with lifting eyes.
   2. Units rated 15kVA and above, the enclosure construction shall be ventilated, NEMA 2, drip-proof, with lifting holes. All ventilation openings shall be protected against falling dirt.
   3. Outdoor units rated 15kVA or above, provide suitable weather-shields over ventilation openings.

V. Finish: Degrease, clean, phosphatize, prime and finish all interior and exterior surfaces with baked enamel, color ANSI 61 or standard factory grey.

W. Connect a grounding strap from the secondary neutral to a grounding lug on the enclosure.

X. Terminals: As specified in Section 16100 - Basic Materials and Methods.

Y. Subject transformers 25kVA above to listed production test at factory:
   1. Ratio tests at the rated voltage connection and at all tap connections.
   2. Polarity and phase relation tests on the rated voltage connection.
   3. Applied ptotential tests.
   4. Induced potential test.
   5. No-load and excitation current at rated voltage on the rated voltage connection.

Z. Factory to perform the listed standard tests on unit of identical design:
   1. No-load losses.
   2. Total losses.
   3. Sound levels.

4. Temperature rise.
5. Impulse.
6. Impedance.
7. Induced potential.
8. Applied potential.

AA. Submit certified test reports for production and standard tests.

AB. Manufacture: Cutler-Hammer, General Electric, Sorgel.

2.03 DRY TYPE POWER TRANSFORMERS (K-FACTOR RATED)

A. General: Provide dry type power transformers, for lighting and general power applications, rated as indicated.

B. Transformers shall be designed for continuous operation at rated kVA, for 24 hours a day, yearly operation, with normal life expectancy as defined in American National Standards Institute (ANSI) C57.96.

C. The transformers shall be specifically designed to supply circuits with a harmonic profile equal to or less than a K-factor of 4 to 13 without exceeding 115 degree C temperature rise.

D. Shipping: Provide lifting holes, accessible without removal of any of the enclosure components.

E. Insulation, as listed:

Insulation Size	Temperature Class	Rating	Hot Spot Allowance
2kVA & below	NEMA B or better	80 degrees C rise	30 degrees C
3kVA thru 15kVA	NEMA F or better	115 degrees C rise	30 degrees C
15kVA & above	NEMA H	150 degrees C rise	30 degrees C

F. Base temperature rating and hot spot allowances in the above table on a 40 degrees C maximum ambient temperature and 30 degrees C average ambient temperature.

G. Case Temperature: Maintain no more than a 35 degrees C rise above a 40 degrees C ambient.

1. Taps, as listed:

Transformer Rating	Phase	Taps
Through 10kVA	Single	None
15kVA thru 25kVA	Single	(2) 5 percent FCBN
6kVA thru 15kVA	Three	(2) 5 percent FCBN
30kVA and larger	Single and Three	(2) 2-1/2 percent FCAN and (4) 2-1/2 percent FCBN

H. Sound levels, not to exceed listed values, as determined by NEMA standards:

Size	Sound Level in dB
10 through 50kVA	45
51 through 150kVA	50

I. Non-linear ratings, to supply circuits with a harmonic profile equal or less than a K-factor of 13 as listed below without exceeding 115 degree C temperature rise:

Harmonic	K-13

Fund.	100%
3rd	70%
5th	42%
7th	5%
9th	3%
11th	3%
13th	1%
15th	.7%
17th	.6%

J. Provide vibration isolating mounts to isolate the enclosure from the core and coil assembly.

K. Mounting, suitable as listed:
   1. Three Phase Transformers, 15kVA and above: Floor or ceiling hung channel.

L. Provide conduit knockouts for line and load conduit entrance.

M. Finish: Degrease, clean, phosphatize, prime and finish all interior and exterior surfaces with baked enamel, color ANSI 61 or standard factory grey.

N. Connect a grounding strap from the secondary neutral to a grounding lug on the enclosure.

O. Terminals: As specified in Section 16100 - Basic Materials and Methods.

P. Subject transformers 25kVA above to listed production test at factory:

Q. Applied potential: 4kV.
   1. Induced potential: 2 times normal to 7200Hz.
   2. Ratio tests at the rated voltage connection and at all tap connections.
   3. Polarity and phase relation tests on the rated voltage connection.
   4. No-load and excitation current at rated voltage on the rated voltage connection.

R. Perform the listed standard tests on unit of identical design:
   1. No-load losses.
   2. Total losses.
   3. Sound levels.
   4. Temperature rise.

S. Impulse:
   1. Impedance.
   2. Induced potential.
   3. Applied potential.

T. Submit certified test reports for production and standard tests.

U. Manufacture: Cutler-Hammer, General Electric, Sorgel.

PART 3 - EXECUTION

3.01 DRY TYPE POWER TRANSFORMER

A. Mount transformer on floor or wall as indicated.

B. Provide one (1) vibration isolating mount, minimum 1 inch thick with 1 inch static deflection, for each mounting point on the transformer.

C. Connect transformer with flexible metal conduit. Provide an insulated grounding bushing on conduit and bond to transformer case.

END OF SECTION

SECTION 26 24 16 - PANELBOARDS

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2008.

B. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.

C. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.

D. UL 67 - Panelboards; Current Edition, Including All Revisions.

1.02 SUMMARY

A. This section describes requirements for branch circuit panelboards.

1.03 RELATED WORK

A. Section 26 0100: General Requirements for Electrical Work.

1.04 REFERENCE STANDARDS

A. The Underwriters Laboratory, Inc. (UL).

B. National Electrical Manufacturers Association (NEMA).

1.05 SUBMITTALS

A. Submit manufacturers' data and shop drawings in accordance with Section 01 3000 - Administrative Requirements and Section 01 6000 - Product Requirements for items listed.

B. Manufacturers Data:
   1. Panelboards.

C. Shop Drawings.
   1. Panelboards.

PART 2 PRODUCTS

2.01 ALL PANELBOARDS

A. Provide products listed and labeled by Underwriters Laboratories Inc. as suitable for the purpose indicated.

B. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
   1. Altitude: Less than 6,600 feet (2,000 m).
   2. Ambient Temperature:

C. Short Circuit Current Rating:
   1. Provide panelboards with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.

D. Mains: Configure for top or bottom incoming feed as indicated or as required for the installation.

E. Branch Overcurrent Protective Devices: Replaceable without disturbing adjacent devices.

F. Bussing: Sized in accordance with UL 67 temperature rise requirements.
   1. Provide solidly bonded equipment ground bus in each panelboard, with a suitable lug for each feeder and branch circuit equipment grounding conductor.

G. Conductor Terminations: Suitable for use with the conductors to be installed.

H. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.

1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
2. Boxes: Galvanized steel unless otherwise indicated.
   a. Provide wiring gutters sized to accommodate the conductors to be installed.
3. Fronts:
4. Lockable Doors: All locks keyed alike unless otherwise indicated.

I. Future Provisions: Prepare all unused spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.

2.02 BRANCH CIRCUIT PANELBOARDS

A. General: Provide bussed, circuit breaker or fusible switch type panelboards with main lugs or circuit breaker in flush or surface mounted enclosures as indicated.

B. Construction:
1. Cabinets: Code gauge steel cabinets, deadfront panels, and doors. Fasten deadfront panels to cabinets with concealed trim fasteners. Conceal front door hinges.
2. Dimensions: 20 inches wide by 6 inches deep.
3. Locks: Flush door locks, keyed alike for all panelboards.
4. Access: Door-in-Door (Not EZ-Trim).
5. Standards: Provide UL label where applicable and conform to No. 67 and 50 Underwriters Laboratories, Inc., and NEMA PB-1.

C. Bussing:
1. Phase Bus: Silver-plated copper, rated 1000 amperes per square inch cross sectional area maximum, braced for 100,000 rms amperes minimum.
2. Neutral Bus: Copper with lugs for connection of neutral conductors.
3. Ground Bus: Copper with terminals for equipment grounding conductors.
4. Terminals: As specified in Section 26 0519 - Building Wire and Cable.

D. Finish: Degrease, clean, phosphatize, prime, and finish cabinets, deadfront panels, and doors with baked enamel, color ASA-61, or standard factory grey. Galvanized cabinets are acceptable for flush cabinets.

E. Nameplates:
1. Provide a nameplate identifying panelboard in accordance with 26 0100 - General Requirements for Electrical Work.
2. Provide a manufacturer's nameplate on the deadfront interior panel indicating panelboard type, voltage rating, current rating and manufacturer's name.

F. Directory: Provide a directory card which fits into slots in the back of the panelboard. Protect directory with non-yellowing clear plastic.

G. Manufacturer: Westinghouse (Pow-R-Line 2), General Electric, Square D.

H. Circuit Breakers:
1. Provide circuit breakers for miscellaneous branch circuits with frame sizes and ratings as shown on the plans.
2. Bolt-on, thermal magnetic, molded case, with inverse time current overload, and instantaneous magnetic trips, trip-free and trip-indicating all poles of multi-pole device shall operate simultaneously during open, close and trip operations. Provide circuit breakers indicated with the following ratings:

Panel Type	Circuit Breaker Frame Size	Trip Rating (Amperes)	Voltage (Ac Rating)	Symmetrical AC Interrupting Capacity
1	100/1 pole	15-100	120	10,000 Min
	100/2 & 3 poles	15 – 100	240	10,000 Min

150/2 & 3 poles	110 - 150	240	18,000 Min
225/3 poles	125 - 225	240	22,000 Min

I. Manufacturer: Eaton Cutler-Hammer (Pow-R-Line 2), General Electric, Square D.

PART 3 EXECUTION

3.01 BRANCH CIRCUIT PANELBOARDS

A. Mount panelboard so that the top is 6 feet-6 inches above the finished floor.

B. Neatly terminate conductors onto breaker, ground bus and neutral bus. Train conductors in an organized grouping with conductors fanning out at the circuit terminals, bundled in the wireways and laced with plastic ties.

C. Identify all conductors with a circuit number and phase color.

D. Type all panelboard directories.

E. Provide a minimum of three (3) 3/4 inch empty conduits into accessible ceiling space.

F. Provide insulated grounding bushings on all conduits which enter the cabinet and bond to ground bus.

G. Install conduits in a vertical line, perpendicular to the cabinet.

END OF SECTION

SECTION 26 27 26 - WIRING DEVICES

PART 1 GENERAL

1.01 SUMMARY

A. Provide electrical materials, installation and testing for the Woodland JUSD Adult Ed CTE Classroom Conversion project.

1.02 DESCRIPTION

A. This section describes requirements for wiring devices and connections.

1.03 RELATED WORK

A. Section 26 0100: General Requirements for Electrical Work.

B. Section 26 0526: Grounding.

1.04 REFERENCE STANDARDS

A. NECA 1 - Standard Practices for Good Workmanship in Electrical Contracting; National Electrical Contractors Association; 2000.

B. NEMA WD 1 - General Color Requirements for Wiring Devices; National Electrical Manufacturers Association; 1999 (R 2005).

C. NEMA WD 6 - Wiring Device -- Dimensional Requirements; National Electrical Manufacturers Association; 2002.

D. CEC - California Electrical Code; most recent edition.

1.05 SUBMITTALS

A. Submit manufacturers' data and shop drawings in accordance with Section 01 3000 - Administrative Requirements and Section 01 6000 - Product Requirements for items listed.

B. Provide submittals for items listed documenting compliance with specification requirements.

C. Product Data:

1. Electrical Materials: Manufacturer's current published catalog sheets.

PART 2 PRODUCTS

2.01 ALL WIRING DEVICES

A. Provide products listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

2.02 WIRING DEVICES

A. Provide UL listed wiring devices, ivory or color selected by Engineer, with voltage and current ratings specified and wire terminations designed to contain stranded conductors. Provide grounding type receptacles. Provide RED color for all wiring devices connected to the emergency power system.

B. Provide 120 volt single and duplex receptacles which meet Federal Specification W-C-596 as listed:

1. SPECIFICATION GRADE - COMMERCIAL (DESIGNER)

	HUBBELL	PASS & SEYMOUR	LEVITON
NEMA 5-20R single	#2161	#26342	#16351

	#2162	#26342	#16352
NEMA 5-20R duplex			

C. Provide receptacles other than 120 volt single and duplex as indicated on drawings.

D. Provide 20 amp AC quiet type switches which meet federal specification W-C596 with voltage ratings to suit branch circuit requirements indicated and as listed:

	HUBBELL	PASS & SEYMOUR	LEVITON
Single Pole	1221	20AC	1221
Double pole	1222	5952	1222
Three Way	1223	20AC3	1223
Four Way	1224	5954	1224
SPST Momentary	1557	5935	1257

E. Listed manufacturers establish a standard of quality. Substitutions will be considered in accordance with Section 26 0100, General Requirements for Electrical Work.

F. Key Switches: Equivalent to listed switches, activated with removable key.

G. Switch with Pilot Light: Leviton #5226, Bryant #6405, G.E. #7945, or equal.

H. Wall Plates: Type 302 stainless steel, satin finish, minimum 0.040 inch thick, single or multiple gang.

PART 3 EXECUTION

3.01 WIRING DEVICES

A. Connect wiring devices to circuits indicated using side or back wiring terminals, designed to contain stranded wire.

B. Connect green grounding pigtail from receptacles to outlet box with screw.

C. Install wiring devices flush with the device plate fronts.

D. Align plates plumb with wall, and cover opening, without use of "jumbo" plates.

END OF SECTION

SECTION 321313 - CONCRETE PAVING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Walks.

B. Related Sections:

1. Section 033053 “Miscellaneous Cast-in-Place Concrete” for general building applications of concrete.

1.2 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash and other pozzolans, and ground granulated blast-furnace slag.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Other Action Submittals:

1. Design Mixtures: For each concrete paving mixture. Include alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1.4 INFORMATIONAL SUBMITTALS

A. Material Certificates: For the following, from manufacturer:

1. Cementitious materials.

2. Steel reinforcement and reinforcement accessories.

3. Admixtures.

4. Curing compounds.

5. Bonding agent or epoxy adhesive.

6. Joint fillers.

B. Material Test Reports: For each of the following:

1. Aggregates.

1.5 QUALITY ASSURANCE

A. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

B. ACI Publications: Comply with ACI 301 unless otherwise indicated.

1.6 PROJECT CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

PART 2 - PRODUCTS

2.1 FORMS

A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces.

B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces.

2.2 STEEL REINFORCEMENT

A. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, fabricated from steel wire into flat sheets.

B. Deformed-Steel Welded Wire Reinforcement: ASTM A 497/A 497M, flat sheet.

C. Reinforcing Bars: ASTM A 615/A 615M, Grade 60; deformed.

D. Tie Bars: ASTM A 615/A 615M, Grade 60, deformed.

E. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete specified, and as follows:

1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.

F. Zinc Repair Material: ASTM A 780.

2.3 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of same type, brand, and source throughout Project:

1. Portland Cement: ASTM C 150, portland cement Type II/V. Supplement with the following:

a. Fly Ash: ASTM C 618, Class C or Class F.

B. Normal-Weight Aggregates: ASTM C 33, uniformly graded. Provide aggregates from a single source.

1. Maximum Coarse-Aggregate Size: 3/4 inch.

2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

C. Water: Potable and complying with ASTM C 94.

D. Air-Entraining Admixture: ASTM C 260.

E. Chemical Admixtures: Admixtures certified by manufacturer shall comply with ASTM C 494 and be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.

2.4 RELATED MATERIALS

A. Joint Fillers: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork in preformed strips.

2.5 WHEEL STOPS

A. Wheel Stops: Precast, air-entrained concrete, 2500-psi minimum compressive strength, 4-1/2 inches high by 9 inches wide by 72 inches long. Provide chamfered corners and drainage slots on underside and holes for anchoring to substrate.

1. Dowels: Galvanized steel, 3/4 inch in diameter, 10-inch minimum length.

2.6 CONCRETE MIXTURES

A. Prepare design mixtures, proportioned according to ACI 301, for each type and strength of normal-weight concrete, and as determined by either laboratory trial mixtures or field experience.

1. Use a qualified independent testing agency for preparing and reporting proposed concrete design mixtures for the trial batch method.

2. When automatic machine placement is used, determine design mixtures and obtain laboratory test results that meet or exceed requirements.

B. Proportion mixtures to provide normal-weight concrete with the following properties:

1. Compressive Strength (28 Days): Per geotechnical report and plans.

2. Slump Limit: 4 inches, plus or minus 1 inch.

2.7 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Furnish batch certificates for each batch discharged and used in the Work.

1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Mix concrete materials in appropriate drum-type batch machine mixer.

1. For concrete batches of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.

2. For concrete batches larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd..

3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixing time, quantity, and amount of water added.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.

A. Proof-roll prepared subbase surface below concrete paving to identify soft pockets and areas of excess yielding.

1. Completely proof-roll subbase. Limit vehicle speed to 3 mph.

2. Proof-roll with a pneumatic-tired and loaded, 10-wheel, tandem-axle dump truck weighing not less than 15 tons, or pneumatic-tired construction equipment with equivalent weight.

3. Correct subbase with soft spots and areas of pumping or rutting exceeding depth of 1/2 inch according to requirements in Division 31 Section "Earth Moving."

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove loose material from compacted subbase surface immediately before placing concrete.

3.3 EDGE FORMS AND SCREED CONSTRUCTION

A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.

B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.4 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.

C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.

D. Install welded wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

E. Zinc-Coated Reinforcement: Use galvanized-steel wire ties to fasten zinc-coated reinforcement. Repair cut and damaged zinc coatings with zinc repair material.

F. Epoxy-Coated Reinforcement: Use epoxy-coated steel wire ties to fasten epoxy-coated reinforcement. Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D 3963/D 3963M.

G. Install fabricated bar mats in lengths as long as practicable. Handle units to keep them flat and free of distortions. Straighten bends, kinks, and other irregularities, or replace units as required before placement. Set mats for a minimum 2-inch overlap of adjacent mats.

3.5 JOINTS

A. General: Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.

1. When joining existing paving, place transverse joints to align with previously placed joints unless otherwise indicated.

B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.

1. Continue steel reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of paving strips unless otherwise indicated.

2. Provide tie bars at sides of paving strips where indicated.

3. Butt Joints: Use bonding agent at joint locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

4. Keyed Joints: Provide preformed keyway-section forms or bulkhead forms with keys unless otherwise indicated. Embed keys at least 1-1/2 inches into concrete.

5. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.

C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where indicated.

1. Locate expansion joints at intervals of 30 feet unless otherwise indicated.

2. Extend joint fillers full width and depth of joint.

3. Terminate joint filler not less than 1/2 inch or more than 1 inch below finished surface if joint sealant is indicated.

4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.

5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.

6. During concrete placement, protect top edge of joint filler with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.

D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows:

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a 1/4-inch radius. Repeat grooving of contraction joints after applying surface finishes. Eliminate grooving-tool marks on concrete surfaces.

a. Tolerance: Ensure that grooved joints are within 3 inches either way from centers of dowels.

2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.

a. Tolerance: Ensure that sawed joints are within 3 inches either way from centers of dowels.

3. Doweled Contraction Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.

E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 1/4-inch radius. Repeat tooling of edges after applying surface finishes. Eliminate edging-tool marks on concrete surfaces.

3.6 CONCRETE PLACEMENT

A. Before placing concrete, inspect and complete formwork installation**,** steel reinforcement, and items to be embedded or cast-in.

B. Remove snow, ice, or frost from subbase surface and steel reinforcement before placing concrete. Do not place concrete on frozen surfaces.

C. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.

D. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.

E. Do not add water to concrete during delivery or at Project site. Do not add water to fresh concrete after testing.

F. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.

G. Consolidate concrete according to ACI 301 by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.

1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating reinforcement dowels and joint devices.

H. Screed paving surface with a straightedge and strike off.

I. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.

J. Curbs and Gutters: Use design mixture for automatic machine placement. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing.

K. Slip-Form Paving: Use design mixture for automatic machine placement. Produce paving to required thickness, lines, grades, finish, and jointing.

1. Compact subbase and prepare subgrade of sufficient width to prevent displacement of slip-form paving machine during operations.

L. Cold-Weather Placement: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures. Comply with ACI 306.1 and the following:

1. When air temperature has fallen to or is expected to fall below 40 deg F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F at point of placement.

2. Do not use frozen materials or materials containing ice or snow.

3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in design mixtures.

M. Hot-Weather Placement: Comply with ACI 301 and as follows when hot-weather conditions exist:

1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated in total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.

2. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.

3. Fog-spray forms**,** steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.7 FLOAT FINISHING

A. General: Do not add water to concrete surfaces during finishing operations.

B. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.

1. Medium-to-Coarse-Textured Broom Finish: Provide a coarse finish by striating float-finished concrete surface 1/16 to 1/8 inch deep with a stiff-bristled broom, perpendicular to line of traffic.

3.8 CONCRETE PROTECTION AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

B. Comply with ACI 306.1 for cold-weather protection.

C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete but before float finishing.

D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.

E. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound, or a combination of these as follows:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

   a. Water.
   b. Continuous water-fog spray.
   c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover, placed in widest practicable width, with sides and ends lapped at least 12 inches and sealed by waterproof tape or adhesive. Immediately repair any holes or tears occurring during installation or curing period using cover material and waterproof tape.

3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas that have been subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating, and repair damage during curing period.

3.9 PAVING TOLERANCES

A. Comply with tolerances in ACI 117 and as follows:

1. Elevation: 3/4 inch.

2. Thickness: Plus 3/8 inch, minus 1/4 inch.

3. Surface: Gap below 10-foot- long, unleveled straightedge not to exceed 1/2 inch.

4. Alignment of Tie-Bar End Relative to Line Perpendicular to Paving Edge: 1/2 inch per 12 inches of tie bar.

5. Lateral Alignment and Spacing of Dowels: 1 inch.

6. Vertical Alignment of Dowels: 1/4 inch.

7. Alignment of Dowel-Bar End Relative to Line Perpendicular to Paving Edge: 1/4 inch per 12 inches of dowel.

8. Joint Spacing: 3 inches.

9. Contraction Joint Depth: Plus 1/4 inch, no minus.

10. Joint Width: Plus 1/8 inch, no minus.

3.10 WHEEL STOPS

A. Install wheel stops in bed of adhesive applied as recommended by manufacturer.

B. Securely attach wheel stops to paving with not less than two galvanized-steel dowels located at one-quarter to one-third points. Install dowels in drilled holes in the paving and bond dowels to wheel stop. Recess head of dowel beneath top of wheel stop.

3.11 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

1. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. or fraction thereof of each concrete mixture placed each day.

    a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.

3. Air Content: ASTM C 231, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.

4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below and when it is 80 deg F and above, and one test for each composite sample.

5. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.

6. Compressive-Strength Tests: ASTM C 39/C 39M; test one specimen at seven days and two specimens at 28 days.

    a. A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at 28 days.

C. Strength of each concrete mixture will be satisfactory if average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.

D. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.

E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.

F. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.

G. Concrete paving will be considered defective if it does not pass tests and inspections.

H. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

I. Prepare test and inspection reports.

3.12 REPAIRS AND PROTECTION

A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Architect.

B. Drill test cores, where directed by Architect, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory paving areas with portland cement concrete bonded to paving with epoxy adhesive.

C. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.

D. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 321313