

**MARTIN LUTHER KING, JR.
MIDDLE SCHOOL
MODERNIZATION**

**SAN BERNARDINO CITY
UNIFIED SCHOOL DISTRICT
777 NORTH F STREET
SAN BERNARDINO, CA 92410**

100%
Construction
Documents
Specifications
BOOK TWO OF TWO

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SECTION 024100

CONCRETE SLAB ON GRADE

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes exterior cement concrete pavement for the following:
 - 1. Mechanical concrete pad expansions.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated, including admixtures.
- B. Design Mixtures: For each concrete pavement mixture.

1.3 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Manufacturer of ready-mixed concrete products who complies with ASTM C 94/C 94M requirements for production facilities and equipment.
- B. ACI Publications: Comply with ACI 301, "Specification for Structural Concrete," unless modified by requirements in the Contract Documents.
- C. All work to be performed and materials to be used shall be in accordance with the Standard Specifications for Public Works Construction, latest edition and supplements.
- D. The Contractor shall have one copy of the Standard Specifications at the job site.
- E. The Standard Specifications apply only to performance and materials and how they are to be incorporated into the Work. The legal/contractual relationship sections and the measurement and pavement sections do not apply to this document.

PART 2 - PRODUCTS

2.1 STEEL REINFORCEMENT

- A. Plain-Steel Welded Wire Reinforcement: ASTM A 185, fabricated from as-drawn steel wire into flat sheets.
- B. Reinforcing Bars: ASTM A 615/A 615M, Grade 60; deformed.

- C. 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."

2.2 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source throughout the Project:
 - 1. Portland Cement: ASTM C 150, Type II, low alkali. Supplement with the following:
 - a. Pozzolan: ASTM C618, Class F or N Fly Ash, 100 pounds maximum per cubic yard, containing one percent or less carbon. Fly ash shall not be used in excess of 15 percent by weight of total cement quantity.
- B. Combined Aggregates: Gradation "C" conforming to SSPWC Section 201-1.3.2.
- C. Water: ASTM C 94/C 94M.

2.3 CURING MATERIALS

- A. Liquid Curing Compound: ASTM C309, fugitive dye dissipating type, complying with Rule II 13 of the South Coast Air Quality Management District and Federal Air Quality Regulation 40 CFR 52.254.
- B. Moisture-Retaining Cover (Curing Sheet): ASTM C 171, non-staining polyethylene film or white burlap-polyethylene sheet.
- C. Water: Potable.
- D. Evaporation Retarder: Waterborne, monomolecular film forming; manufactured for application to fresh concrete.

2.4 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.

2.5 CONCRETE MIXTURES

- A. Prepare design mixtures, proportioned according to ACI 301, with the following properties:
 - 1. Compressive Strength (28 Days): 3,000 psi
 - 2. Maximum Water-Cementitious Materials Ratio at Point of Placement: 0.60
 - 3. Slump Limit: 4 inches, plus or minus 1 inch.

2.6 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Furnish batch certificates to Architect for each batch discharged and used in the Work.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Proof-roll prepared subbase surface below concrete pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding.

3.2 EDGE FORMS AND SCREED CONSTRUCTION

- A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides for pavement 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.

3.3 STEEL REINFORCEMENT

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

3.4 JOINTS

- A. General: Form construction, isolation, and control joints and tool edgings true to line with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline, unless otherwise indicated.
- B. Construction Joints: Set construction joints at side and end terminations of pavement and at locations where pavement operations are stopped for more than one-half hour unless pavement terminates at isolation joints.
- C. Control Joints: Form weakened-plane control joints, sectioning concrete into areas as indicated. Construct control joints for a depth equal to at least one-fourth of the concrete thickness to match jointing of existing adjacent concrete pavement.
- D. Edging: Tool edges of pavement, gutters, curbs, and joints in concrete after initial floating with an edging tool to a 1/4-inch radius. Repeat tooling of edges after applying surface finishes. Eliminate tool marks on concrete surfaces.

3.5 CONCRETE PLACEMENT

- A. Moisten subbase to provide a uniform dampened condition at time concrete is placed.
- B. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.
- C. 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.
- D. Screed pavement surfaces with a straightedge and strike off.
- E. 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.

3.6 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.

3.7 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 manufacturers 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 methods.

3.8 PAVEMENT TOLERANCES

- A. Comply with tolerances as follows

1. Elevation: 1/4 inch
2. Thickness: Plus 3/8 inch minus 1/4 inch
3. Surface: Gap below 10-foot-long, unlevelled straightedge not to exceed 1/4 inch.
4. Joint Spacing: 3 inches.
5. Contraction Joint Depth: Plus 1/4 inch no minus.
6. Joint Width: Plus 1/8 inch, no minus.

3.9 REPAIRS AND PROTECTION

- A. Remove and replace concrete pavement that is broken, damaged, or defective or that does not comply with requirements in this Section.
- B. Protect concrete from damage. Exclude traffic from pavement for at least 14 days after placement.
- C. Maintain concrete pavement free of stains, discoloration, dirt, and other foreign material. Sweep concrete pavement not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION

SECTION 032000

CONCRETE REINFORCEMENT

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The Contract Documents including the General Conditions and Divisions 1 & 2 as applicable shall apply to this section.
- B. This Section describes the requirements for furnishing and installing concrete reinforcement.
- C. Related Sections:
 - 1. Cast-in-place concrete as specified in Section 033000.

1.2 SUBMITTALS

- A. Submittals shall be in accordance with Section 013000.
- B. Submit shop drawings for fabrication, bending, and placement of reinforcing. Comply with ACI 315.

1.3 QUALITY ASSURANCE

- A. Concrete reinforcement shall comply with the 2016 CBC.
- B. Welding procedures, welding operators and welders shall be qualified in accordance with AWS D1.4 and CBC. Welders whose work fails to pass inspection shall be requalified before proceeding further welding.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Reinforcing Bars: ASTM A615, deformed, Grade 60 as designated on the structural drawings.
- B. Reinforcement for Steel Wire: ASTM A1064.
- C. Bars for Welded Splices: ASTM A706, low-alloy steel.
- D. Supports for Reinforcement: Bolsters, chairs, spacers and other devices for spacing, supporting and fastening reinforcement in place. Use wire bar type supports complying with CRSI recommendations.

2.2 FABRICATION

- A. Fabricate reinforcing bars to conform to required shapes and dimensions, with fabrication tolerances complying with 2016 CBC. In case of fabricating errors, do not re-bend or straighten reinforcing in a manner that will weaken the material.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install reinforcement in compliance with referenced codes and standards.
- B. Clean reinforcement to remove loose rust and mill scale, earth, and other materials which reduce or destroy bond with concrete. Accurately position, support and secure reinforcement against displacement by formwork, construction, or concrete placement operations. Locate and support reinforcing by metal chairs, runners, bolsters, spacers and hangers, as required. Place reinforcement to obtain minimum cover for concrete protection.
- C. Ensure bar spacing meets requirements of 2016 CBC. Arrange, space, and securely tie bars and bar supports together with 16-gauge wire to hold reinforcement in position during concrete placement operations. Set wire ties so that twisted ends are away from exposed concrete surfaces.

- D. Install welded wire fabric in as long lengths as possible. Lap adjoining pieces at least one full mesh and lace splices with 16-gauge wire.
- E. Splices: Splice bars by lapping ends and tightly wire tying. Minimum lap of spliced bars shall be as indicated.
- F. Weld splices in bars larger than No. 11, where No. 11 bars are spliced to larger size bars, and where shown. Use full penetration butt welds by electric-arc method. Use welders who have passed AWS standard qualification tests within previous year. Weld splices to develop 125-percent of specified yield strength of bars, or of smaller bar in transition splices.
- G. Welding: Comply with requirements of AWS D1.4 and CBC for field welding. Deputy inspection shall be required for all field welding.

3.2 FIELD QUALITY CONTROL

- A. Inspection and Test of Welds: The following tests may be made by Contractor's testing laboratory for reinforcing bar welds: Certification of welders performing electric-arc welding of reinforcing; verification of accurate location of reinforcing; inspection of reinforcing bar welds; X-ray test of one of first 3-arc-welds made by each welder; tensile tests of sample welds of largest size bar for each type of welding. Deficient welds shall require Contractor to provide and pay for additional X-rays and tests as directed by Architect. Repair or replace defective welds.

END OF SECTION

SECTION 033000

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

- A. The Contract Documents including the General Conditions and Divisions 1 & 2 as applicable shall apply to this section.
- B. This Section includes cast-in-place concrete, including reinforcement, concrete materials, mix design, placement procedures, exterior paving and finishes not covered in other architectural sections.

1.2 SUBMITTALS

- A. Submittals shall be in accordance with Section 013000.
- B. Product Data: For each manufactured material and product indicated.
- C. Design Mixes: For each concrete mix indicated. All design mixes shall be stamped and signed by a licensed engineer.
- D. Provide submittals to document material selection:
 - 1. Complete Materials Cost Tracking Sheet for concrete.
 - 2. Data from manufacturer/batch plant to certify fly ash content in concrete mix.

1.3 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products complying with ASTM C 94 requirements for production facilities and equipment.
- B. Comply with ACI 301, "Specification for Structural Concrete," including the following, unless modified by the requirements of the Contract Documents.
 - 1. General requirements, including submittals, quality assurance, acceptance of structure, and protection of in-place concrete.
 - 2. Formwork and form accessories.
 - 3. Steel reinforcement and supports.
 - 4. Concrete mixtures.

5. Handling, placing, and constructing concrete.
- C. Inspections: Deputy inspector shall inspect placing of steel and concrete per 2016 CBC, where noted on the structural plans. The deputy inspector shall be paid for by the Owner.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Formwork: Furnish formwork and form accessories according to ACI 301.
- B. Steel Reinforcement: See Section 032000.
- C. Concrete Materials:
 1. Portland Cement: ASTM C 150, Type II/V cement for concrete in contact with soil.
 2. Normal-Weight Aggregate: ASTM C 33, uniformly graded, not exceeding 1 inch nominal size. Smaller aggregate may be required in areas of high concentration of steel reinforcement, or may be required due to the size of the concrete pumping equipment used by the Contractor. ASTM C330 for lightweight aggregate.
 3. Water: Complying with ASTM C 1602.
- D. Vapor Retarder: Multi-ply reinforced polyethylene sheet, ASTM E 1745, Class C, not less than 15 mils thick; or polyethylene sheet, ASTM D 4397, not less than 15 mil thick.
 1. Fine-Graded Granular Material: Natural sand; ASTM D 448, Size 10, with 100 percent passing a No. 4 sieve and 10 to 30 percent passing a No. 100 sieve; complying with deleterious substance limits of ASTM C 33 for fine aggregates.
- E. Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber
- F. Curing Materials:
 1. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
 2. Water: Potable.

2.2 CONCRETE MIXES

- A. Comply with ACI 301 requirements for concrete mixtures.
- B. Prepare design mixes, proportioned according to ACI 301, for normal-weight concrete determined by either laboratory trial mix or field test data bases, as follows:
 - 1. Compressive Strength (28 Days): follow specifications on structural engineering plans.
 - 2. Slump: 4 inches.
 - 3. Air content of trowel-finished interior concrete floors shall not exceed 3.0 percent.
- C. Mix design:
 - 1. Include the highest percentage of fly ash in concrete mix that will meet the specified performance criteria, as indicated in the drawings.

2.3 CONCRETE MIXING

- A. Ready-Mixed Concrete: Comply with ASTM C 94
 - 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.
 - 2. 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 INSTALLATION, GENERAL

- A. Formwork: Design, construct, erect, shore, brace, and maintain formwork according to ACI 301.
- B. Vapor Retarder: Install, protect, and repair vapor-retarder sheets 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 tape.
 - 2. Cover vapor retarder with fine-graded granular material, moisten, and compact with mechanical equipment to elevation tolerances of plus 0 inch or minus 3/4 inch.
- C. Steel Reinforcement: See Section 032000.

- D. Joints: Construct joints true to line with faces perpendicular to surface plane of concrete.
 - 1. Construction Joints: Locate and install so as not to impair strength or appearance of concrete, at locations indicated or as approved by Architect.
 - 2. 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.
 - a. Extend joint fillers full width and depth of joint, terminating flush with finished concrete surface, unless otherwise indicated.
 - 3. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated or as approved by Architect. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows:
 - a. 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.
 - b. Spacing of Joints: Provide for joints at 5'-0" on center minimally in each direction at exterior paving
- E. Tolerances: Comply with ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

3.2 CONCRETE PLACEMENT

- A. Comply with recommendations in ACI 304R for measuring, mixing, transporting, and placing concrete.
- B. Do not add water to concrete during delivery, at Project site, or during placement.
- C. Consolidate concrete with mechanical vibrating equipment.

3.3 FINISHING UNFORMED SURFACES

- A. General: Comply with ACI 302.1R for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Screed surfaces with a straightedge and strike off. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane before excess moisture or bleedwater appears on the surface. Do not further disturb surfaces before starting finishing operations.
- C. Float Finish: Apply float finish to surfaces indicated in plans.

3.4 CONCRETE PROTECTION 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 follow recommendations in ACI 305R for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions occur 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. Cure formed and unformed concrete for at least seven days as follows:
 - 1. Use no curing method that could impair the appearance of architectural concrete surfaces.
 - 2. Curing material used will restrict the loss of moisture to not more than 0.055 grams per square centimeter of surface.
 - 3. All concrete shall be cured for a period of not less than 10 days. During this curing period no part of the concrete shall be permitted to become dry even for a short while. The curing medium shall be applied so as to prevent checking and cracking of the surface of the concrete immediately after placing and it shall be maintained so as to prevent loss of water from the concrete for the duration of the entire curing period. Fresh concrete shall be protected from heavy rains, flowing water, and mechanical injury. All concrete shall be protected from injurious action of the sun.
 - 4. Methods of Curing: If cured with water, concrete shall be kept wet by mechanical sprinklers or by any other approved method, which will keep the surfaces continuously wet with "fresh" water.
- E. All retaining walls shall cure for 28 days before being backfilled, unless specifically approved by the structural engineer.
- F. All horizontal elements, such as beams and slabs, shall be shored for 28 days, unless specifically approved by the structural engineer.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to sample materials, perform tests, and submit test reports during concrete placement. Tests will be performed according to ACI 301.
 - 1. Testing Frequency: One composite sample 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, and for each 2000 sq.ft of surface area for slabs and walls.

3.6 DEFECTIVE CONCRETE:

- A. Concrete that is discolored, stained or mottled, and cannot be satisfactorily repaired to the Owner's Representative's satisfaction, will be considered defective and shall be replaced with satisfactory concrete at no additional cost to the owner.
- B. Contractor shall sack and patch concrete as necessary to ensure a uniform appearance if finish is not satisfactory to the Owner's Representative.

END OF SECTION

SECTION 042200

CONCRETE UNIT MASONRY

PART 1 - GENERAL

1.1 GENERAL

- A. The Contract Documents including the General Conditions and Division 1 sections as applicable shall apply to this section.
- B. Deviations from the plans and specifications shall not be made without the written approval of the architect and/or engineer.

1.2 SCOPE OF WORK

- A. Furnish and install concrete masonry units where indicated on the drawings including mortar, grout, and masonry reinforcing steel. Provide equipment necessary for their installation.
- B. Install items furnished by others: bolts, anchor bolts, shelf angles, and built-ins.
- C. Arrange for adequate bracing, forming, and shoring required in conjunction with and in the course of constructing the concrete masonry.
- D. Advise the general contractor as to the position of all dowels for the masonry. The general contractor shall be responsible for the placement of all dowels in any adjoining construction.
- E. Arrange for inspections.

1.3 RELATED WORK SPECIFIED ELSEWHERE

- A. Related sections:
 - 1. Concrete: Section 033000.
 - 2. Concrete Reinforcement: Section 032000.
 - 3. Structural Steel: Section 051200.
 - 4. Rough Carpentry: Section 061000.

1.4 QUALITY ASSURANCE

- A. Submittals:
 - 1. Submittals shall be in accordance with Section 013000.

2. Product Data: Submit the following for approval of Owner's Representative

- a. Materials list of items proposed under this Section.
- b. Manufacturer's data sheet indicating compliance with the specified requirements.
- c. Supplier's certificate of compliance identifying the cement used and stating that the cement complies with ASTM C 150-07.
- d. Provide submittals to document material selection as follows:

Complete Materials Cost Tracking Sheet.

Data from manufacturer to certify recycled content, manufacture location and harvest location (i.e. cut sheets and/or manufacturer certification letters)

B. Quality Assurance

1. Regulatory Requirements: Except as modified by the requirements specified herein or the details indicated, reinforced concrete unit masonry construction shall conform to the 2016 CBC.
2. Certifications: Furnish a certificate, signed by the unit masonry manufacturer, executed in triplicate, stating that masonry units have been properly and thoroughly cured at the plant before shipment, and that they conform to the requirements of this specification. Include the name of the Contractor, the project location, and the quantity and date or dates of shipment or delivery to which the certificate applies.
3. Field Construction Mock-up: Before the installation of masonry work, erect a sample wall panel mock-up using materials, bond and joint tooling specified for final work. Build mock-up at the site where directed, of full thickness and approximately 4 feet by 4 feet, indicating range of colors, textures, patterns, and workmanship to be expected in completed work. Obtain the Owner's Representative acceptance of visual qualities of the mock-up. Retain the mock-up during construction as a standard for judging completed masonry work. Do not alter remove or destroy mock-up until work is completed.
4. Inspections: Deputy inspector shall inspect placing of steel and concrete masonry per 2016 CBC, where noted on the structural plans. The deputy inspector shall be paid for by the Owner.
5. Comply with the Stormwater Pollution Prevention Plan developed for the Project, and comply with the Erosion Control Plan for the Project.
6. Comply with CBC 2016 section 2105 for quality assurance Including Prism Tests and Masonry core testing per CBC 2105A2.2.2.2 and CBC 2105a.5

1.5 PRODUCT HANDLING AND STORAGE

- A. Materials of this section shall be protected to maintain quality and physical requirements.
- B. All masonry units shall be stored on the jobsite so that they are protected from rain, stored off the ground and kept clean from contamination and out of the way of other trades.
- C. Handle units carefully to avoid breakage and damage to finished faces. Use of damaged units will not be permitted.

1.6 PROJECT CONDITIONS

- A. Cold Weather Conditions (40°F or below):
 - 1. Wet or frozen units shall not be laid. Temperature of units when laid shall not be less than 20°F.
 - 2. Aggregates and mixing water shall be heated to produce mortar and grout temperatures between 40°F and 120°F.
 - 3. Maintain mortar temperature on boards above 32°F.

PART 2 - MATERIALS

2.1 CONCRETE MASONRY UNITS

- A. Loadbearing concrete masonry units shall conform to ASTM C 90. All units shall be Mediumweight, 1900 net psi, as manufactured by Angelus Block Co., Inc.
- B. Some item(s) indicated below may be special order and will require manufacturing lead-time. The contractor shall contact an Angelus Block Co., Inc. representative for details to ensure the material is ordered well in advance of anticipated masonry start.
- C. All units shall be supplied from the same source aggregates to ensure a uniform quality, appearance and color, or as required by the architect.
- D. Provide veneer units as shown on drawings for areas over concrete or metal studs, to align with regular CMU and in brick pattern as shown in elevation.

2.2 MORTAR AND GROUT

- A. Mortar Materials:
 - 1. Mortar shall be type M (if $f'm=2500$) and Type S (if $f'm=1500$)
 - 2. Mortar Should conform to ASTM C270-08a
 - 3. Cement: ASTM C 150, Type I or II, low alkali.

2. Hydrated Lime: Meeting the requirements of ASTM C 207-06, Type S, or quicklime meeting the requirements of ASTM C 5-03.
3. Sand: Natural sand, clean and graded, meeting ASTM C 144-04, except not less than 3 percent shall pass No. 100 sieve.
4. Latex additive (water emulsion) of type specifically recommended by latex additive manufacturer for use with job-mixed latex-modified materials.
5. Use only preblended mortars manufactured by computer controlled batching. Digital printouts of the material proportions of each batch must be available upon request.

B. Grout Materials:

1. Grout shall conform to ASTM C476-09
2. Cement ASTM C 150, Type I or II, low alkali.
3. Coarse Aggregate: Composed of gravel and crushed aggregate meeting the requirements of ASTM C 404-07 except graded with not more that 5 percent passing a No. 8 sieve and 100 percent passing 3/8 inch sieve.
4. Coarse and fine aggregates for grout shall comply with ASTM C404
5. Sand: Washed, natural sand meeting the requirements of ASTM C 404-07 and having hard, strong durable particles evenly graded with 5 percent minimum passing #100 screen and which does not contain more than 2 percent by weight of such deleterious substances as clay lumps, shale, shist, alkali, mica, coated grains or soft flaky particles.

C. Admixtures:

1. Grout Admixture: Acceptable product includes, but not limited to:
Silka Corporation Grout Aid Type II.
2. Mortar Waterproofing: Metallic stearate type admixtures. Acceptable products include, but not limited to:
Berylex Western; Berylex
A.C. Horn, Inc.; Hydratite Liquid
Master Builders; Omicron
Sonneborn Building Products; Hydracide Powder

- D. Water: Fresh, clean, non-alkaline, and potable, free from such amounts of mineral and organic substances as would adversely affect the hardening of cement mortar.

1. Select materials that have the highest possible recycled content while still meeting performance criteria. Select materials from local manufacturers wherever possible.

2.3 REINFORCING STEEL

- A. Reinforcing steel shall be in accordance with section 032000
- B. Reinforcing bars shall conform to ASTM A 615, Grade 60, or as specified on the structural plans.
- C. Joint Reinforcement shall conform to ASTM a951-6 and 2013 CBC.
- D. Metal Ties and Anchors shall meet the requirements of 2013 CBC.
- E. All metal reinforcement shall be free from loose rust and other matter or coatings detrimental to bond.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Materials
 1. Masonry units shall be sound, dry, and clean from all foreign matter when placed in the wall.
 2. Reinforcement bars shall be free of kinks or bends, except for bends detailed in the drawings.
- B. Layout and Foundation
 1. If site conditions or layout is in any way improper, masonry work shall not begin until cleared by the governing authority.
 2. Foundation shall be level and at correct grade so that the initial bed joint shall not be less than 1/4 inch nor more than 1 inch.
 3. Surface of foundation shall be clean and free of deleterious materials. Surface shall be roughened to a full amplitude of 1/16 inch.
 4. If a foundation dowel must be bent to align with a vertical cell, it shall not slope more than 1 inch horizontally to 6 inches vertically.

3.2 MIXING OF MORTAR

- A. Place required water and required sand into rotating mixer, followed by all cement and remaining water, sand and lime. Add admixture in proportion and sequence as recommended by admixture manufacturer.

- B. Conventional Mortar: Lime shall be the last material added to the mix. Mix at least 3 minutes after all materials are in mixer. Use mixer of at least on sack capacity. Hand mixing is not allowed. Measure materials for mortar and grout in suitable calibrated devices.
- C. Maintain mortar on boards to slump of 2-3/4 inches plus or minus 1/4 inch, using a truncated cone 4-inch to 2-inch diameter, 6-inch tall. Re-temper mortar on boards only. Add water to a basin formed in the mortar and carefully mix together. Dashing or pouring water over mortar is not permitted. Discard mortar that has become harsh and non-plastic. When mortar has been maintained plastic, it may be used up to but not more than one hour after original mixing.
- D. Minimum Compressive Strength of Mortar: 1800 psi at 28 days. Include an approved admixture in the mortar to reduce shrinkage and prevent efflorescence.
- E. No mortar shall be used beyond 2 1/2 hours from the time it was originally mixed.

3.3 MIXING OF GROUT

- A. Mix in mechanical mixer until workable, but not to exceed 10 minutes
- B. Add admixtures in the proportion and sequence as recommended by admixture manufacturer.
- C. Water content of the grout shall be adjusted to provide proper fluid consistency to enable placement under existing field conditions without segregation of the constituents.
- D. Move from mixer to place of final deposit as rapidly as practical by methods that prevent separation or loss of ingredients
- E. Do not use grout more than 1 1/2 hours after initial mixing.
- F. Minimum Compressive Strength of Grout: 2000 psi at 28 days.

3.4 INSTALLATION OF MASONRY UNITS

- A. General
 - 1. All masonry shall be laid true, level, plumb, and in accordance with the plans.
 - 2. Units shall be laid in running bond unless otherwise shown on the drawings.
 - 3. Cutting of units shall be neat, true, and made by masonry saw.
 - 4. Concrete masonry units shall not be wetted unless otherwise approved.
 - 5. Construction supports shall not be attached to the wall except where specifically permitted by the architect or engineer.

B. Protection

1. Extreme care shall be taken to prevent grout or mortar stains on exposed surfaces. Any mortar or grout contact shall be cleaned immediately.
2. Tops of all unsheltered walls and partially completed walls shall be covered when work is not in progress.

3.5 JOINTS

A. Mortar Joints

1. Initial bed joint shall not be less than 1/4 inch nor more than 1 inch in thickness. All cells to be filled with grout shall be kept free from mortar droppings so the grout will make full contact with the foundation.
2. Thickness of joints shall be $3/8 \pm 1/8$ inch for precision or split units, and $1/2 \pm 1/8$ inch for slumped units.
3. Head and bed joints of hollow units shall be filled with mortar for the thickness of the face shell. Solid units shall have full head and bed joints.
4. horizontal joint reinforcement shall be fully embedded in mortar with a minimum 5/8 inch cover between joint reinforcement and exposed face. Mortar joints with wire reinforcement shall be at least twice the thickness of the wire diameter.
5. All mortar joints on exposed walls, unless otherwise specified, shall be concave and double struck to produce a dense, slightly concave surface well bonded to the surface of the masonry unit.
6. Flush cut or sacked joints shall be used where surface is to be plastered.
7. If an installed unit is moved, it shall be removed from the wall, cleaned, and set in fresh mortar.

B. Control Joints

1. Control joints shall be constructed as detailed in the drawings.

3.6 INSTALLATION OF REINFORCING STEEL

- A. Reinforcement shall be placed as detailed on the drawings and secured against displacement at intervals not to exceed 200 bar diameters.

B. Tolerance for placement:

1. In flexural elements shall be $\pm 1/2$ inch for d equal to 8 inches or less, ± 1 inch for d equal to 24 inches or less but more than 8 inches, $\pm 1 1/4$ inches for d greater than 24 inches. (d is the distance from compression face of flexural member to the centroid of tensile reinforcement.)

2. Longitudinal location shall be \pm 2 inches.
- C. Reinforcing bars, except joint reinforcement, shall be completely embedded in mortar or grout and have a minimum cover, including the masonry unit, of at least 3/4 inch, 1 1/2 inches when exposed to weather, and 2 inches when exposed to soil.
- D. Clear distance between surface of reinforcing bar and any surface of a masonry unit shall not be less than 1/4 inch for fine grout and 1/2 inch for course grout.
 1. Horizontal reinforcement bars may rest on the cross webs of hollow masonry units.
- E. Reinforcing bars and wire joint reinforcement shall be lapped as indicated on the drawings.

3.7 GROUTING

A. General

1. Reinforcement bars shall be in place and secured prior to grouting.
2. All cells and areas where grout is to be placed shall be free from mortar fins greater than 1/2 inch, droppings, and foreign materials that would prevent the wall from being properly grouted.
3. Grout shall completely fill all designated spaces, and shall be confined to those spaces.
4. Segregation of grout materials and damage to the masonry shall be avoided during the grouting process.
5. Grout shall be consolidated before loss of plasticity.
 - a. Grout pours 12 inches or less may be puddled.
 - b. Grout pours greater than 12 inches shall be consolidated and reconsolidated by mechanical vibration using a low velocity vibrator with a maximum head diameter of 3/4 inch.
6. Stop grout pours 1 1/2 inches below top of wall unless indicated otherwise in the drawings. Where bond beams occur, stop grout a minimum of 1/2 inch below.
7. All masonry shall be solid grouted unless otherwise specified.
8. Grouting of beams across openings shall be done in one continuous pour.
9. Anchor bolts shall be solidly grouted in place with 1-inch minimum of grout between the bolt and the masonry.

10. Spaces around all metal door frames and other built-in items shall be solidly grouted.

B. Low Lift Grouting

1. Grout pours shall not exceed 4 feet. Cleanouts are not required.

C. High-Lift Grouting:

1. Cleanout holes shall be provided at the bottom of all cells in hollow unit masonry.

2. Maximum height of pour per DSA IR 21-2.13 shall be 12 feet for 8" CMU wall and 16 feet for 12" and 16" CMU walls.

3. Grout shall be placed in lifts not to exceed 5 feet 4 inches. The full height in each wall section shall be poured in 1 day with no interruption greater than 1 hour.

4. Provide deputy-inspections per 2013 CBC for the high-lift grouting.

3.8 WALL CLEANING AND PROTECTION

A. Minimize any mortar or grout stains on the wall during construction. Any stains that occur shall be removed immediately.

B. The tops of all unsheltered walls and partially completed walls shall be covered when work is not in progress.

C. Where atmosphere is dry, a light fog spray may be applied to masonry surfaces for three days after construction.

D. At the conclusion of the masonry work, remove all scaffolding and equipment used during construction, and remove all debris, refuse, and surplus masonry material from the site.

E. Clean exposed CMU walls with a light sandblast to remove any stains from the work of other trades or efflorescence that may occur prior to the application of the water repellent. All openings, doors, window frames, etc. near the area to be sandblasted shall be covered or protected before the sandblasting starts. Care shall be taken to avoid contamination to areas that are not to be sandblasted.

END OF SECTION

SECTION 048120

MASONRY VENEER ASSEMBLIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes masonry veneer assemblies consisting of the following:
 - 1. Concrete masonry units.
 - 2. Mortar and grout.
 - 3. Masonry joint reinforcement.
 - 4. Ties and anchors.
 - 5. Embedded flashing.
 - 6. Miscellaneous masonry accessories.
- B. Related Sections include the following:
 - 1. Division 7 Section "Water Repellents" for water repellents applied to unit masonry assemblies.
 - 2. Division 7 Section "Sheet Metal Flashing and Trim" for exposed sheet metal flashing.
- C. Products installed, but not furnished, under this Section include the following:
 - 1. Steel lintels for unit masonry, furnished under Division 5 Section "Metal Fabrications."
 - 2. Hollow-metal frames in unit masonry openings, furnished under Division 8 Section "Steel Doors and Frames."

1.3 SUBMITTALS

- A. Product Data: For each different masonry unit, accessory, and other manufactured product specified.
- B. Samples for Initial Selection: For the following:
 - 1. Unit masonry Samples in small-scale form showing the full range of colors and textures available for each different exposed masonry unit required.
- C. Material Certificates: Signed by manufacturers certifying that each of the following items complies with requirements:

1. Each type of masonry unit required.
 - a. Include size-variation data for brick, verifying that actual range of sizes falls within specified tolerances.
2. Each cement product required for mortar and grout, including name of manufacturer, brand, type, and weight slips at time of delivery.

1.4 QUALITY ASSURANCE

- A. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, through one source from a single manufacturer for each product required.
- B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from one manufacturer for each cementitious component and from one source or producer for each aggregate.
- C. Sample Panels: Before installing unit masonry, build sample panels, using materials indicated for the completed Work, to verify selections made under sample Submittals and to demonstrate aesthetic effects. Build sample panels for each type of exposed unit masonry assembly in sizes approximately 48 inches long by 48 inches high by full thickness.
 1. Locate panels in the locations indicated or, if not indicated, as directed by Architect.
 2. Clean exposed faces of panels with masonry cleaner indicated.
- D. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Meetings."

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.
 1. Protect Type I concrete masonry units from moisture absorption so that, at the time of installation, the moisture content is not more than the maximum allowed at the time of delivery.
- B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- D. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.6 PROJECT CONDITIONS

- A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
 - 1. Extend cover a minimum of 24 inches down both sides and hold cover securely in place.
- B. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
 - 1. Protect base of walls from rain-splashed mud and from mortar splatter by coverings spread on ground and over wall surface.
 - 2. Protect sills, ledges, and projections from mortar droppings.
 - 3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
 - 4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.
- C. Hot-Weather Requirements: Protect unit masonry work when temperature and humidity conditions produce excessive evaporation of water from mortar and grout. Provide artificial shade and wind breaks and use cooled materials as required.
 - 1. When ambient temperature exceeds 100 deg F, or 90 deg F with a wind velocity greater than 8 mph, do not spread mortar beds more than 48 inches ahead of masonry. Set masonry units within one minute of spreading mortar.

PART 2 - PRODUCTS

2.1 CONCRETE MASONRY UNITS

- A. General: Provide shapes indicated and as follows:
 - 1. Provide square-edged units for outside corners, unless indicated as bullnose.
- B. Concrete Masonry Units: as follows:
 - 1. Weight Classification: Lightweight, unless otherwise indicated.
 - 2. Provide Type I, moisture-controlled units.
 - 3. Exposed Faces: Manufacturer's standard color and texture, unless otherwise indicated.
 - a. Where units are to be left exposed, provide color and texture matching the range represented by Architect's sample.
 - b. Standard finish, scored vertically so units laid in running bond appear as square units laid in stacked bond.
- C. Prefaced Concrete Masonry Units: Lightweight concrete units indicated below with manufacturer's standard smooth resinous tile facing, complying with ASTM C 744:

1. For concrete masonry units to which prefaced surfaces are applied, comply with the following:
 - a. Concrete Masonry Units: Type I, moisture-controlled, hollow units.
2. Size: Manufactured to dimensions indicated for unfaced units, but with prefaced surfaces having 1/16-inch- wide returns of facing to create 1/4-inch- wide mortar joints with modular coursing.
3. Color and Pattern: Match Architect's samples.

2.2 MORTAR MATERIALS

- A. Portland Cement: ASTM C 150, Type I or II. Provide natural color or white cement as required to produce mortar color indicated.
- B. Hydrated Lime: Type S.
 1. For pigmented mortar, use a colored cement formulation as required to produce the color indicated or, if not indicated, as selected from manufacturer's standard formulations.
 - a. Pigments shall not exceed 10 percent of portland cement by weight for mineral oxides nor 2 percent for carbon black.
- C. Aggregate for Mortar: ASTM C 144; except for joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.
- D. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes. Use only pigments with a record of satisfactory performance in masonry mortar.
- E. Water: Potable.

2.3 MASONRY JOINT REINFORCEMENT

- A. General: as follows:
 1. Hot-dip galvanized, carbon-steel wire.
 2. Wire Size for Side Rods: W2.8 or 0.188-inch diameter.
 3. Wire Size for Cross Rods: W2.8 or 0.188-inch diameter.
 4. Provide in lengths of not less than 10 feet, with prefabricated corner and tee units.
- B. Provide ladder type with single pair of side rods and cross rods spaced not more than 16 inches o.c.

2.4 TIES AND ANCHORS, GENERAL

- A. General: Provide ties and anchors, specified in subsequent articles, made from materials that comply with this Article, unless otherwise indicated.

- B. Hot-Dip Galvanized Carbon-Steel Wire: ASTM A 82; with ASTM A 153, Class B-2 coating.
- C. Steel Sheet, Galvanized after Fabrication: ASTM A 366/A 366M cold-rolled, carbon-steel sheet hot-dip galvanized after fabrication to comply with ASTM A 153.
- D. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

2.5 ADJUSTABLE ANCHORS FOR CONNECTING TO STEEL FRAME

- A. General: Provide two-piece assemblies that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.
 - 1. Anchor Section: Crimped 1/4-inch- diameter, hot-dip galvanized steel wire anchor section for welding to steel.

2.6 ANCHORS FOR CONNECTING TO CONCRETE

- A. General: Provide two-piece assemblies that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.
 - 1. Anchor Section: Dovetail anchor section formed from 0.0528-inch- thick, steel sheet, galvanized after fabrication
 - 2. Tie Section: Triangular-shaped wire tie, sized to extend within 1 inch of masonry face, made from 0.25-inch- diameter, hot-dip galvanized steel wire.

2.7 RIGID ANCHORS

- A. General: Fabricate from steel bars as follows:
 - 1. 1-1/2 inches wide by 1/4 inch thick by 24 inches long, with ends turned up 2 inches or with cross pins.
 - 2. As indicated.
 - 3. Finish: Hot-dip galvanized to comply with ASTM A 153.

2.8 ADJUSTABLE MASONRY-VENEER ANCHORS

- A. General: Provide two-piece assemblies that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall, for attachment over sheathing to wood or metal studs, and as follows:
 - 1. Structural Performance Characteristics: Capable of withstanding a 100-lbf load in both tension and compression without deforming or developing play in excess of 0.05 inch.
- B. Seismic Masonry-Veneer Anchors: Units consisting of a metal anchor section and a connector section designed to engage a continuous wire reinforcement embedded in the veneer mortar joint, complying with the following requirements:

1. Anchor Section: Rib-stiffened, sheet metal plate with screw holes top and bottom, 2-3/4 inches wide by 3 inches high; with projecting tabs having slotted holes for inserting vertical leg of connector section.
 - a. Connector Section: Rib-stiffened, sheet metal bent plate with down-turned leg designed to fit in anchor section slot and with integral tabs designed to engage continuous wire. Size connector to extend at least halfway through veneer but with at least 5/8-inch cover on outside face.
 2. Contractor's Option - Anchor Section: Gasketed sheet metal plate with screw holes top and bottom; top and bottom ends bent to form pronged legs to bridge insulation or sheathing and contact studs; and raised rib-stiffened strap stamped into center to provide a slot between strap and plate for connection of wire tie.
 - a. Plate 1-1/4 inches wide by 6 inches long with strap 5/8 inch wide by 6 inches long; slot clearance formed between face of plate and back of strap shall not exceed diameter of wire tie by more than 1/32 inch.
 - b. Provide anchor manufacturer's standard, self-adhering, modified bituminous gaskets manufactured to fit behind anchor plate and to prevent moisture from penetrating sheathing at pronged legs and screw holes.
 - c. Connector Section: Triangular wire tie and rigid PVC extrusion with snap-in grooves for inserting continuous wire. Size wire tie to extend at least halfway through veneer but with at least 5/8-inch cover on outside face.
 3. Fabricate sheet metal anchor sections and other sheet metal parts from 0.0966-inch-thick, steel sheet, galvanized after fabrication.
 4. Fabricate wire connector sections from 0.25-inch-diameter, hot-dip galvanized steel wire.
- C. Steel Drill Screws for Steel Studs: ASTM C 954 except manufactured with hex washer head and neoprene washer, No. 10 diameter by length required to penetrate steel stud flange by not less than 3 exposed threads, and with the following corrosion protective coating:
1. Organic polymer coating with salt-spray resistance to red rust of more than 800 hours per ASTM B 117.
- D. Contractor's Option - Stainless-Steel Drill Screws for Steel Studs: Proprietary fastener consisting of carbon-steel drill point and 300 Series stainless-steel shank, complying with ASTM C 954 except manufactured with hex washer head and neoprene washer, No. 10 diameter by length required to penetrate steel stud flange by not less than three exposed threads.
- E. Products: Subject to compliance with requirements, provide one of the following:
1. Seismic Masonry-Veneer Anchors:
 - a. D/A 213S; Dur-O-Wal, Inc.
 - b. DW-10-X-Seismicclip; Hohmann & Barnard, Inc.
 2. Organic-Polymer-Coated, Steel Drill Screws:
 - a. Dril-Flex; Elco Industries, Inc.

- b. Traxx; ITW-Buildex.
- 3. Stainless-Steel Drill Screws for Steel Studs:
 - a. Stainless Steel SX Fastener; Dur-O-Wal, Inc.

2.9 EMBEDDED FLASHING MATERIALS

- A. Concealed Flashing: For flashing not exposed to the exterior, use the following, unless otherwise indicated:
 - 1. Copper-Laminated Flashing: Manufacturer's standard laminated flashing consisting of 5-oz./sq. ft. sheet copper bonded with asphalt between 2 layers of glass-fiber cloth. Use only where flashing is fully concealed in masonry.
- B. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by the flashing manufacturer for bonding flashing sheets to each other and to substrates.
- C. Products: Subject to compliance with requirements, provide one of the following:
 - 1. Copper-Laminated Flashing:
 - a. Copper Fabric; AFCO Products, Inc.
 - b. H & B C-Fab Flashing; Hohmann & Barnard, Inc.
 - c. Copper Fabric Flashing; Sandell Manufacturing Co., Inc.
 - d. York Copper Fabric Flashing; York Manufacturing, Inc.

2.10 MISCELLANEOUS MASONRY ACCESSORIES

- A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene.
- B. Round Plastic Weep/Vent Tubing: Medium-density polyethylene, 3/8-inch OD by 4 inches long.

2.11 MASONRY CLEANERS

- A. Job-Mixed Detergent Solution: Solution of 1/2-cup dry measure tetrasodium polyphosphate and 1/2-cup dry measure laundry detergent dissolved in 1 gal. of water.

2.12 MORTAR MIXES

- A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.
 - 1. Do not use calcium chloride in mortar.

- B. Mortar for Unit Masonry: Comply with CCR, Property Specification.
 - 1. Limit cementitious materials in mortar to portland cement, mortar cement, and lime.
 - 2. Use Type S.
- C. Pigmented Mortar: Select and proportion pigments with other ingredients to produce color required. Limit pigments to the following percentages of cement content by weight:
 - 1. For mineral-oxide pigments and portland cement-lime mortar, not more than 10 percent.
 - 2. For carbon-black pigment and portland cement-lime mortar, not more than 2 percent.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Build chases and recesses to accommodate items specified in this Section and in other Sections of the Specifications.
- B. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to the opening.
- C. Cut masonry units with motor-driven saws to provide clean, sharp, unchipped edges. Cut units as required to provide a continuous pattern and to fit adjoining construction. Where possible, use full-size units without cutting. Allow units cut with water-cooled saws to dry before placing, unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.
- D. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.

3.3 CONSTRUCTION TOLERANCES

- A. Comply with tolerances in ACI 530.1/ASCE 6/TMS 602 and the following:
- B. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/4 inch in 20 feet, nor 1/2 inch maximum.

- C. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet, nor 1/2 inch maximum.
- D. For conspicuous horizontal lines, such as exposed lintels, sills, parapets, and reveals, do not vary from level by more than 1/4 inch in 20 feet, nor 1/2 inch maximum.
- E. For exposed bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch. Do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
- F. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch. Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch.

3.4 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
- B. Bond Pattern for Exposed Masonry: Lay exposed masonry in the following bond pattern; do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.
 - 1. One-half running bond with vertical joint in each course centered on units in courses above and below.
- C. Stopping and Resuming Work: In each course, rack back one-half-unit length for one-half running bond or one-third-unit length for one-third running bond; do not tooth. Clean exposed surfaces of set masonry, wet clay masonry units lightly if required, and remove loose masonry units and mortar before laying fresh masonry.
- D. Built-in Work: As construction progresses, build in items specified under this and other Sections of the Specifications. Fill in solidly with masonry around built-in items.
- E. Fill space between hollow-metal frames and masonry solidly with mortar, unless otherwise indicated.

3.5 MORTAR BEDDING AND JOINTING

- A. Lay solid brick-size masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.
- B. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than the joint thickness, unless otherwise indicated.
 - 1. For glazed masonry units, use a nonmetallic jointer 3/4 inch or more in width.

- C. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint), unless otherwise indicated.

3.6 MASONRY JOINT REINFORCEMENT

- A. General: Provide continuous masonry joint reinforcement as indicated. Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.
 - 1. Space reinforcement not more than 16 inches o.c.
 - 2. Space reinforcement not more than 8 inches o.c. in foundation walls and parapet walls.
 - 3. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings.
 - a. Reinforcement above is in addition to continuous reinforcement.
- B. Cut or interrupt joint reinforcement at control and expansion joints, unless otherwise indicated.
- C. Provide continuity at corners and wall intersections by using prefabricated "L" and "T" sections. Cut and bend reinforcing units as directed by manufacturer for continuity at returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.7 ANCHORING MASONRY TO STRUCTURAL MEMBERS

- A. Anchor masonry to structural members where masonry abuts or faces structural members to comply with the following:
 - 1. Provide an open space not less than 1 inch in width between masonry and structural member, unless otherwise indicated. Keep open space free of mortar or other rigid materials.
 - 2. Anchor masonry to structural members with flexible anchors embedded in masonry joints and attached to structure.
 - 3. Space anchors as indicated, but not more than 24 inches o.c. vertically and 24 inches o.c. horizontally per 2016 CBC Section 1405.7.

3.8 ANCHORING MASONRY VENEERS

- A. Anchor masonry veneers to wall framing with seismic masonry-veneer anchors to comply with the following requirements:
 - 1. Fasten each anchor section through sheathing to wall framing with two metal fasteners of type indicated.
 - 2. Embed tie sections in masonry joints to engage horizontal reinforcing. Provide not less than 1-1/2 inches of air space between back of masonry veneer and face of sheathing.

3. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
4. Space anchors as indicated, but not more than 16 inches o.c. vertically and 16 inches o.c. horizontally with not less than 1 anchor for each 2.67 sq. ft. of wall area. Install additional anchors within 12 inches of openings and at intervals, not exceeding 36 inches, around perimeter.

3.9 CONTROL AND EXPANSION JOINTS

- A. General: Install control and expansion joints in unit masonry where indicated. Build-in related items as masonry progresses. Do not form a continuous span through movement joints unless provisions are made to prevent in-plane restraint of wall or partition movement.
- B. Form control joints in concrete masonry as follows:
 1. Install temporary foam-plastic filler in head joints and remove filler when unit masonry is complete.
- C. Form expansion joints in brick made from clay or shale as follows:
 1. Build in joint fillers where indicated.
 2. Form open joint of width indicated, but not less than 3/8 inch for installation of sealant and backer rod specified in Division 7 Section "Joint Sealants." Keep joint free and clear of mortar.
- D. Build in horizontal, pressure-relieving joints where indicated; construct joints by leaving an air space or inserting a compressible filler of width required for installing sealant and backer rod specified in Division 7 Section "Joint Sealants."
 1. Locate horizontal, pressure-relieving joints beneath shelf angles supporting masonry veneer and attached to structure behind masonry veneer.

3.10 LINTELS

- A. Install steel lintels where indicated.
- B. Provide minimum bearing of 8 inches at each jamb, unless otherwise indicated.

3.11 FLASHING AND WEEP HOLES

- A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated.
- B. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Unless otherwise indicated, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
- C. Install flashing as follows:

1. At masonry-veneer walls, extend flashing from exterior face of veneer, through veneer, up face of sheathing at least 8 inches, and behind air-infiltration barrier or building paper.
 2. At lintels and shelf angles, extend flashing a minimum of 4 inches into masonry at each end. At heads and sills, extend flashing 4 inches at ends and turn flashing up not less than 2 inches to form a pan.
 3. Cut flashing off flush with face of wall after masonry wall construction is completed.
- D. Install weep holes in the head joints in exterior wythes of the first course of masonry immediately above embedded flashing and as follows:
1. Use round plastic tubing to form weep holes.
 2. Space weep holes 16 inches o.c.
- E. Install reglets for flashing and other related construction where they are shown to be built into masonry.

3.12 FIELD QUALITY CONTROL

- A. Refer to Section 014120 – Quality Control for inspection requirements for spot checking of masonry throughout the course of the work.

3.13 REPAIRING, POINTING, AND CLEANING

- A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.
- B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application.
- C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
 2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
 3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent, polyethylene film, or waterproof masking tape.

4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing the surfaces thoroughly with clear water.
5. Clean brick by the bucket-and-brush hand-cleaning method described in BIA Technical Notes No. 20, using job-mixed detergent solution.
6. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2 applicable to type of stain on exposed surfaces.

END OF SECTION

SECTION 051200
STRUCTURAL STEEL

PART 1 – GENERAL

1.1 SUMMARY

- A. The Contract Documents including the General Conditions and Divisions 1 & 2 as applicable shall apply to this section.
- B. Work includes:
 - 1. Structural steel members as indicated on the Drawings, complete with all shop and field connections.
 - 2. Shop priming structural steel installed at interior locations; hot dip galvanizing structural steel members and structural steel connections and bolts installed as noted on the architectural or structural plans.
 - 3. Furnish anchor bolts, loose bearing plates, wedges, guying and bracing as required for structural steel erection.
 - 4. Cooperate with the Testing Laboratory in the performance of its duties and permit its personnel unrestricted access to the work at all times.
- C. Related work includes:
 - 1. Installing anchor bolts and loose bearing plates for structural steel members.
 - 2. Grouting beneath base and bearing plates.

1.2 SUBMITTALS

- A. Submittals shall be in accordance with Section 013000.
- B. Material selection:
 - 1. Select materials that have the highest possible recycled content while still meeting performance criteria.
 - 2. Select materials from local manufacturers wherever possible.
- C. Provide submittals to document material selection as follows:
 - 1. Complete Materials Cost Tracking Sheet.
 - 2. Data from manufacturer to certify recycled content, manufacture location and harvest location (i.e. cut sheets and/or manufacturer certification letters)

- D. Product Data: For each product indicated.
- E. Shop drawings:
 - 1. Submit complete shop drawings and erection diagrams for this work.
 - a. Should more than one submittal be required, later submittals shall clearly identify material added or revised subsequent to previous submittal.
 - b. Indicate all shop and erection details, including cuts, copes, connections, holes, threaded fasteners, rivets and welds.
 - 2. Submit proposed welding sequence and welding qualifications to indicate the method of all welded connections. Identify all welds, both shop and field, in accordance with AWS A2.4, "Symbols for Welding and Non-Destructive Testing".
- F. Mill certificates.

1.3 QUALITY ASSURANCE

- A. Fabricator's qualifications: All structural steel fabrication shall be performed in the shop of a fabricator licensed by the governing agency.
- B. Tests to be performed by the structural steel fabricator: Tests to identify unidentified structural steel as required by the Building Code.
- C. Applicable reference standards:
 - 1. American Welding Society:
 - a. AWS D1.1, "Structural Welding Code".
 - b. AWS A2.4, "Symbols for Welding and Non-Destructive Testing".
 - 2. American Institute of Steel Construction, AISC "Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings" and "Code of Standard Practice for Steel Buildings and Bridges".
 - 3. Research Council on Riveted and Bolted Structural Joints of the Engineering Foundation, "Specifications for Structural Joints Using ASTM A325 Bolts".
 - 4. ASTM 385, Providing High-Quality Zinc Coatings (Hot-Dip).
 - 5. ASTM A123 Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - 6. ASTM A143, Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement.
 - 7. ASTM A153, Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - 8. ASTM A780, Repair of Damaged Hot-Dip Galvanized Coatings.

9. SSPC - Steel Structures Painting Manual, Volume 2, Systems and Specifications.
- D. American Galvanizers Association (AGA) Publications:
 1. "Inspection of Products Hot Dip Galvanized After Fabrication".
 2. "The Design of Products to be Hot Dip Galvanized after Fabrication".
 3. "Recommended Details of Galvanized Structures".
- E. Structural General Notes: Applicable Structural General Notes shall apply to the work of this Section as though repeated verbatim herein.

1.4 STORAGE AND PROTECTION

- A. Comply with the requirements of Section 012100 – Contractor's Use of Project Site.
- B. Store steel members off ground and protect steel members and packaged materials from erosion and deterioration.
- C. Store fasteners in a protected place. Clean and re-lubricate bolts and nuts that become dry or rusty before use.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Structural-Steel Shapes, Plates, and Bars: Use ASTM A36 Steel, except wide flange shapes shall be ASTM A992, carbon steel unless noted otherwise on the structural or architectural drawings.
- B. Cold-Formed Structural-Steel Tubing: ASTM A 500, Grade B.
- C. Steel Pipe Columns: ASTM A53, Grade B.
- D. Threaded Rods: ASTM A 36/A 36M, unheaded rods, unless noted otherwise on the structural or architectural drawings.
- E. Non-high-Strength Bolts, Nuts, and Washers: ASTM A 307, Grade A; carbon-steel, hex-head bolts; carbon-steel nuts; and flat, unhardened steel washers, uncoated. Fasteners used at exterior locations shall be hot dip galvanized as specified hereafter.
- F. High-Strength Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, heavy hex steel structural bolts, heavy hex carbon-steel nuts, and hardened carbon-steel washers, uncoated. Fasteners used at exterior locations shall be hot dip galvanized as specified hereafter.

- G. Use ASTM A563 for nuts, ASTM F436 for washers, and ASTM F1554 GR 36. For headed anchor rods or threaded & nutted anchor rods.(Conform with AISC Table 2-6)
- H. Welding electrodes: As specifically recommended by the American Welding Society and conforming to the City San Bernardino Building Dept. requirements.
- I. Primer: Shop primer for interior structural steel: 13-F (or R)-78 (2.5 mils DFT) by Ameron, or Tnemec 10-99 modified alkyd Tnemec Primer (2.5 to 3.5 mils DFT), by Tnemec, Inc.
- I Primer: Shop primer for interior structural steel: 13-F (or R)-78 (2.5 mils DFT) by Nonmetallic, Shrinkage-Resistant Grout: Premixed, ASTM C 1107, of consistency suitable for application Structural-Steel Shapes, Plates, and Bars: ASTM A 36/A 36M, carbon steel unless noted otherwise on the structural or architectural drawings.

2.2 FABRICATION

- A. Fabrication shall be equal to that produced in modern structural steel shops, in accordance with the AISC "Code of Standard Practice", the Drawings and Building Code requirements.
 - 1. Close open ends of tubular steel members with steel closure plates continuously welded and ground flush and smooth with parent metal.
- B. Fabrication requirements for structural steel to be hot dip galvanized:
 - 1. Fabricate structural steel in accordance with Class I, II, III guidelines as described in AGA's "Recommended Details for Galvanized Structures."
 - 2. Fabrication practices for Products to be in accordance with the applicable portions of ASTM A143, A384, and A385, except as specified herein. Avoid fabrication techniques that could cause distortion or embrittlement of the steel.
 - 3. The Fabricator shall consult with the City's Representative and hot dip galvanizer regarding potential problems or potential handling problems during the galvanizing process that may require modification of design before fabrication proceeds.
 - 4. Remove all welding slag, splatter, anti-splatter compounds and burrs prior to delivery for galvanizing.
 - 5. Provide holes and/or lifting lugs to facilitate handling during the galvanizing, at locations acceptable by the Architect.
 - 6. Avoid unsuitable marking paints. Consult with the galvanizer about removal of grease, oil paint and other deleterious material prior to fabrication.
 - 7. Remove by blast cleaning or other methods surface contaminants and coatings that would not be removable by the normal chemical cleaning process in the galvanizing operation.

8. When ever possible, slip joints should be used to minimize field welding of material.
- D. Finishing: Prior to start of finishing process straighten structural steel members by non-injurious methods so they conform to AISC tolerances.
1. Hot-dip galvanize all exterior structural steel in accordance with ASTM A123 or A153 as applicable except where not practicable due to galvanizing process limitations, in which case items shall be primed using specified zinc-rich primer applied in accordance with its manufacturer's printed instructions.
 - a. Safeguard assemblies against steel embrittlement in accordance with ASTM A143.
 - b. Coating weight shall conform to paragraph 5.1 of ASTM A123, or Table 1 of ASTM A153, as applicable.
 - c. Visual requirements for hot dip galvanized surfaces that are exposed to public view in the finished work: Hot dip galvanized surfaces shall present and smooth appearance, free of sags and evenly distributed, and shall be of even spangle.
 - 1) Surface finish: Continuous, adherent, as smooth and evenly distributed as possible and free from any defect detrimental to the stated end use of the coated.
 - d. Adhesion: Withstand normal handling consistent with the nature and thickness of the coating and normal use of the article.
 - e. Tests:
 - 1) Inspection and testing of hot dip galvanized coatings shall be done under the guidelines provided in the AGA publication "Inspection of Products Hot Dip Galvanized After Fabrication."
 - 2) Include visual examination and tests in accordance with ASTM A123, A767 or A153 as applicable to determine the thickness of the zinc coating on the metal surface.
 - 3) Furnish Certificate of Compliance with ASTM Standards and Specifications herein listed. The Certificate must be signed by the galvanizer and contain a detailed description of the material processed. The Certificate shall include information as to the ASTM standard used for the coating.
 2. Shop prime interior structural steel items as follows:
 - a. Remove loose mill scale, loose rust, cutting and punching burrs, oil, grease and other deleterious materials before priming. Comply with SSPC-SP 3 – Power Tool Cleaning, requirements.

- b. Re-clean any metal surface that is not primed the same day, or that becomes contaminated or visibly rusts before the primer is applied.
- c. Immediately after surface preparation, brush or spray primer in strict accordance with the paint manufacturer's printed instructions at the rate required to provide a uniform dry film thickness of not less than 2.5 mils dry film thickness per coat. Use painting methods which will result in full coverage of joints, corners, edges and all exposed surfaces indicated to be painted.
- d. Apply shop primer to completely cover all exposed surfaces as well as surfaces concealed after assembly. Allow paint to dry thoroughly before handling.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Examine adjacent construction and make sure that all conditions detrimental to the proper and timely execution of this work have been corrected before proceeding.

3.2 ERECTION

- A. Erect the structural steel in accordance with the Drawings and the referenced AISC Specifications. Structural steel tolerances shall conform to AISC "Specification for Structural Steel Buildings", and AISC "Code of Standard Practice for Steel Buildings and Bridges", 2010 editions, except that maximum deviation of exterior columns toward the building line shall not exceed 1/2".
- B. Field assembly:
 - 1. All structural steel members shall be of the sizes, weights and shapes indicated, closely fitted as required to permit its accurate erection and joining in the field.
 - 2. Drifting to enlarge misaligned holes will not be permitted.
 - 3. Rolled sections, except for minor details, shall not be heated without prior written approval.
- C. Gas cutting:
 - 1. A cutting torch may be used where the steel member being cut is not carrying stress during the operation, and provided stresses will not be transmitted through a flame-cut surface.
 - 2. Make contours of gas cuts smooth and regular.
 - 3. To determine the effective width of members so cut, deduct 1/8" from the width of the gas cut edges.

4. Make the radius or re-entrant gas cut fillets as large as practicable, but not less than 1".
- D. Bolting: Use high-strength steel bolts at all indicated locations. Conform to the latest edition of "Specifications for Structural Joints Using ASTM A325 or A490 Bolts" as approved by the Research Council on Riveted and Bolted Structural Joints of the Engineering Foundation.
- E. Structural steel shall be carefully planned and laid out so a minimum of cutting is required.
 1. Erect the structural steel plumb, square and level in accordance with tolerances listed in the referenced AISC specifications.
 2. Provide temporary bracing and guys wherever necessary to provide for loads and stresses to which the structure may be subjected, including those due to erection equipment and its operation, and leave in place as long as it may be necessary for safeguarding the work.
- F. Temporary connections:
 1. Securely bolt up the structural steel framing as required to maintain it in proper position while field bolting and welding is being done, and as necessary to resist the loads and stresses it will be subjected to.
 2. Do not perform any field welding or high-strength bolting until the structural steel framing has been properly aligned, plumbed and leveled.
- G. Set column base plates in indicated positions and support them on steel wedges until the grout beneath them has reached its full strength.
 1. The center of each base shall be located within 1/16" of the column center.
 2. Plates shall be level on both axes.

3.3 WELDING

- A. Comply with the requirements of the American Welding Society Standards D1.1, the referenced AISC Specifications and the Drawings. In case of conflict, the Drawings take precedence. Take all necessary precautions when welding galvanized surfaces.
- B. Welders shall be approved in accordance with AWS requirements and, if required, shall have a currently valid certification by the Building Dept. If welder's recertification is required, it shall be the Contractor's responsibility to obtain it.

3.4 ANCHOR BOLTS

- A. Furnish all anchor bolts and connection material to be embedded in the concrete when and as required to maintain job progress.

- B. Setting anchor bolts in hardened concrete, necessitated through error or oversight, shall be performed under the Owner's Representative's direction in suitable drilled holes solidly grouted in place, or embedded in an approved structural epoxy.

3.5 BEARING PLATES

- A. Maintain bearing plates in proper location and in proper level while they are being grouted. Note that grouting is specified to be performed in Section 033000 - "Cast-In-Place Concrete".

3.6 TOUCH-UP

- A. Damaged zinc coating: Repair using flame spray metallizing process in accordance with the requirements of ASTM A780 method A3 – "Repair Using Sprayed Zinc (Metallizing)", with coating applied evenly to provide an appearance matching that of adjacent hot dip galvanized surfaces as closely as possible. Minimum thickness requirements for the repair are those described in ASTM A123 section 4.6 current edition. Do not use either of the other repair methods allowed by ASTM A780.
- B. Damaged primer: Clean the damaged area, sand smooth, reclean and spot prime with a coat of the applicable specified primer applied to a dry film thickness in accordance with the manufacturer's printed instructions.

3.7 FIELD QUALITY CONTROL

- A. Contractor will engage a qualified testing and inspecting agency to perform field tests and inspections and to prepare test reports. The testing and inspection agency shall be paid directly by the Owner.
 - 1. Correct deficiencies in or remove and replace structural steel that test reports and inspections indicate do not comply with specified requirements.
 - 2. Additional testing, at Contractor's expense, will be performed to determine compliance of corrected Work with specified requirements.
 - 3. High-strength bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using High-Strength Bolts."
 - 4. In addition to visual inspection, welded connections will be tested and inspected according to AWS D1.1 procedures.
 - 5. Deputy Inspection is required for all field welding and high strength bolting.
 - 6. Provide non-destructive testing of welded frame joints per 2016 CBC.

END OF SECTION

ARCHITECTURALLY EXPOSED STRUCTURAL STEEL FRAMING

SECTION 051213

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes architecturally exposed structural-steel (AESS).
 - 1. Requirements in Section 051200 "Structural Steel Framing" also apply to AESS.
- B. Related Requirements:
 - 1. Section 051200 "Structural Steel Framing"
 - 2. Section 099000 "Paints and Coatings"

1.3 DEFINITIONS

- A. AESS: Structural steel designated as "architecturally exposed structural steel" or "AESS" in the Contract Documents.
- B. Category 1 AESS: AESS that is within 96 inches (2400 mm) vertically and 36 inches (900 mm) horizontally of a walking surface and that is visible to a person standing on that walking surface or is designated as "Category 1 architecturally exposed structural steel" or "AESS-1" in the Contract Documents.
- C. Category 2 AESS: AESS that is within 20 feet (6 m) vertically and horizontally of a walking surface and that is visible to a person standing on that walking surface or is designated as "Category 2 architecturally exposed structural steel" or "AESS-2" in the Contract Documents.
- D. Category 3 AESS: AESS that is not defined as Category 1 or Category 2 or that is designated as "Category 3 architecturally exposed structural steel" or "AESS-3" in the Contract Documents.

1.4 COORDINATION

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

1.5 ACTION SUBMITTALS

- A. Shop Drawings: Show fabrication of AESS components. Shop Drawings for structural steel may be used for AESS provided items of AESS are specifically identified and requirements below are met for AESS.

1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
2. Include embedment Drawings.
3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain. Indicate grinding, finish, and profile of welds.
4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections. Indicate orientation of bolt heads.
5. Indicate exposed surfaces and edges and surface preparation being used.
6. Indicate special tolerances and erection requirements.

- B. Samples: Submit Samples of AESS to set quality standards for exposed welds for Category 1 AESS.

1. Two steel plates, 3/8 by 8 by 4 inches (9.5 by 200 by 100 mm), with long edges joined by a groove weld[and with weld ground smooth].
2. Steel plate, 3/8 by 8 by 8 inches (9.5 by 200 by 200 mm), with one end of a short length of rectangular steel tube, 4 by 6 by 3/8 inches (100 by 150 by 9.5 mm), welded to plate with a continuous fillet weld[and with weld ground smooth and blended].
3. Round steel tube or pipe, minimum 8 inches (200 mm) in diameter, with end of another round steel tube or pipe, approximately 4 inches (100 mm) in diameter, welded to its side at a 45-degree angle with a continuous fillet weld[and with weld ground smooth and blended].

1.6 INFORMATIONAL SUBMITTALS

- A. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

1.7 QUALITY ASSURANCE

- A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category STD, or is accredited by the IAS Fabricator Inspection Program for Structural Steel (AC 172).
- B. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category ACSE
- C. Shop-Painting Applicators: Qualified according to AISC's Sophisticated Paint Endorsement P1 or SSPC-QP 3, "Standard Procedure for Evaluating Qualifications of Shop Painting Applicators."

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Use special care in handling to prevent twisting, warping, nicking, and other damage. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
 - 1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

1.9 FIELD CONDITIONS

- A. Field Measurements: Where AESS is indicated to fit against other construction, verify actual dimensions by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 BOLTS, CONNECTORS, AND ANCHORS

- A. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, round-head assemblies, consisting of steel structural bolts with splined ends, heavy-hex carbon-steel nuts, and hardened carbon-steel washers.
 - 1. Finish: Plain].
- B. Corrosion-Resisting (Weathering Steel), Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 3, round-head assemblies, consisting of steel structural bolts with splined ends, heavy-hex carbon-steel nuts, and hardened carbon-steel washers.

2.2 FILLER

- A. Filler: Polyester filler intended for use in repairing dents in automobile bodies.

2.3 PRIMER

- A. Primer: Comply with Section 099000 "Paints and Coatings"
- B. Primer: SSPC-Paint 25 BCS, Type I, zinc oxide, alkyd, linseed oil primer.
- C. Primer: SSPC-Paint 23, latex primer.
- D. Primer: Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.
- E. Etching Cleaner for Galvanized Metal: MPI#25.
- F. Galvanizing Repair Paint: MPI#18, MPI#19, or SSPC-Paint 20 - ASTM A 780/A 780M.
- G. Shop Primer for Galvanized Steel: MPI#134, water-based galvanized metal primer.

2.4 FABRICATION

- A. Shop fabricate and assemble AESS to the maximum extent possible. Locate field joints at concealed locations if possible. Detail assemblies to minimize handling and to expedite erection.
- B. In addition to special care used to handle and fabricate AESS, comply with the following:
 - 1. Fabricate with exposed surfaces smooth, square, and free of surface blemishes including pitting, rust, scale, and roughness.
 - 2. Grind sheared, punched, and flame-cut edges of Category 1 AESS to remove burrs and provide smooth surfaces and edges.
 - 3. Fabricate Category 1 AESS with exposed surfaces free of mill marks, including rolled trade names and stamped or raised identification.
 - 4. Remove blemishes by filling or grinding or by welding and grinding, before cleaning, treating, and shop priming.
 - 5. Fabricate with piece marks fully hidden in the completed structure or made with media that permits full removal after erection.
 - 6. Seal-weld open ends of hollow structural sections with 3/8-inch (9.5-mm) closure plates for Category 1 AESS.
- C. Curved Members: Fabricate indicated members to curved shape by rolling to final shape in fabrication shop.
 - 1. Distortion of webs, stems, outstanding flanges, and legs of angles shall not be visible from a distance of 20 feet (6 m) under any lighting conditions.

2. Tolerances for walls of hollow steel sections after rolling shall be approximately 1/2 inch (13 mm).
- D. Coping, Blocking, and Joint Gaps: Maintain uniform gaps of 1/8 inch (3.2 mm) with a tolerance of 1/32 inch (0.8 mm) for Category 1 AESS.
- E. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.
- F. Cleaning Corrosion-Resisting Structural Steel: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
- G. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.
 1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
 2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
 3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.5 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
 1. Joint Type: Pretensioned.
- B. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work, and comply with the following:
 1. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding specified tolerances.
 2. Use weld sizes, fabrication sequence, and equipment for AESS that limit distortions to allowable tolerances.
 3. Provide continuous, sealed welds at angle to gusset-plate connections and similar locations where Category 1 AESS is exposed to weather.
 4. Grind butt and groove welds flush to adjacent surfaces within tolerance of plus 1/16 inch, minus zero inch (plus 1.5 mm, minus zero mm) for Category 1 and Category 2AESS.
 5. Make butt and groove welds flush to adjacent surfaces within tolerance of plus 1/16 inch, minus zero inch (plus 1.5 mm, minus zero mm) for Category 1 and Category 2 AESS. Do not grind unless required for clearances or for fitting other components, or unless directed to correct unacceptable work.
 6. Remove backing bars or runoff tabs; back-gouge and grind steel smooth for Category 1 and Category 2 > AESS.

7. At locations where welding on the far side of an exposed connection of Category 1 and Category 2 > AESS occurs, grind distortions and marking of the steel to a smooth profile aligned with adjacent material.
8. Make fillet welds for Category 1 and Category 2 AESS oversize and grind to uniform profile with smooth face and transition.
9. Make fillet welds for Category 1 and Category 2 AESS of uniform size and profile with exposed face smooth and slightly concave. Do not grind unless directed to correct unacceptable work.

2.6 SHOP PRIMING

- A. Shop prime steel surfaces except the following:
 1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches (50 mm).
 2. Surfaces to be field welded.
 3. Surfaces to be high-strength bolted with slip-critical connections.
 4. Surfaces to receive sprayed fire-resistive materials.
 5. Galvanized surfaces.
- B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:
- C. Preparing Galvanized Steel for Shop Priming: After galvanizing, thoroughly clean steel of grease, dirt, oil, flux, and other foreign matter, and treat with etching cleaner.
- D. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils (0.038 mm). Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
 2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify, with steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
 1. Prepare a certified survey of bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.

- B. Examine AESS for twists, kinks, warping, gouges, and other imperfections before erecting.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep AESS secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.
 - 1. If possible, locate welded tabs for attaching temporary bracing and safety cabling where they will be concealed from view in the completed Work.
 - 2. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.

3.3 ERECTION

- A. Set AESS accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.
 - 1. Erect Category 1AESS to the tolerances specified in AISC 303 for steel that is designated AESS.
 - 2. Erect Category 2 and Category 3AESS to the tolerances specified in AISC 303 for steel that is not designated AESS.
- B. Do not use thermal cutting during erection.

3.4 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
 - 1. Joint Type: Pretensioned
 - 2. Orient bolt heads in same direction for each connection and to maximum extent possible in same direction for similar connections.
- B. Weld Connections: Comply with requirements in "Weld Connections" Paragraph in "Shop Connections" Article.
 - 1. Remove backing bars or runoff tabs; back-gouge and grind steel smooth for Category 1 and Category 2 AESS.
 - 2. Remove erection bolts in Category 1 and Category 2 AESS, fill holes, and grind smooth.
 - 3. Fill weld access holes in Category 1 and Category 2 AESS and grind smooth.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect AESS as specified in Section 051200 "Structural Steel Framing." The testing agency is not responsible for enforcing requirements relating to aesthetic effect.
- B. Architect will observe AESS in place to determine acceptability relating to aesthetic effect.

3.6 REPAIRS AND PROTECTION

- A. Remove welded tabs that were used for attaching temporary bracing and safety cabling and that are exposed to view in the completed Work. Grind steel smooth.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780/A 780M.
- C. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - 1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
- D. Touchup Painting: Cleaning and touchup painting are specified in Section 099000 "Paint"

END OF SECTION

SECTION 059000

ALUMINUM CANOPIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Work in this section includes furnishing and installation of roll-formed aluminum overhead hanger rod style canopies over windows and doors as indicated.
- B. Anchors and fasteners for connection to concrete block construction
- C. Soffit aluminum panel system.

1.2 RELATED SECTIONS

- A. Section 076000 Flashing and Sheet Metal.

1.3 REFERENCES

- A. Aluminum Association (AA):
 - AA - Standards for Architectural Aluminum.
 - AA - Designation System for Aluminum Finishes.

1.4 SUBMITTALS

- A. Product Data: Submit catalog data for all standard production products.
- B. Shop Drawings:
 - Indicate fabrication and installation of metal fabrications, per Section 013000.
 - Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories.
 - Include erection drawings, elevations, and details where applicable.
 - Indicate welded connections using standard AWS welding symbols. Indicate net weld lengths.
 - For products indicated to comply with certain design loadings, include structural analysis data sealed and signed by a Professional Structural Engineer currently registered to practice in the State of California, who was responsible for their preparation
- C. Product Data: Submit catalog data for all standard production products.

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements: Conform to California Building Code (CBC).
- B. Fabricator's Qualifications: Fabricator of light structural steel framing members and other miscellaneous metal fabrications of structural character shall be approved by the Building Official in accordance with applicable Code provisions.
- C. Coordination: Provide templates and sleeves for incorporation of embedded items into the work specified elsewhere herein.

- D. Field-Verified Dimensions: Prior to fabrication, field verify dimensions and details of construction. Immediately report variances in writing to Architect. Do not proceed with the work until clarification has been received from the Architect.

1.6 QUALITY ASSURANCE

- A. Storage, General: Store products in enclosed, well-ventilated spaces, not in contact with soil or vegetation and not subject to inclement weather.
- B. Delivery, Storage and Handling, Galvanized Products:
 - Stack and bundle during transport and store to allow air flow between galvanized surfaces.
 - Load for transport to permit continuous drainage should wetting occur.
 - Do not rest galvanized products on cinders or clinkers.
- C. Bundles shall be intact and identified with appropriate and legible labels or tags.

1.7 PROJECT CONDITIONS

- A. Field Inspection: Prior to installation, inspect products for damage and verify markings and dimensions against reviewed submittal shop drawings.
- B. Coordination: Coordinate metal fabrications Work with Work specified in other Sections so that related Work shall be accurately and properly joined.

PART 2 - PRODUCTS

2.1 ALUMINUM CANOPIES BASED ON:

- A. Mapes Canopies, LLC
7748 North 56th Street
Lincoln, NE 68514
Phone: 888-273-1132
- B. Requests to use equivalent products of other manufacturers shall be submitted in accordance with Division 1.

2.2 MATERIALS

- A. Decking shall consist of an interlocking roll-form 2 1/2 W style pan (.032" aluminum).
- B. Intermediate framing members shall be extruded aluminum, alloy 6063-T6, in profile and thickness shown in current Mapes brochures.
- C. Hanger rods and attachment hardware shall be a standard finish.
- D. Fascia shall be standard extruded 10" C-Channel style.

2.3 FINISHES

- A. Finish type shall be 2-Coat Kynar Finish.

2.4 FABRICATION

- A. All Mapes canopies are shipped in preassembled sections for ease of installation.
- B. All connections shall be mechanically assembled utilizing 3/16 fasteners with a minimum shear stress of 350 lb. Pre-welded or factory-welded connections are not acceptable.
- C. Decking shall be designed with interlocking roll-formed aluminum members.
- D. Concealed drainage. Water shall drain from covered surfaces into intermediate trough and be directed to Front Scupper.

2.5 ALUMINUM METAL PANEL

- A. Acceptable manufacturer: Alucobond, or approved equal
- B. All connections shall be mechanically assembled utilizing fasteners per manufacturer's recommendations.
- C. Provide submittal and shop drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Confirm that surrounding area is ready for the canopy installation.
- B. Installer shall confirm dimensions and elevations to be as shown on drawings provided by Mapes Industries.
- C. Erection shall be performed by an approved installer and scheduled after all concrete, masonry and roofing in the area is completed

3.2 INSTALLATION

- A. Installation shall be in strict accordance with manufacturer's shop drawings. Particular attention should be given to protecting the finish during handling and erection.
- B. After installation clean entire assembly.

END OF SECTION

SECTION 061000
ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

- A. The Contract Documents including the General Conditions and Divisions 1 & 2 as applicable shall apply to this section.
- B. Work includes:
 - 1. Wood furring, stripping, blocking, backing, bridging, nailers and other items shown and required to complete the work.
 - 2. Rough hardware and anchorage for rough carpentry.
- C. Related work includes:
 - 1. Concrete formwork: Section 033000.
 - 2. Finish carpentry and millwork.
 - 3. Regarding custom casework and countertops: Section 064100

1.2 SUBMITTALS

- A. Make submittals in accordance with the requirements of Section 013000.
- B. Wood treatment data: Submit chemical treatment manufacturer's instructions for handling, storing, installation and finishing of treated material.
 - 1. Preservative treatment: For each type specified, include certification by treating plant stating type of preservative solution and pressure process used, net amount of preservative retained and conformance with applicable standards.
 - 2. For water-borne treatment include statement that moisture content of treated materials was reduced to levels indicated prior to shipment to project site.

1.3 HANDLING

- A. Deliver lumber to the site banded and clearly grade marked in accordance with the applicable grading rules. Keep materials under cover and dry. Protect against exposure to weather and contact with damp or wet surfaces. Stack lumber as well as plywood and other panels; provide for air circulation within and around stacks and under temporary coverings including polyethylene and similar materials.

1. For lumber and plywood pressure treated with waterborne chemicals, sticker between each course to provide air circulation.
- B. Take care not to mar surfaces and edges of wood members that will be exposed in the finished work. Replace wood members damaged beyond satisfactory field repair, as determined by the District's Representative, with satisfactory members at no additional cost to the District.

1.4 PROJECT CONDITIONS

- A. Coordination: Fit carpentry work to other work; scribe and cope as required for accurate fit. Correlate location of furring, nailers, blocking, grounds and similar supports to allow attachment of other work.
- B. Comply with "Treated Wood Handling Advisory", published by the Western Wood Products Association, when handling pressure treated materials.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
- B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.
- C. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 WOOD PRODUCTS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of lumber grading agencies certified by the American Lumber Standards Committee Board of Review.
 1. Factory mark each piece of lumber with grade stamp of grading agency.
 2. For exposed lumber indicated to receive stained or natural finish, mark grade stamp on end or back of each piece.
 3. Provide dressed lumber, S4S, unless otherwise indicated.
 4. Provide dry lumber with 19 percent maximum moisture content at time of dressing for 2-inch nominal (38-mm actual) thickness or less, unless otherwise indicated.
 5. Provide fire blocking and draft stops as required by the drawings and per CBC Sections 708.4, 718.2, 718.3.

- B. Engineered Wood Products: Acceptable to authorities having jurisdiction and for which current model code research or evaluation reports exist that show compliance with building code in effect for Project.
 - 1. Allowable Design Stresses: Meet or exceed those indicated per manufacturer's published values determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.
- C. Wood Structural Panels:
 - A. Plywood: DOC PS 1. Plywood shall be formaldehyde free.
 - B. Comply with "Code Plus" provisions in APA Form No. E30K, "APA Design/Construction Guide: Residential & Commercial."
 - D. Sustainability:
 - 1. When possible, all wood and wood products shall come from Forest Stewardship Council (FSC) Certified lumber mills and/or suppliers.
 - 2. The contractor shall submit documentation for all FSC Certified products that are used.

2.3 WOOD-PRESERVATIVE-TREATED MATERIALS

- A. Preservative Treatment by Pressure Process: AWPA C2 (lumber) and AWPA C9 (plywood), except that lumber that is not in contact with the ground and is continuously protected from liquid water may be treated according to AWPA C31 with inorganic boron (SBX).
- B. Kiln-dry material after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood.
- C. Mark each treated item with treatment quality mark of an inspection agency approved by the American Lumber Standards Committee Board of Review.
- D. Application: Treat items indicated on Drawings, and the following:
 - 1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
 - 2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.
 - 3. Wood framing members less than 18 inches (460 mm) above grade.
 - 4. Wood floor plates that are installed over concrete slabs directly in contact with earth.

2.4 DIMENSION LUMBER

- A. General: Of grades indicated according to the American Lumber Standards Committee National Grading Rule provisions of the grading agency indicated.
- B. All Framing Lumber: Grade as specified on the structural plans, and of the following species:
 - 1. Douglas fir-larch,; NLGA, WCLIB, or WWPA.

2.5 TIMBER AND MISCELLANEOUS LUMBER

- A. For timbers of 5-inch nominal size and thicker, provide material complying with the following requirements:
 - 1. Species and Grade: Douglas fir-larch, No. 1 grade, unless noted otherwise on the structural plans; NLGA, WCLIB, or WWPA.
- B. Provide miscellaneous lumber for support or attachment of other construction, including the following:
 - 1. Blocking.
 - 2. Cants.
 - 3. Nailers.
 - 4. Furring.
 - 5. Grounds.
- C. For items of dimension lumber size, provide grade lumber as specified on the structural plans, with 19 percent maximum moisture content of any species.
- D. For concealed boards, provide lumber with 19 percent maximum moisture content and of the following species and grades:
 - 1. See structural drawings.

2.6 ENGINEERED WOOD PRODUCTS

- A. Laminated-Veneer Lumber: Composite of wood veneers with grain primarily parallel to member lengths, manufactured with exterior-type adhesive complying with ASTM D 2559. Allowable design values determined according to ASTM D 5456.
 - 1. Available Manufacturer:
 - a. iLevel by Weyerhaeuser.
- B. Rim Boards: Performance-rated product complying with APA PRR-401.
 - 1. Material, as noted on the structural drawings.
 - 2. Thickness and Grade: as noted on the structural drawings

3. Trademark: Factory mark with APA trademark indicating thickness, grade, and compliance with APA standard.

C. Parallel Strand Lumber and Laminated Strand Lumber:

1. Available Manufacturer:
 - a. iLevel by Weyerhaeuser.

2.7 MISCELLANEOUS MATERIALS

A. Fasteners:

1. Where rough carpentry is exposed to weather, in ground contact, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.
2. Power-Driven Fasteners: CABO NER-272.
3. Bolts: Steel bolts complying with ASTM A 307, Grade A with ASTM A 563 hex nuts and, where indicated, flat washers.

B. Metal Framing Anchors: Made from hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, G60 coating designation.

1. Approved Manufacturers:
 - a. Simpson Strong-Tie Company, Inc.
2. Research/Evaluation Reports: Provide products acceptable to authorities having jurisdiction and for which model code research/evaluation reports exist that show compliance of metal framing anchors, for application indicated, with building code in effect for Project.
3. Allowable Design Loads: Meet or exceed those indicated per manufacturer's published values determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

C. Building Paper: As required per the architectural drawings or specifications.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry to other construction; scribe and cope as needed for accurate fit. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.
- B. Apply field treatment complying with AWWPA M4 to cut surfaces of preservative-treated lumber and plywood.
- C. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
 - 1. ICC Evaluation Service Report for power-driven fasteners.
 - 2. Published requirements of metal framing anchor manufacturer.
 - 3. Per 2016 California Building Code: .Table 2304.10.1, "Nailing Schedule," and Table 2306.2(1), "Wood Structural Panel Roof Sheathing Nailing Schedule."
- D. Use finishing nails for exposed work, unless otherwise indicated. Countersink nail heads and fill holes with wood filler.
- E. Framing Standard: Comply with AFPA's "Manual for Wood Frame Construction," unless otherwise indicated.
- F. Framing with Engineered Wood Products: Install engineered wood products to comply with manufacturer's written instructions.
- G. Comply with applicable recommendations contained in APA Form No. E30K, "APA Design/Construction Guide: Residential & Commercial," for types of structural-use panels and applications indicated.
 - 1. Comply with "Code Plus" provisions in above-referenced guide.
- H. Apply building paper as required per the architectural drawings or specifications.

END OF SECTION

SECTION 062000
FINISH CARPENTRY

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes requirements for provision of new finish carpentry materials and hardware accessories, including but not limited to:
 - 1. Interior wood trim and bases.
 - 2. Audience chamber wood veneer.
 - 3. Accessories for connecting finish carpentry.

- B. Related Sections
 - 1. Section 081100 – Hollow Metal Doors And Frames
 - 2. Section 087100 - Door Hardware
 - 3. Section 099000 - Paint

1.2 REFERENCES

- A. CBSC - California Building Standards Commission
 - 1. CBC - California Building Code, 2016 Edition
- B. WI - Woodwork Institute.
 - 1. Manual of Millwork, 2010 Edition

1.3 SYSTEM DESCRIPTION

- A. Performance Requirements:
 - 1. Finish Carpentry Wood Materials and Work of this Section are to conform to following WI grade requirements as follows
 - 2. Finish Carpentry Items: Premium Grade.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's literature completely describing products.
- B. Shop Drawings
 - 1. Wood Finish Carpentry Items
 - 2. Submit drawings showing all items at large scale, including methods of fabrication and construction, and methods of attachment to adjacent work. First page is to bear WI Certified compliance label.
- C. Samples
 - 1. Wood Finish Carpentry Items
 - 2. Minimum 12" square segments of wood material proposed for use for each item, complete with specified finish.
 - 3. Resubmit material samples with finishes adjusted as directed, until material and finish are accepted.

- D. Certificates of Compliance: Submit certificates of compliance required under Article titled "Source Quality Control" in this Section prior to delivery of casework items to Project site.

1.5 QUALITY ASSURANCE

- A. Contractor's Fabricators Qualifications
 - 1. Equipped for and experienced in Work equal to standard specified; able to evidence such experience to the Owner's Representative's satisfaction.
 - 2. The documents require high quality millwork suitable for commercial use. WI standards set the general intent of the documents.
- B. Regulatory Requirements
 - 1. For Wood Finish Carpentry Items
 - a. Seismic Requirements: Design anchorage systems to comply with CBSC CBC as applicable for Seismic Zone 4.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Do not deliver finish carpentry items until site conditions are adequate to receive the work of this Section.
- B. Protect materials from weather while in transit.
- C. Store materials indoors in ventilated areas with a constant but minimum temperature of 60 degrees F and maximum relative humidity of 25 to 55 percent.

1.7 PROJECT CONDITIONS

- A. Verify dimensions at Project Site. Verify details and dimensions of equipment and fixtures integral with casework and other items for proper fit and accurate alignment.

1.8 SEQUENCING AND SCHEDULING

- A. Provide information as required for timely and proper placement of backing and support systems.
- B. Coordinate details with other work supporting, adjoining, or fastening to casework and other items.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Interior wood trim and bases.
- B. Plywood paneling and reflector panels in Audience Chamber
 - 1. Cherry, Premium grade, plain sliced, book matched, prepared to be stained, per Section 099000.
 - 2. Finish Materials
 - a. WI Section 5, Table 5-1, generic finish type per Section 099000.
- C. Accessories for connecting finish carpentry.

2.2 ACCESSORIES

- A. For Wood Finish Carpentry Items
 - 1. Nails: Size and type to suit application, double hot-dipped galvanized with painted heads for exterior locations, interior concealed locations and interior locations subject to wetting during construction.
 - 2. Bolts, Nuts, Washers, Lags, Pins, and Screws: Size and type to suit application; hot-dipped galvanized for exterior locations and for concealed interior locations and interior locations subject to wetting during construction.
 - 3. Putty: Linseed oil type, complying with FS TT-P-00791B, tinted to match surface finish color.

2.3 FABRICATION

- A. Shop Assembly
 - 1. For Wood Finish Carpentry Items
 - a. General Fabrication Requirements
 - 1) Shop-fabricate and assemble Work in complete units insofar as dimensions permit shipment and installation.
 - 2) Solid Wood Members: Kerf back of solid members more than 5 inches wide or more than 1 inch nominal thickness.
 - 3) Nailing: Conceal nailing where possible and set nail heads for putty in exposed portions.
 - 4) Plug and sand smooth access holes required for joint fasteners.
 - b. Fabricate in accordance with WI Section 9, requirements of Article titled System Description in this Section and following.
 - 1) Wood Trim (Wood Chair Rails, Map Rails, Picture Rails, And Wood Bases)
 - 2) Fabricate audience chamber wall and ceiling panels of ¼" bendable plywood, as notated in the drawings
 - 3) Interior Wood Door And Wood Borrowed Lite Trim

(Casings), Jambs, And Trim

- a) Location: Typical.
 - (1) Material: Paint-grade solid stock, material to match existing profile.
- 4) Finish: As specified in Section 099000.
- c. Metal Clad Wood Doors
 - 1) Fabricate in accordance with WI Section 12 as applicable, requirements of Article titled System Description in this Section and following.
 - a) Provide solid core wood doors that are copper metal clad that match existing in appearance and finish.
 - b) Copper: 16 or 20 ounces as required for indicated conditions.
 - c) Copper Finish: Statuary Brown
 - (1) Step 1: Clean copper with pumice and water or pumice and solvent to remove all dirt, grease, oil or tarnish.
 - (2) Step 2: Brush entire surface with 2 percent solution of liquid ammonium sulfide (technical grade) in water.
 - (3) Step 3: Let dry. Even out color by rubbing lightly with pumice and water, using stub or fine brass wire brush.
 - (4) Repeat Steps 2 and 3 to obtain desired color.

2.4 FINISHES

A. Field Finishing

- 1. For Wood Finish Carpentry Items
 - a. To be shop-finished in accordance with requirements of WI Section 5.

2.5 SOURCE QUALITY CONTROL

A. Inspections For Wood Finish Carpentry Items

- 1. General: Maintain places of fabrication open to examination by the Owner's Representative.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine surfaces scheduled to receive finish carpentry items for conditions that would adversely affect installation.
- B. Do not install work until unsatisfactory conditions have been corrected.
- C. Paneling: install as detailed; coordinate installation of sound absorptive and reflective panels to assure continuity of grain, tight fitting joints, uniform curves, Support as indicated in details.

3.2 PREPARATION

- A. Prior to installation verify that items to be in contact with cementitious materials have been shop-back-primed. If not back prime prior to installation.
- B. Ensure all metal flashings and mechanical and electrical items affecting this Section of work are properly placed and completed prior to commencement of installation.
- C. Pressure Treated Lumber: Protect cut-surfaces of pressure treated lumber prior to assembly

3.3 INSTALLATION

- A. For Wood Finish Carpentry Items
 - 1. Setting
 - a. Set and secure materials and components in place, rigid, plumb and square.
 - b. Kerf underside of wide trim members where indicated on drawings, to prevent cupping.
 - c. Scarf joints at splices of exterior trim.
 - 2. Wood Trim: Miter inside and outside corners of running trim.
 - 3. Door and Borrowed Lite Jamb: Install with solid backing in such manner that no voids exist between strike side of jamb and frame opening for a vertical distance of 6" above and below strike.
 - 4. Install hardware and accessories, supplied under other Sections, in accordance with manufacturer's recommendations.

3.4 CLEANING

- A. Finished Carpentry Items: Wash in strict accordance with manufacturer's instructions and comply with following
 - 1. Ensure that washed surfaces do not differ from clean unwashed portions. Any difference will be considered unsatisfactory work.

3.5 PROTECTION:

- A. Protect work of this Section from disfigurement or damage until final acceptance.

END OF SECTION

SECTION 064100

CUSTOM CASEWORK

PART 1 GENERAL

1.1 SECTION

- A. Section includes requirements for provision of the following new items:
 - 1. Laminated plastic casework and countertops.
 - 2. Laminated plastic finished cabinets, casework and countertops.
 - 3. Stainless Steel countertops
 - 4. Custom casework hardware.
 - 5. Section does not include requirements for solid surface counters in rest rooms.

1.2 SYSTEM DESCRIPTION

- A. Materials and work of this Section are to conform to following:
 - 1. Plastic Laminate/ wood Custom Casework and Countertops:
 - a. Grade: WI Premium – as basis of design.

1.3 SUBMITTALS

- A. Shop Drawings: Submit drawings showing all items at minimum scale of 1"=1'- 0", including methods of fabrication and construction, and methods of attachment to adjacent work. First page is to bear WI Certified compliance label.
- B. Certificates of Compliance: Submit certificates required under Article titled "Source Quality Control" in this Section prior to delivery of casework items to project site.
- C. Samples
 - 1. Wood Items Designated To Receive Transparent Finish
 - a. Minimum foot long segments of material proposed for use for each item, complete with specified finish.
 - b. Resubmit material samples with finishes adjusted as directed, until material and finish are accepted.
 - 2. Other samples only as requested.

1.4 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Comply with requirements set forth in CA Green Building Code, Section 5.504.4 for Finish Material Pollution Control.

2. Provide wall hung cabinets, storage shelving and connections that comply with the following requirements:
 - a. Seismic Requirements: Design anchorage systems to comply with CBSC CBC, Chapter 16A, Section 1613A.
 - b. Nonstructural Components Articles D. and E. as applicable, for seismic Zone 4.
3. Operable parts for all accessible casework shall comply with CBC Section 11B-309.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Lumber, Plywood, with plywood cores.
 1. Grade: Complying with requirements of Article titled "System Description" in this Section.
 2. Moisture Content: Lumber and plywood are to be kiln-dried to equilibrium moisture content suitable for fabrication in shop and suitable for use intended; minimum 8 percent; maximum 12 percent.
 3. Lumber
 - a. Solid Stock, Typical: Douglas Fir or Pine.
 4. Cores
 - a. Type A: Plywood.
 - b. Note: particle board is not acceptable
 5. Veneers
 - a. Type V-1: Match existing, one piece face.
 - b. Stainless steel at box office counter
- B. Fasteners
 1. General
 - a. Furnish necessary screws, staples, bolts, or other fastenings of proper size and type to secure items in position.
 - b. No exposed fasteners are to be used, except where detailed on the drawings. Provide exposed fasteners that have same finish as item fastened
 2. Nails, Typical Interior: Common wire galvanized.
 3. Unfinished Bolts, Lag Bolts (Lag Screws), Nuts And Washers: Low carbon steel standard fasteners, bolts, ASTM A307 and nuts, ASTM A563; malleable washers.
- C. Hardware
 1. Casework Hardware: Provide casework with hardware in accordance with WI Appendix titled "Cabinet Hardware Requirements" and following:
 - a. Hinges
 - 1) Manufacturer: RPC: 454-260

- 2) Number Hinges
 - a) Doors Over 36-Inches High: 3 hinges.
 - b) Doors Over 60 Inches High: 5 hinges.
 - b. Drawer Slides: Accuride.
 - c. Keying
 - 1) Key locks as directed by the Owner.
 - 2) Type: Provide removable core type locks.
- D. Putty: Linseed oil type, complying with FS TT-P-00791B, tinted to match surface finish color.
- E. Paint Materials
1. For Back Priming: As specified in WI Section 5 Article 6.2.9.
 2. Intended For Transparent Finish: WI Section 5, System No. 4 Conversion Varnish clear or opaque.

2.2 FABRICATION

A. Wood Custom Casework

1. Fabricate wood casework in accordance with requirements of Article titled "System Description" in this Section, WI Section 14 requirements and following:
 - a. Fabricate of lumber Type 1, core material Type A and veneer material 1V as indicated.
 - b. Construction Style: WI Style A (Frameless).
 - c. Construction Type: WI Type I, multiple self-supporting units rigidly joined together.
 - d. Door And Drawer Front Style: WI Flush overlay.
 - e. Door Types: As selected by the Architect from WI Section 14, Article 1.9
 - f. Shelves: Provide wood shelves, unless cabinet is open or has glass doors, then match cabinet exterior finish..
 - g. Finish: Intended for stained transparent finishes as indicated.
2. Plastic Laminate Countertops, cabinets and shelving
 - a. See drawings for type and location
 - b. Fabricate Plastic Laminate/ wood countertops in accordance with requirements of Article titled "System Description" in this Section, WI Section 19 requirements and following:
 - 1) Fabricate of lumber Type 1, core material Type A and veneer material 1V as indicated.
 - 2) Countertop Profile: Solid banded.
3. Casework Hardware
 - a. Make provisions in accordance with accepted hardware manufacturer's templates.

- b. Fit hardware to casework and attach for smooth, trouble-free, non-binding operation using hardware manufacturer's approved fasteners.
- B. Shop Finishing
 - 1. General: Provide items, specified in this section of the specifications to be fabricated in accordance with WI standards, that are shop finished in accordance with following requirements:
 - a. Back Priming Of Wood: Back prime items that will come into contact with cementitious surfaces in accordance with requirements of WI Section 5, Table 5-4 Article 6.2.9.
 - b. Items Intended For Transparent Or Opaque Finish
 - 1) Preparation: Open-grain hardwoods designated to receive varnish or lacquer smooth coating finish are to be filled in accordance with requirements of WI Section 5, Article 1.12.
 - 2) Finish: Provide WI Section 5, Table 5-1 System 4 Conversion Varnish, clear or opaque finishes as selected by the Architect.
 - 2. Hardware
 - a. Typical: BHMA A156.18 satin chrome 626 (US 26D), unless otherwise specified.
 - b. Hardware Fasteners: Where exposed, to match finish of hardware item fastened.
- C. Field Finishing
 - 1. Field Touch Up Of Wood Custom Casework And Wood Countertops: Touch up damaged surfaces in accordance with requirements of WI Section 5.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces scheduled to receive casework for conditions that would adversely affect installation.
- B. Do not install work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install plastic laminate in accordance with WI Premium grade.
- B. Set work square, level, plumb with edges scribed accurately and secure in place with fastenings, clips, braces, brackets, anchors, shims, and blocks.

- C. Conceal fasteners where possible and set nail heads for putty in exposed portions.

3.3 ADJUSTING

- A. Adjust hardware for smooth operation.
- B. Remove damaged or otherwise disfigured portions and replace with new prior to Substantial Completion.

END OF SECTION

SECTION 071100

FLEXIBLE FLASHING

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes
 - 1. Provision of flexible rubberized asphalt, self-sealing through-wall flashing and wall flashing accessories, as shown on details at roof parapet locations.
- B. Related Sections
 - 1. Section 076000 - Flashing and Sheet Metal
 - 2. Section 079000 - Joint Sealants

1.2 REFERENCES

- A. ASTM - American Society for Testing and Materials
 - 1. D412 - Standard Test Methods for Rubber Properties in Tension
 - 2. D570 – Standard Test Method for Water Absorption of Plastics.
 - 3. D1004 – Test Method for Initial Tear Resistance of Plastic Film and Sheeting
 - 4. D1876 – Test Method for Peel Resistance of Adhesives
 - 5. D1938 - Test Method for Tear Propagation Resistance of Plastic Film and Thin Sheeting by a Single-Tear Method
 - 6. D1970 - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection
 - 7. E 96 -Test Methods for Water Vapor Transmission of Materials
 - 8. E154 Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover.

1.3 SYSTEM DESCRIPTION

- A. Performance Requirements: Provide system that complies with following requirements:
 - 1. Provide materials for system type specified, which are products of single manufacturer.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's product data completely describing products.
- B. Manufacturer's Instructions: Manufacturers installation instructions.

1.5 QUALITY ASSURANCE

- A. Applicator's Qualifications: Contractor is have Work of this Section performed by applicator who has at least 5 years' experience in the application of the specified system and shall be able to show successful completion of such installations.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver and store materials in accordance with manufacturer's instructions.

1.7 PROJECT CONDITIONS

- A. Proceed with Work of this Section only when existing and predicted weather conditions will permit Work to be performed in accordance with manufacturer's installation instructions.
- B. Environmental Requirements: Install flashing to dry surfaces at air and surface temperatures of 25 degrees F and above in accordance with manufacturer's recommendations at locations indicated.

1.8 WARRANTY

- A. Manufacturer is to supply, with supervised application, 5 year written warranty against water penetration through treated areas.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Flexible Membrane Wall Flashing
 - 1. Description
 - a. Membrane: 32 mils of self-adhesive rubberized asphalt integrally bonded to 8 mils of cross laminated, high-density polyethylene film to provide minimum 40 mil thick membrane.
 - b. Membrane is to be interleaved with disposable silicone-coated release paper until installed.
 - 2. Performance Requirements
 - a. Water Vapor Transmission: ASTM E96, Method B: 0.05 perms maximum.
 - b. Water Absorption: ASTM D570: Maximum 0.1 percent by weight.
 - c. Puncture Resistance: ASTM E154: 80 pounds minimum..
 - d. Tear Resistance
 - 1) Initiation: ASTM D1004: Minimum 13.0 pounds M.D.
 - 2) Propagation: ASTM D1938: Minimum 9.0 pounds M.D.

- e. Lap Adhesion At 25 degrees F: ASTM D1876: 5.0 pounds per inch of width
 - f. Low Temperature Flexibility ASTM D1970: Unaffected to minus 45 degrees F.
 - g. Tensile Strength: ASTM D 412, Die C Modified: Minimum 800 pounds per square inch.
 - h. Elongation, Ultimate Failure of Rubberized Asphalt: ASTM D412, Die C: Minimum 200 percent.
3. Manufacturer And Product: Grace Construction Products Model Perm-A-Barrier Wall Flashing, or equal.

2.2 ACCESSORIES

A. Surface Conditioner

1. Description: Water-based latex liquid for substrate preparation.
2. Physical Characteristics
 - a. Flash Point: No flash to boiling point.
 - b. Solvent Type: Water.
 - c. VOC Content: Not to exceed 125 g/L
 - d. Application Temperature: 25 degrees F and above.
 - e. Freeze And Thaw Stability: 5 cycles minimum.
 - f. Freezing point (as packaged): 14 degrees F.
3. Manufacturer And Product: Grace Construction Products Model Perm-A-Barrier Surface Conditioner, or equal.

B. Termination Mastic

1. Description: Rubberized asphalt-based mastic with 200 g/L max. VOC Content.
2. Manufacturer And Product: Grace Construction Products Model Perm-A-Barrier Model Bituthene Mastic, or equal.

PART 3 EXECUTION

3.1 INSPECTION

- #### A. Examine surfaces designated to receive flexible flashing:
1. Verify curing methods used for cementitious materials are compatible with membrane system.
 2. Verify curing methods used for sealant materials are compatible with membrane system.
 3. Ensure items which pass through surfaces to receive waterproofing materials are properly and rigidly installed.
 4. Ensure surfaces are free of cracks, waves, depressions and projections or sharp objects which may be detrimental to proper installation and performance of waterproofing membrane.
 5. Ensure that backing materials are in place and properly installed.

6. Ensure adjoining materials are in proper condition to receive and maintain the waterproofing material installations.

- B. Do not proceed with application until unsatisfactory conditions are corrected.

3.2 PREPARATION

- A. Surface Preparation: Prepare surfaces to receive waterproofing in accordance with manufacturer's installation instructions.
- B. Cleaning
 1. Clean surfaces of dust, dirt, and curing and parting compounds if required to be removed by waterproofing materials manufacturer.
 2. Curing and parting compounds are to be thoroughly removed by chemical or mechanical means.
- C. Seal items projecting through membrane, such as pipes, conduits, and the like, in accordance with manufacturer's installation instructions.
- D. Condition of surfaces, prior to application of waterproofing membrane, is to meet manufacturer's requirements.
- E. Do not apply waterproofing membrane to damp, frozen, dirty, dusty or otherwise unsuitable surfaces.
- F. Applications shall not commence when the temperature is below 40 degrees Fahrenheit or when precipitation is imminent.
- G. Take adequate precautions if inclement weather is anticipated during Work, to ensure those materials, already applied materials and the interior are protected from moisture.
- H. Provide primer at substrate where recommended by manufacturer.

3.3 INSTALLATION

- A. Apply waterproofing membranes in accordance with manufacturer's installation instructions and as indicated on the Drawings.
- B. Application of Flexible Membrane Wall Flashing
 1. Precut pieces of flashing to easily handled lengths for each location.
 2. Remove silicone coated release paper and position flashing carefully before placing it against surface.
 3. When properly positioned, place against surface by pressing firmly into place by hand roller.
 4. Fully adhere flashing to substrate to prevent water from migrating under flashing.
 5. Overlap adjacent pieces 2 inches and roll seams with hand roller.
 6. Trim bottom edge 1/2 inch back from exposed face of wall.

7. Flashing is not to be permanently exposed to sunlight.
8. At heads, sills and flashing terminations, turn up ends minimum of 2 inches and make careful folds to form end dam, with seams sealed.
9. Do not allow rubberized asphalt surface of flashing membrane to come in contact with polysulfide sealants, creosote, uncured coal tar products or EPDM.
10. Do not expose flashing membrane to sunlight for more than thirty days prior to enclosure.

3.4 ACCESSORIES

- A. Surface Conditioner
 1. When required by dirty or dusty site conditions or by surfaces having irregular or rough texture, apply surface conditioner by spray, brush, or roller at the rate recommended by manufacturer, prior to flashing installation.
 2. Allow surface conditioner to dry completely before flashing application.
- B. Termination Mastic
 1. Apply bead or trowel coat of mastic along flashing top edge, seams, cuts, and penetrations.

3.5 ADJUSTING AND CLEANING

- A. Remove masking materials after installation. Clean stains on materials which will be exposed in the completed Work.
- B. Clean stains from adjacent surfaces with appropriate cleaning agents.
- C. Remove masking protection, equipment, material and debris from surface and storage area.

3.6 PROTECTION

- A. Protect Work in this Section both during and after installation, from damage of any kind and from any source, until the Work has been covered.

END OF SECTION

SECTION 071150

WATERPROOFING

PART 1 - GENERAL

1.01 DESCRIPTION: Provide waterproofing spray.

A. Work In This Section includes:

1. Waterproofing on floors and walls under mortar set masonry, ceramic tile, and elsewhere as indicated or required.

1.02 QUALITY ASSURANCE:

- A. Manufacturer: waterproofing system shall be manufactured by a firm with a minimum of 10 years' experience.
- B. Installer with 3 years' experience in work of the type required by this section, and is recommended by manufacturer to install the specified products.
- C. Materials shall comply with current State of California and local Air Quality Management District requirements for volatile organic compounds, {not over 350 grams per liter}.

1.03 SUBMITTALS:

- A. Product Data: Submit manufacturer's product data including installation instructions.

1.04 PRODUCT DELIVERY AND HANDLING:

- A. Deliver material to the site in original unbroken packages bearing manufacturer's label showing brand, type, and weight.
- B. Store materials at site under cover and maintain in dry condition. Protect from damage from excessive temperature and construction operations. Do not double-stack pallets of membrane. Protect mastic and adhesive from moisture and potential sources of ignition.
- C. Remove and dispose of damaged material in accordance with applicable regulations.

1.05 JOB CONDITIONS:

- A. Coordination: Coordinate substrate surface requirements with all related work. Install membranes on below grade walls and retaining walls not earlier than 7 days prior to application of backfilling or subsequent surfacing.
- B. Protection: Place temporary coverings and protection to prevent staining or marring of surfaces not to be covered with waterproofing.
- C. Application temperatures: Temperature of surfaces to receive waterproofing shall be not less than 40 degrees F.

- 1.06 WARRANTY: Furnish a warranty against defects in material or workmanship for 5 years covering coating performance of the systems for the entire warranty period including ruptures caused by substrate cracks up to 1/16" width.

PART 2 - PRODUCTS

2.01 MATERIALS:

- A. Provide waterproofing by Custom Building Products, "RedGard:" Custom Building Products, 10400 Pioneer Boulevard, Unit 3, Santa Fe Springs, CA 90670 or approved equal:

2.02 DESCRIPTION:

- A. Elastomeric waterproofing membrane for both tile, masonry and stone application; for vertical and horizontal, interior and exterior substrate applications.
- B. Provide a continuous waterproof membrane barrier with adhesion; bonds directly to clean slab-on-grade and other surfaces.

2.03 TECHNICAL DATA:

- A. American National Standards Institute (ANSI) ANSI A108.01, A108.17, A108.13, A118.10 and A118.12
- B. American National Standards for the Installation of Ceramic Tile ASTM International (ASTM) ASTM C627 Standard Test Method for Evaluating Ceramic Floor Tile Installation Systems Using the Robinson-Type Floor Tester ASTM D638 Standard Test Method for Tensile Properties of Plastics
- C. Tile Council of North America (TCNA) TCNA Handbook for Ceramic Tile Installation, TCNA Method EJ171, F125 & F125A

PART 3 - EXECUTION

- 3.01 INSPECTION: Inspect and verify condition of substrates and related work. Do not start installation of membranes until defects in substrates have been corrected.

- A. Exterior and wet areas must have proper sloping to drains. All surfaces must be structurally sound, clean, dry and free from contaminants that would prevent a good bond. Newly prepared concrete must be troweled smooth and textured to a fine broom finish and cured for 28 days. Existing surfaces must be scarified and leveled, and all defects must be repaired. Cracks exceeding 1/8" (3 mm) should be treated in accordance with TCNA F125 or TCNA F125A.

3.02 PREPARATION

- A. Surface Preparation: Prepare surfaces to receive waterproofing in accordance with manufacturer's installation instructions.
- B. Cleaning
 - 1. Clean surfaces of dust, dirt, and curing and parting compounds if required to be removed by waterproofing materials manufacturer.
 - 2. Curing and parting compounds are to be thoroughly removed by chemical or mechanical means.

3.03 INSTALLATION

- A. Apply waterproofing membranes in accordance with manufacturer's installation instructions and as indicated on the Drawings.

3.04 TESTS OF MEMBRANES: All horizontal membranes shall be subjected to standing water test after completion, but before protection board is applied. Tests shall be conducted as soon as possible after completion of membrane in each area.

3.05 COMPLETION: Protect membrane systems from injury during application and until finished installation is approved.

END OF SECTION

SECTION 072100

BUILDING INSULATION

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: Formaldehyde-free thermal insulation.
- B. Related Sections:
 - 1. Section 079000: Joint Sealants.
 - 2. Section 084100: Curtain Wall System.
 - 3. Section 092500: Gypsum Board System.
 - 4. Section 095000: Acoustical Ceiling System.
 - 5. Division 23: Mechanical

1.02 REFERENCES

- A. ASTM International:
 - 1. ASTM C165 Standard Test Method for Measuring Compressive Properties of Thermal Insulations.
 - 2. ASTM C356 Standard Test Method for Linear Shrinkage of Preformed High-Temperature Thermal Insulation Subjected to Soaking Heat.
 - 3. ASTM C411 Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
 - 4. ASTM C423 Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
 - 5. ASTM C518 Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.

1.03 SYSTEM DESCRIPTION

- A. Design Requirements: Provide [Products/systems] that have been manufactured, fabricated and installed to the following criteria:
 - 1. Fire-Test-Response Characteristics: Provide insulation and related materials with the fire-test-response characteristics indicated, as determined by testing identical products per test methods indicated below or other testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.
 - a. Surface Burning Characteristics (ASTM E84)
 - b. Assembly Fire Resistance Rating (ASTM E119)
 - c. Combustion Characteristics (ASTM E136)
 - 2. Thermal Performance (ASTM C518): R-19 at exterior walls and below.
- B. Performance Requirements: Provide products that have been manufactured,

fabricated and installed to the following criteria:

1. Surface Burning Characteristics, Unfaced (ASTM E84): Flamespread index 25, smoke developed 50.
2. Recycled Glass Content: 25%.
3. Combustibility (ASTM E136): Noncombustible.
4. Formaldehyde Content: Free of formaldehyde.

1.04 SUBMITTALS

- A. General: Submit listed submittals in accordance with provisions of Section 013000 Submittals.
- B. Product Data: Submit manufacturer's product data and installation instructions
- C. Samples: Submit manufacturer's standard selection and verification samples.
- D. Quality Assurance/Control Submittals: Submit the following:
 1. Test Reports: Upon request, submit thermal test reports from recognized test laboratories.
 2. Certificates: Submit manufacturer's certificate that products meet or exceed specified requirements.

1.05 QUALITY ASSURANCE

- A. Obtain each type of building insulation through a single source.
- B. Installer Qualifications: Utilize an installer having demonstrated experience on projects of similar size and complexity.

1.06 DELIVERY, STORAGE & HANDLING

- A. General: Comply with Division 1 Product Requirement Section.
- B. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- C. Storage and Protection: Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by the manufacturer.

PART 2 – PRODUCTS

2.01 FORMALDEHYDE-FREE BUILDING INSULATION

- A. Manufacturer: Johns Manville, or an approved equal.
- B. Proprietary Products/Systems: Building insulation, including the following:
 1. JM Formaldehyde-free™ Unfaced Batts, or equal.
 - a. Thermal Resistance (R-Value) (ASTM C518): R-values:
 - 1) R-19 - interior floors over exterior spaces
 - 2) R-30 – roof at concealed areas

- b. Combustion Characteristics (ASTM E136): Pass.
 - c. Critical Radiant Flux (ASTM E970): Greater than $0.11 \text{ Btu/ft}^2 \times \text{s}$ (0.12 W/cm^2).
 - d. Water Vapor Sorption (ASTM C1104): 5% or less.
 - e. Odor Emission (ASTM C1304): Pass.
 - f. Corrosiveness (ASTM C665): Pass.
 - g. Fungi Resistance (ASTM C1338): Pass.
 - h. Recycled Content: Certified by Scientific Certification Systems to contain minimum of 20% post-consumer and 5% pre-consumer recycled glass product, on average of manufacturer's products.
 - i. Prove through documentation that product complies with CIWMB Section 01350 for indoor air quality.
 - j. Thickness: min 4"
 - k. Flamespread (ASTM E84): 25, maximum.
 - l. Smoke Developed (ASTM E84): 50, maximum.
 - m. Material Standard: ASTM C665, Type I.
 - n. Smoke Developed (ASTM E84/ CBC Section 720.2)
 - 1) Foil-faced Batts: 450, maximum.
 - 2) Kraft-faced Batts: Unrated.
 - o. Material Standard:
 - 1) Foil-faced Batts: ASTM C665, Type III, Class B, Category 1.
 - 2) Kraft-faced Batts: ASTM C665, Type II, Class C, Category 1.
 - p. Recycled Content: Certified by Scientific Certification Systems to contain minimum of 20% post-consumer and 5% pre-consumer recycled glass product, on average of manufacturer's products.
 - q. Prove through documentation that product complies with CIWMB Section 01350 for indoor air quality.
 - 1) MR-faced Batts: ASTM C665, Type II, Class C, Category 1.
- C. JM Formaldehyde-free™ Kraft and Foil-faced Batts, or equal
- 1. Thermal Resistance (R-Value) (ASTM C518): R-values:
 - 2. R-13 – walls
 - 4. R-13 – roof at exposed areas

2.02 ACCESSORIES

- A. Tape: Self-adhesive vapor retarder tape with flame-spread index of 25 or less, smoke developed index of 50 or less.
- B. Wire supports for roof insulation at exposed ceilings to be at 24" spacing maximum. Simpson Strong-Tie "IS" or equal.

PART 3 EXECUTION

3.01 MANUFACTURER'S INSTRUCTIONS

- A. Comply with the instructions and recommendations of the building insulation manufacturer.

3.02 EXAMINATION

- A. Site Verification of Conditions:
 - 1. Verify that site conditions are acceptable for installation of building insulation.
 - 2. Do not proceed with installation of building insulation until unacceptable conditions are corrected.

3.03 PREPARATION

- A. Protection: Protect adjacent work areas and finish surfaces from damage during product installation.

3.04 INSTALLATION

- A. General: Comply with insulation manufacturer's written instructions applicable to products and application indicated.
 - 1. Install insulation that is undamaged, dry and unsoiled and that has not been left exposed at any time to ice and snow.
 - 2. Extend insulation in thickness indicated to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation.
 - 3. Water Piping Coordination: If water piping is located on inside of insulated exterior walls, coordinate location of piping to ensure that it is placed on warm side of insulation and insulation encapsulates piping.
 - 4. Apply single layer of insulation to produce thickness indicated, unless multiple layers are otherwise shown or required to make up total thickness.
- B. Installation of General Building Insulation:
 - 1. Seal joints between closed-cell (non-breathing) insulation units by applying adhesive, mastic or sealant to edges of each unit to form a tight seal as units are shoved into place. Fill voids in completed installation with adhesive, mastic or sealant as recommended by insulation manufacturer.
 - 2. Set vapor-retarder-faced units with vapor retarder to warm side of construction, unless otherwise indicated. Do not obstruct ventilation spaces, except for firestopping.
 - a. Tape ruptures in vapor retarder, and seal each continuous area of insulation to surrounding construction to ensure airtight installation.
 - 3. Install glass-fiber blankets in cavities formed by framing members according to the following requirements:

- b. Use blanket widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill cavity, provide lengths that will produce a snug fit between ends.
 - c. Place blankets in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
 - d. For metal-framed wall cavities where cavity heights exceed 96 inches, support unfaced blankets mechanically and support faced blankets by taping stapling flanges to flanges of metal studs.
4. Loose-Fill Insulation: Place loose-fill insulation into spaces and onto surfaces as shown, by machine blowing to comply with ASTM C1015. Level horizontal applications to uniform thickness as indicated. Hold insulation back from air vents, flues and heat-generating appliances.
- C. Installation of Vapor Retarders:
1. General: Extend vapor retarder to extremities of areas to be protected from vapor transmission. Secure in place with adhesives or other anchorage system as indicated. Extend vapor retarder to cover miscellaneous voids in insulated substrates, including those filled with loose-fiber insulation.
 2. Firmly attach vapor retarders to substrates with mechanical fasteners or adhesives as recommended by vapor retarder manufacturer.
 3. Seal joints caused by pipes, conduits, electrical boxes and similar items penetrating vapor retarders with vapor retarder tape to create an airtight seal between penetrating objects and vapor retarder.
 4. Repair any tears or punctures in vapor retarders immediately before concealment by other work. Cover with vapor retarder tape or another layer of vapor retarder.

3.05 PROTECTION

- A. Protect installed work from damage due to subsequent construction activity on the site. Repair damage to installed products prior to installation of finish materials.

END OF SECTION

SECTION 072600

WATER VAPOR TESTING AND CONTROL

PART 1 - GENERAL

1.01 DESCRIPTION: Division 1 applies to this Section. Provide water vapor testing and pH testing necessary to remove excessive moisture and reduce pH from on grade slabs to receive moisture and alkaline sensitive finishes, complete.

A. Related Work Not In This Section:

1. Thin-set ceramic floor tile.
2. Other moisture sensitive floor coverings as indicated or required.

1.02 SYSTEM DESCRIPTION: The work of this Section consists of 2 parts as follows:

A. Moisture and pH testing of all on-grade, below-grade and above-grade floor slabs scheduled to receive moisture sensitive floor finishes, including thinset ceramic tile, resilient flooring and carpet.

1.03 QUALITY ASSURANCE:

A. Qualifications of Manufacturer: Systems and materials shall be product of a manufacturer regularly engaged in engineering and servicing of vapor reduction systems for not less than 10 years. Manufacturer shall supply references of at least 5 satisfactory installations in which specified systems have been in service for at least 5 years.

B. Qualifications of Installer: Installer shall be an employee of manufacturer. Supervisor of crew shall have a minimum 5 years experience in successfully performing moisture testing work.

C. Materials shall comply with current State of California and local Air Quality Management District requirements for volatile organic compounds, (not over 100 grams per liter).

D. Pre-application Conference and Inspection: After approval of submittals but prior to beginning installation of work of this section, Contractor shall hold a meeting at the site attended by Architect, Contractor, vapor testing and control systems applicator, and the water vapor testing and control systems manufacturer to describe in detail the systems to be installed and to establish agreement, coordination and responsibilities. The Contractor shall prepare a detailed report of this meeting and furnish copies to the Architect and all attendees. The surfaces to receive moisture sensitive floor finishes shall be inspected and all defective conditions shall be corrected before beginning work of this section.

1.04 SUBMITTALS:

A. Manufacturer's Experience Qualifications: Submit evidence of manufacturer's experience record as specified.

B. Applicator's Experience Qualifications: Submit list of not less than 5 projects, extending over period of not less than 5 years, indicating applicator's experience record. Submit letter from manufacturer showing manufacturer's approval for installer of the products.

C. Data: Obtain from each manufacturer of moisture sensitive floor coverings, the respective recommended test results, and submit prior to commencing work of this section.

D. Moisture Testing Results: Submit written reports covering all moisture test results. Provide a floor plan, indicating finish flooring for each room or space, manufacturer's maximum recommended moisture content for each finish flooring material, location of each test and the moisture release at each location.

E. Product Data: Submit manufacturer's product data including complete testing and control installation instructions.

F. Experience Record: Submit a list of at least five installations on which each of the materials and systems proposed for use have been in satisfactory service for at least 3 years.

1.5 JOB CONDITIONS: Perform testing immediately prior to scheduled installation of moisture sensitive floor finishes.

1.6 DELIVERY, STORAGE AND HANDLING

A. Delivery of Materials: Deliver materials (except bulk material) in manufacturer's unopened containers fully identified with manufacturer's name, trade name, and application instructions.

B. Storage of Materials: Store materials in unopened containers. Store off ground and under cover, protect from damage.

1.07 WARRANTY: Furnish a manufacturer's written 10 year warranty, against all defects in materials and workmanship. In the event of treatment system failure by concrete moisture or alkalinity over slab surfaces, joints or cracks, manufacturer shall provide materials and labor to repair or replace the damaged floor system. Warranty shall include all materials and equipment necessary to treat the affected subfloor and to replace the finish flooring.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS:

A. For testing:

Vaprecision Professional Emission Testing Systems
2941 West Mac Arthur Blvd. Suite 138
Santa Ana, CA 92704
(800)449-6190
FAX (714) 759-6143.

Sealflex Industries, Inc.
 2925 College Avenue, Suite B-4
 Costa Mesa, CA 92626
 (714)708-0850
 FAX (714)708-2711.

C. For underlayment:
 Ardex, Inc.
 630 Stoops Ferry
 Road Coraopolis,
 PA 15108
 (412)264-4240

2.02 MATERIALS

A. Moisture Detection Equipment: Calcium chloride testing system, consisting of pre-packaged anhydrous calcium chloride crystal test kits, and an electronic gram weight scale measurable in 1/10 grams.

B. pH Testing Equipment: Wide range of pH testing strips with color chart. Water shall be distilled or deionized, furnished in unopened containers with labels intact.

C. Resin Membrane System, Type 1: MES Penetrant, VOC compliant, low viscosity, anti microbial chemical formulation, and elastomeric properties to expand and contract with slab movement; formulated to saturate concrete surfaces and mechanically restrict moisture and alkalinity levels, and conforming to the following:

PHYSICAL PROPERTIES		
Physical property, units	Test Method	Acceptable value
Water vapor transmission, grains/hour/sq. ft.	ASTM E 96	1.25
Alkali resistance	ASTMD 1308	pass
Adhesion strength, psi	ASTM D 4541	500, (100% concrete failure

D. Resin Membrane System, Type 2: MES Penetrant plus MES Coating, VOC compliant, low viscosity, anti-microbial chemical formulation and elastomeric properties to expand and contract with slab movement; formulated to saturate concrete surfaces and mechanically restrict higher levels of moisture and alkalinity.

PHYSICAL PROPERTIES		
Physical property, units	Test Method	Acceptable value

Water vapor transmission, grains/hour/sq. ft.	ASTM E 96	0.69
Alkali resistance	ASTM D 1308	pass
Adhesion strength, psi	ASTM D 4541	500, (100% concrete failure

E. Material for Concrete Floor Levelling: Self-levelling, self smoothing, cementitious, factory mixed compound requiring only addition of water at the site. Materials shall be Ardex K-15, conforming to the following:

PHYSICAL PROPERTIES		
Physical property, units	Test Method	Acceptable value
Initial set, minutes	ASTM C191	30, at 70 degrees F.
Final set, hours	ASTM C191	2, at 70 degrees F.

PHYSICAL PROPERTIES		
Physical property, units	Test Method	Acceptable value
Compressive strength, psi: After 24 hours After 28 days	ASTMC109	2,630 4,100
Flexural strength, psi After 24 hours After 28 days	ASTM C348	770 1,000
Flammability Flame spread Smoke developed Fuel contributed	ASTM E84	0 0 0

F. All Other materials: Manufacturer's standard for items required or type be suited for intended use.

PART 3 - EXECUTION

3.1 INSPECTION: Examine substrate, adjoining construction and conditions under which work is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 MOISTURE TESTING:

A. Test concrete slabs for adequate dryness, as indicated by each manufacturer of moisture sensitive floor finishes.

B. Testing shall conform to ASTM F 1869 for moisture, and ASTM F710 for pH.

C. Minimum testing requirements are 3 calcium chloride tests for the first 1,000 square feet of floor area, and one for each additional 1,000 square feet or fraction thereof.

D. Unless more stringent requirements are recommended by flooring manufacturer, maximum allowable moisture release at time of flooring installation shall be 3.0 pounds per 24 hours per 1,000 square feet.

E. For each test, perform the following steps:

1. Weigh the sealed dish of crystals immediately prior to exposure. Record starting weight, date and time.
2. Open kit and set crystal dish on clean concrete surface. Immediately install plastic dome over the dish. Mask sure the dome is gasketed to the concrete and is air tight.
3. Leave test to absorb moisture for 60 to 72 hours. Keep room temperature above 55 degrees F. for duration of test.
4. After exposure, remove and discard housing. Replace dish lid and tape shut. Weigh the sample within one hour of removal from floor.
5. Compute the vapor emission in pounds, indicate location of test and vapor emission on report.

3.3 pH TESTING: Conform to requirements of ASTM F 710. Perform one test per 1,000 square feet or fraction of slab area. Place a few drops of water on the surface of the concrete. Allow to stand approximately 60 minutes. Dip the pH paper into the water and compare to chart. Finish flooring shall not be installed unless pH is 9.0 or less.

3.4 MOISTURE VAPOR CONTROL

A. Areas where moisture content exceeds 3.0 pounds of water per 24 hours per 1,000 square feet shall be treated as follows:

1. Moisture content between 3.0 pounds and 8.5 pounds, pH levels above 10: System I.
2. Moisture content between 8.5 pounds and 12.5 pounds, pH levels above 10:: System II.
3. Moisture content over 12.5 pounds: Consult manufacturer of vapor reduction system for specific requirements.

B. Preparation of Slabs to be Treated:

1. Mask and protect walls and equipment.
2. Shot blast or grind concrete surfaces and clean joints.
3. Broom and vacuum slabs to remove dust and debris.
4. Fill cracks, joints and surface irregularities with resin fill.

C. Application of System I: Roll and squeegee penetrant to entire treatment area until saturation. Apply cementitious underlayment on tacky surface, as specified below.

D. Application of System II: Over the penetrant, applied as specified above, roll and squeegee the coating until saturation, while penetrant is still tacky. Apply cementitious underlayment on tacky surface, as specified below.

3.05 pH CONTROL: Where pH of slabs exceeds 9.0 or less if required to finish flooring and adhesive manufacturers, reduce the pH by one or a combination of the following methods:

Abrasive grinding to remove carbonated layer.
Additional waiting time Application of
underlayment

3.06 APPLICATION OF CEMENTITIOUS UNDERLAYMENT:

A. Preparation: After application of moisture vapor and pH control systems as applicable, apply cementitious underlayment to level and smooth the surface. Apply the underlayment while the resin membrane is still in a tacky state. Install to level the floor, to minimum 1/16 inch thickness.

B. Mix the material in accordance with manufacturer's instructions, and apply and smooth the material over the floor. Where pumping of the material is feasible, use manufacturer's recommended equipment and methods. Finished surfaces shall be level to within 1/8" in 10 feet in any direction, non-accumulative. Texture of finish shall be smooth, as recommended by finish flooring manufacturers.

3.07 FINAL TESTS: Test surfaces for moisture and pH in sufficient quantity to assure that moisture and pH of treated floors is within finished floor manufacturers acceptable limits.

END OF SECTION

SECTION 072700

FIRE-STOPPING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes: Requirements for provision of:
 - 1. Fire and smoke barrier penetration seals for openings in walls, floor/ceiling, roof assemblies and other elements of construction. Safing insulation at duct and pipe penetrations of sound rated constructions.
- B. Related Sections
 - 1. Section 061000 – Rough Carpentry

1.2 REFERENCES

- A. ASTM - American Society for Testing and Materials.
 - 1. E814-88 Methods for Fire Tests of Through- Penetration Fire Stops.
- B. CBSC - California Building Standards Commission
 - 1. CBC California Building Code, 2016 Edition
- C. ICBO - International Conference of Building Officials.
 - 1. CBC California Building Code
- D. UL - Underwriters' Laboratories, Inc.
 - 1. BMD Building Materials Directory.
- E. WHI- Warnock Hersey Inc.
 - 1. Listings.

1.3 DEFINITIONS

- A. Fire-stopping: Material or combination of materials and their installation to retain integrity of fire rated construction by maintaining effective barrier against spread of flame, smoke and gases. Included would be openings, gaps and joints through rated assemblies.

1.4 SYSTEM DESCRIPTION

- A. Performance Requirements
 - 1. Fire-stopping is to be listed and labelled in accordance with requirements of UL BMD.
 - 2. Form materials to remain in place in completed Work, if any, and sealant used for fire-stopping Work, if any, shall be UL listed and labelled.
 - 3. Provide fire-stopping materials that are asbestos free and be rated F and T in accordance with ICBO CBC (ASTM E814-88).
 - 4. Provide materials that are asbestos free.
 - 5. Do not use fire-stop products which re-emulsify, leach active intumescent ingredients or dissolve when placed in water after curing.
 - 6. Provide soft non-hardening material that will not transmit sound or vibration.

7. Provide caulking, putties, wrap strips, mortars, composite boards and mechanical devices appropriate to specific condition.
8. Provide materials that comply with requirements as specified.
9. Fire-stop every newly installed penetrations in newly installed and existing rated assemblies including:
 - a. Wiring, raceways, cables and conduits.
 - b. Other locations indicated, specified or required by codes and authority having jurisdiction.
10. Provide materials having rating periods capable of achieving following:
 - a. Smoke barriers.
 - b. 1-hour fire rated walls.
 - c. 2-hour fire rated shafts.

1.5 SUBMITTALS

- A. Product Data: Provide data on product characteristics, performance and limitation criteria.
- B. Shop Drawings
 1. Typical
 - a. Submit drawings indicating material installation details, including reinforcement, anchorage and fastenings as required for each of the firestopping conditions encountered on the Project.
 - b. If product data includes information as specified for Shop Drawings, the Owner's Representative may accept product data in lieu of Shop Drawings.
 2. Additionally, include schedule indicating each firestopping material.
 3. If required by Owner's Representative: Submit Shop Drawings of each type of penetration indicating compliance with requirements of Articles titled Regulatory Requirements and Performance Requirements in this Section.
- C. Certificates Of Compliance: Manufacturer is to submit certificates of compliance stating that firestopping material, or combination of materials, meet requirements specified in ICBO CBC S (ASTM E814-88) and are classified in UL BMD.
- D. Manufacturer's Instructions: Submit manufacturer's installation instructions.
- E. Test Reports: Submit complete test reports from Independent Laboratory attesting that firestopping materials and installation methods conforms to ASTM E814 requirements.
- F. For Firestopping Conditions Encountered That Are Not Indicated Or Specified: For materials proposed to be used submit Product Data, Shop Drawings and Test Reports.

1.6 QUALITY ASSURANCE

- A. Qualifications: Contractor shall obtain material and engage firestopping installer that complies with the following:
 - 1. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum 5 years documented experience.
 - 2. Installer: Company specializing in performing the Work of this Section with minimum 5 years documented experience and approved by manufacturer.

- B. Regulatory Requirements
 - 1. Provide through-penetration fire stops that comply with requirements of CBSC CBC Chapter 7, sections as follows:
 - a. Through Penetration of Bearing Walls Required To Fire-Resistive Rating And Walls Requiring Protected Openings: Section 709.6.
 - b. Through Penetration Fire Stops: Section 714.
 - 2. Comply with requirements set forth in CA Green Building Code, Section 5.504.4 for Finish Material Pollution Control.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Packing and Shipping
 - 1. Deliver materials in the manufacturer's original unopened containers or packages with manufacturer's name, trade name, testing agency labels, product identification, lot numbers, mixing and installation instructions, as applicable.

- B. Storage and Protection
 - 1. Store materials in the original, unopened containers or packages and under conditions recommended by manufacturers.
 - 2. Leave seals unbroken and labels intact until time of use.
 - 3. Remove from Project site rejected or damaged packages found unsuitable for use.

1.8 PROJECT CONDITIONS

- A. Environmental Requirements
 - 1. Do not apply materials when temperature of substrate material and ambient air is below 60 degrees F.
 - 2. Maintain this minimum temperature before, during and for 3 days after installation of materials.
 - 3. Provide ventilation in areas to receive solvent cured materials.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Fire Safing
 - 1. Type: Semi-rigid mineral fiber insulation.
 - 2. Density: Not less than 4 pounds per cubic foot.
 - 3. Manufacturer And Product: U.S. Gypsum "Thermafiber Safing"; Manville Pyro-Fiber Safing Insulation"; or equal.

- B. Fire Stopping Materials
 - 1. Elastomeric Type: Single component; synthetic elastomeric intumescent material; asbestos free; non-sagging; UL BMD classified; 3M Brand fire Barrier Caulk CP-25 N/S No Sag, RectorSeal Corporation "Metacaulk" 835, 880, and 950 Fire Stopping Sealant.
 - 2. Intumescent Wrap: Intumescent elastomeric material faced one side with aluminum or stainless steel foil; bearing UL BMD classification marking; 3M Brand Fire Barrier Wrap/Strip FS 195, RectorSeal Corporation Metawrap 60.

2.2 ACCESSORIES

- A. Forming Materials
 - 1. Fiber Type: Mineral wool; minimum 4.0 pounds per cubic feet.
 - 2. Foam Type: Foam backer rod.
 - 3. Sleeves
 - a. Steel Type: Cylindrical; gauge, seam lap and length as required by UL BMD listed.
 - 4. Wire Mesh Type: No. 8 steel wire cloth fabricated from galvanized steel wire that is 0.020 inch.
 - 5. Collars for Plastic Pipe: 30 gauge galvanized sheet steel; nominal 2 inches deep with 1 1/4 inch wide by 2 inches long die cut predrilled anchor tabs and minimum 1/4 inches long die cut retaining tabs.

2.3 MIXES

- A. Mix firestopping materials in accordance with manufacturer's installation instructions.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine openings and voids to be sealed to determine if conditions are satisfactory for proper installation of firestopping. Prior to beginning installation, verify that:
 - 1. Building is sufficiently enclosed or protected against adverse weather conditions.
 - 2. Supporting framing and surrounding construction is in thoroughly dry condition.

- B. Do not commence Work until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Protection: Where firestopping is installed at locations which will remain exposed in completed Work, provide protection as necessary to prevent damage to adjacent surfaces and finishes, and protect as necessary against damage by other construction operations.
- B. Surface Preparation
 - 1. Ensure that anchoring devices, backup materials, clips, sleeves, supports and other materials used in the actual fire test are installed.
 - 2. Prepare surfaces designated to receive firestopping in accordance with manufacturer's installation instructions.
 - 3. Clean substrate surfaces of dirt, dust, grease, oil, loose material or other matter which may affect bond of fire stopping material.
 - 4. Remove incompatible materials that affect bond.

3.3 APPLICATION

- A. Apply materials in accordance with manufacturer's instructions and UL System Design.
- B. Apply firestopping material as required to achieve rating equal to that of partition in which firestopping is installed.
- C. Install material at wall openings which contain penetrating sleeves, piping, conduit and other items and voids requiring firestopping.
- D. Finish surfaces of firestopping which is to remain exposed in completed Work to uniform and level condition.
- E. At Sound Rated Constructions: Install safing material at duct and pipe penetrations.

3.4 FIELD QUALITY CONTROL

- A. Inspection And Access
 - 1. Examine areas of firestopping to ensure proper installation and full compliance with requirements of this Section.
 - 2. Do not close in until inspected by Owner's Representative.
 - 3. Maintain accessibility to areas of firestopping Work until completion of inspection by Owner's Representative.

3.5 ADJUSTING AND CLEANING

- A. Adjusting: Correct deficiencies in areas of firestopping prior to concealing or enclosing areas.
- B. Cleaning
 - 1. Remove spilled and excess materials adjacent to firestopping without damaging adjacent surfaces.
 - 2. Leave finished Work in neat, clean condition with no evidence of spillovers and damage to adjacent surfaces.

3.6 PROTECTION

- A. Protect firestopping materials from damage until final completion

3.7 SCHEDULE: Provide submittals for following construction conditions, if applicable.

- A. Horizontal Penetrations Through Fire Rated Gypsum Board/Stud Wall Assemblies
 1. Steel Pipe up to 12 Inches in Diameter.
 2. Steel Pipe up to 12 Inches in Diameter with up to 2 Inches of Insulation.
 3. Copper Pipe up to 4 Inches in Diameter.
 4. Copper Pipe up to 4 Inches in Diameter with up to 1 1/2 Inches of Insulation.
 5. Rigid Steel Conduit up to 6 Inches in Diameter:
 6. Electrical Metallic Tubing up to 4 Inches in Diameter.
 7. Flexible Metallic Conduit up to 1 Inch in Diameter.
 8. Rectangular Steel Duct.
 9. Insulated Rectangular Steel Duct.
 10. Round Duct Up to 10 Inches in Diameter.
 11. Round Duct Up to 10 Inches in Diameter with Up to 1 Inch of Insulation.
 12. Joints up to 1 Inch Wide.
- B. Penetrations Through Rated Floor/Ceiling Assemblies
 1. Steel Pipe Up to 12 Inches in Diameter.
 2. Steel Pipe Up to 12 Inches in Diameter With Up to 2 Inches of Insulation.
 3. Copper Pipe Up to 3 Inches in Diameter.
- C. Vertical Penetrations within Rated Walls.

END OF SECTION

SECTION 074000

ALUMINUM FAÇADE CLADDING

1.01 SCOPE

A. SECTION INCLUDES

1. The extent of panel system work is indicated on the drawings and in these specifications.
2. Panel system requirements include the following components:
 - a. Aluminum faced composite panels with mounting system. Panel mounting system including anchorages, shims, furring, fasteners, gaskets and sealants, related flashing adapters, and masking (as required) for a complete watertight installation.
 - b. Parapet coping, column covers, soffits, sills, border, and filler items indicated as integral components of the panel system or as designed.

B. RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1 Specification Sections, and Technical Specification Divisions 2 through 32 apply to this Section.

1.02 QUALITY ASSURANCE

1. Composite Panel Manufacturer shall have a minimum of 10 years' experience in the manufacturing of this product.
2. Composite Panel Manufacturer shall be solely responsible for panel manufacture and application of the finish.
3. Fabricator/installer shall be acceptable to the composite panel manufacturer.
4. Fabricator/Installer shall have a minimum 5 years experience of metal panel work similar in scope and size to this project.
5. Field measurements should be taken prior to the completion of shop fabrication whenever possible. However, coordinate fabrication schedule with construction progress as directed by the Contractor to avoid delay of work. Field fabrication may be allowed to ensure proper fit. However, field fabrication shall be kept to an absolute minimum with the majority of the fabrication being done under controlled shop conditions.
6. Shop drawings shall show the preferred joint details providing a watertight and structurally sound wall panel system that allows no uncontrolled water penetration on the inside face of the panel system as determined by ASTM E 331. Systems not utilizing a construction sealant at the panel joints (i.e. Rout and Return Dry and Rear Ventilated System) shall provide a means of concealed drainage with baffles and weeps for water which may accumulate in members of the system.
7. Maximum deviation from vertical and horizontal alignment of erected panels: 6mm (1/4") in 6m (20') non-accumulative.

8. Panel fabricator/installer shall assume undivided responsibility for all components of the exterior panel system including, but not limited to attachment to sub-construction, panel to panel joinery, panel to dissimilar material joinery, and joint seal associated with the panel system.
9. Composite panel manufacturer shall have established a Certification Program acceptable to the local Code Authorities.

1.03 REFERENCES

A. ALUMINUM ASSOCIATION

1. AA-C22-A41: Anodized - Clear Coatings.
2. AA-C22-A42: Anodized - Integral Color Coatings.

B. AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION

1. AAMA 508-05: Voluntary Test Method and Specification for Pressure Equalized Rain Screen Wall Cladding Systems

C. AMERICAN SOCIETY FOR TESTING AND MATERIALS

1. E 330 Structural Performance of Exterior Windows, Curtain Walls, and Doors Under the Influence of Wind Loads
2. E 283 Rate of Leakage through Exterior Windows, Curtain Walls, and Doors
3. D 1781 Climbing Drum Peel Test for Adhesives

1.04 SUBMITTALS

A. SAMPLES

1. Panel System Assembly: Two samples of each type of assembly.
2. Two samples of each color or finish selected

B. SHOP DRAWINGS

Submit shop drawings showing project layout and elevations; fastening and anchoring methods; detail and location of joints, sealants, and gaskets, including joints necessary to accommodate thermal movement; trim; flashing; and accessories.

C. CODE COMPLIANCE

Documents showing product compliance with the national and local building code shall be submitted prior to the bid. These documents shall include, but not be limited to, appropriate Evaluation Reports and/or test reports supporting the use of the product.

1.05 DELIVERY, STORAGE AND HANDLING

1. Protect finish and edges in accordance with panel manufacturer's recommendations.
2. Store material in accordance with panel manufacturer's recommendations.

PART 2: PRODUCTS

2.01 PANELS

A. COMPOSITE PANELS

1. At exterior canopies
2. Provide flat lock between panels

B. THICKNESS: 0.118" TO 0.157"

C. PRODUCT PERFORMANCE

1. Bond Integrity

When tested for bond integrity, in accordance with ASTM D1781 (simulating resistance to panel delamination), there shall be no adhesive failure of the bond a) between the core and the skin nor b) cohesive failure of the core itself below the following values:

Peel Strength: 115 N mm/mm (22.5 in lb/in) as manufactured
115 N mm/mm (22.5 in lb/in) after 21 days soaking in water at 70°F

2. Fire Performance

ASTM E 84 Flame Spread Index must be less than 25, Smoke Developed Index must be less than 450.

ASTM D 1929 A self ignition temperature of 650°F or greater

ASTM D-635 Requires a CC1 classification

D. FINISHES

1. Brushed Aluminum High Performance Clear with an application over brushed aluminum substrates, provide single coat clear finish.

2.02 PANEL FABRICATION

A. COMPOSITION:

Two sheets of aluminum sandwiching a solid core of extruded thermoplastic material formed in a continuous process with no glues or adhesives between dissimilar materials. The core material shall be free of voids and/or air spaces and not contain foamed insulation material. Products laminated sheet by sheet in a batch process using glues or adhesives between materials shall not be acceptable.

B. TOLERANCES

1. Panel Bow: Maximum 0.8% of any 1828mm (72") panel dimension.
2. Panel Dimensions: Field fabrication shall be allowed where necessary, but shall be kept to an absolute minimum. All fabrication shall be done under controlled shop conditions when possible.
3. Panel lines, breaks, and angles shall be sharp, true, and surfaces free from warp and buckle.

4. Maximum deviation from panel flatness shall be 1/8" in 5'0" on panel in any direction for assembled units. (Non-accumulative - No Oil Canning)

C. SYSTEM CHARACTERISTICS

1. Plans, elevations, details, characteristics, and other requirements indicated are based upon standards by one manufacturer. It is intended that other manufacturers, receiving prior approval, may be acceptable, provided their details and characteristics comply with size and profile requirements, and material/performance standards.
2. System must not generally have any visible fasteners, telegraphing or fastening on the panel faces or any other compromise of a neat and flat appearance.
3. System shall comply with the applicable provisions of the "Metal Curtain Wall, Window, Storefront, and Entrance Guide Specifications Manual" by AAMA and ANSI/AAMA 302.9 requirements for aluminum windows.
4. Fabricate panel system to dimension, size, and profile indicated on the drawings based on a design temperature of 70°F.
5. Fabricate panel system so that no restraints can be placed on the panel, which might result in compressive skin stresses. The installation detailing shall be such that the panels remain flat regardless of temperature change and at all times remain air and water tight.
6. The finish side of the panel shall have a removable plastic film applied prior to fabrication, which shall remain on the panel during fabrication, shipping, and erection to protect the surface from damage.

D. SYSTEM TYPE

1. Rout and Return Wet:
System must provide a wet seal (caulked) reveal joint as detailed on drawings. The sealant type shall be as specified in Section 07900 and with foamed type backer rod as indicated on architectural drawings.

E. SYSTEM PERFORMANCE

1. Composite panels shall be capable of withstanding building movements and weather exposures based on the following test standards required by the Architect and/or the local building code.

a. Wind Load

If system tests are not available, mock-ups shall be constructed and tests performed under the direction of an independent third party laboratory, which show compliance to the following minimum standards:

Panels shall be designed to withstand the Design Wind Load based upon the local building code, but in no case less than 20 pounds per square foot (psf) and 30 psf on parapet and corner panels. Wind load testing shall be conducted in accordance with ASTM E330 to obtain the following results.

Normal to the plane of the wall between supports, deflection of the secured perimeter-framing members shall not exceed $L/175$ or $3/4"$, whichever is less.

Normal to the plane of the wall, the maximum panel deflection shall not exceed $L/60$ of the full span.

Maximum anchor deflection shall not exceed $1/16"$.

At 1-1/2 times design pressure, permanent deflections of framing members shall not exceed $L/100$ of span length and components shall not experience failure or gross permanent distortion. At connection points of framing members to anchors, permanent set shall not exceed $1/16"$.

b. Air/Water System Test

If system tests are not available, mock-ups shall be constructed and tests performed under the direction of an independent third party laboratory, which show compliance to the following minimum standards:

Air Infiltration - When tested in accordance with ASTM E283, air infiltration at 1.57 psf must not exceed 0.06 cfm/ft² of wall area.

Water Infiltration - Water infiltration is defined as uncontrolled water leakage through the exterior face of the assembly. Systems not using a construction sealant at the panel joints (i.e. Rout and Return Dry and Rear Ventilated Systems) shall be designed to drain any water leakage occurring at the joints. No water infiltration shall occur in any system under a differential static pressure of 6.24 psf after 15 minutes of exposure in accordance with ASTM E331.

c. Pressure Equalized Rain Screen Systems shall comply with AAMA 508-05 Voluntary Test Method and Specification for Pressure Equalized Rain Screen Wall Cladding Systems

2.03 ACCESSORIES

1. Extrusions, formed members, sheet, and plate shall conform with ASTM B209 and the recommendations of the manufacturer.
2. Panel stiffeners, if required, shall be structurally fastened or restrained at the ends and shall be secured to the rear face of the composite panel with silicone of sufficient size and strength to maintain panel flatness. Stiffener material and/or finish shall be compatible with the silicone.
3. Sealants and gaskets within the panel system shall be as per manufacturer's standards to meet performance requirements.
4. Fabricate flashing materials from 0.030" minimum thickness aluminum sheet painted to match the adjacent curtain wall / panel system where exposed. Provide a lap strap under the flashing at abutted conditions and seal lapped surfaces with a full bed of non-hardening sealant.

5. Fasteners (concealed/exposed/non-corrosive): Fasteners as recommended by panel manufacturer. Do not expose fasteners except where unavoidable and then match finish of adjoining metal.

PART 3: EXECUTION

3.01 INSPECTION

1. Surfaces to receive panels shall be even, smooth, sound, clean, dry and free from defects detrimental to work. Notify contractor in writing of conditions detrimental to proper and timely completion of the work. Do not proceed with erection until unsatisfactory conditions have been corrected.
2. Surfaces to receive panels shall be structurally sound as determined by a registered Architect/Engineer.

3.02 INSTALLATION

1. Erect panels plumb, level, and true.
2. Attachment system shall allow for the free and noiseless vertical and horizontal thermal movement due to expansion and contraction for a material temperature range of -20°F to +180°F. Buckling of panels, opening of joints, undue stress on fasteners, failure of sealants or any other detrimental effects due to thermal movement will not be permitted. Fabrication, assembly, and erection procedure shall account for the ambient temperature at the time of the respective operation.
3. Panels shall be erected in accordance with an approved set of shop drawings.
4. Anchor panels securely per engineering recommendations and in accordance with approved shop drawings to allow for necessary thermal movement and structural support.
5. Conform to panel fabricator's instructions for installation of concealed fasteners.

3.03 ADJUSTING AND CLEANING

1. Remove and replace panels damaged beyond repair as a direct result of the panel installation. After installation, panel repair and replacement shall become the responsibility of the General Contractor.
2. Repair panels with minor damage.
3. Any additional protection, after installation, shall be the responsibility of the General Contractor.
4. Make sure weep holes and drainage channels are unobstructed and free of dirt and sealants.
5. Final cleaning shall not be part of the work of this section.

END OF SECTION

SECTION 075000

SINGLE-PLY ROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Repairs at existing roof.
 - 2. Base sheet.
 - 3. Sheathing paper.
 - 4. Substrate board.
- B. Related Sections include the following:
 - 1. Section 061000 - Rough Carpentry for wood nailers, curbs, and blocking and for wood-based, structural-use roof deck panels.
 - 2. Section 076000 - Sheet Metal Flashing and Trim for metal roof penetration flashings, flashings, and counterflashings.
 - 3. Section 079000 - Joint Sealants.

1.3 DEFINITIONS

- A. Roofing Terminology: Refer to ASTM D 1079 "Terminology Relating to Roofing and Waterproofing"; glossary of NRCA's "The NRCA Roofing and Waterproofing Manual"; and the Roof Consultants Institute "Glossary of Roofing Terms" for definition of terms related to roofing work in this Section.
- B. Sheet Metal Terminology and Techniques: SMACNA Architectural Sheet Metal Manual.

1.4 PERFORMANCE REQUIREMENTS

- A. General: Provide repairs to existing and new roof areas for single-ply roofing and flashings that are to remain watertight and that do not permit the passage of water and resist specified uplift pressures, thermally induced movement, and exposure to weather without failure.

- B. **Material Compatibility:** Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by roofing membrane manufacturer based on testing and field experience.
- C. **Jobsite Safety:** Execute all operations and provide a safe work environment in accordance to OSHA standards and regulations. This requirement applies to all contractor personnel, associated subcontractors, workers in other trades, and jobsite visitors.
 - 1. Follow all industry fire prevention guidelines for storage of materials, staging areas, roof access, and application means and methods.
 - 2. Any applicable local fire codes supersede industry guidelines.
- D. **Roofing System Design:** Provide a membrane roofing system that is identical to systems that have been successfully tested by a qualified testing and inspecting agency to resist uplift pressure calculated according to ASCE 7.
 - 1. Corner Uplift Pressure: 28.8 lbf/sq. ft.
 - 2. Perimeter Uplift Pressure: 28.8 lbf/sq. ft.
 - 3. Field-of-Roof Uplift Pressure: 24.7 lbf/sq. ft.
 - 4. Fire/Windstorm Classification: Class 1A-90 MPH

1.5 SUBMITTALS

- A. **Product Data:** For each type of product indicated.
- B. **Shop Drawings:** plan and details
 - 1. Flashings and membrane terminations.
 - 2. Sheet layout with perimeter and corner defined.
- C. **Installer Certificates:** Signed by roofing system manufacturer certifying that Installer is approved, authorized, or licensed by manufacturer to install roofing system.
- D. **Manufacturer Certificates:** Signed by roofing manufacturer certifying that roofing system complies with requirements specified in "Performance Requirements" Article.
 - 1. Submit evidence of meeting performance requirements.
- E. **Product Test Reports:** Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for components of roofing system.

- F. Research/Evaluation Reports: For components of membrane roofing system.
- G. Maintenance Data: For roofing system to include in maintenance manuals.
- H. Warranties: Special warranties specified in this Section.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's warranty.
- B. Manufacturer Qualifications: A qualified manufacturer that has UL listing for membrane roofing system identical to that used for this Project.
- C. Testing Agency Qualifications: An independent testing agency with the experience and capability to conduct the testing indicated, as documented according to ASTM E 548.
- D. Test Reports:
 - 1. Roof drain and leader test or submit plumbers verification.
 - 2. Core cut (if requested).
 - 3. Roof deck fastener pullout test.
- E. Source Limitations: Obtain all components from single source roofing manufacturer.
- F. Fire-Test-Response Characteristics: Provide membrane roofing materials with the fire-test-response characteristics indicated as determined by testing identical products per test method below by UL, FMG, or another testing and inspecting agency acceptable to authorities having jurisdiction. Materials shall be identified with appropriate markings of applicable testing and inspecting agency.
 - 1. Exterior Fire-Test Exposure: Class A; ASTM E 108, for application and roof slopes indicated.
 - 2. Fire-Resistance Ratings: ASTM E 119, for fire-resistance-rated roof assemblies of which roofing system is a part.
- G. Preliminary Roofing Conference: Before starting roof deck construction, conduct conference at Project site. Comply with requirements for preinstallation conferences in Division 01 Section "Project Management and Coordination." Review methods and procedures related to roof deck construction and roofing system including, but not limited to, the following:
 - 1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, and installers whose work

- interfaces with or affects roofing including installers of roof accessories and roof-mounted equipment.
2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
 3. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
 5. Review structural loading limitations of roof deck during and after roofing.
 6. Require that all complimentary trades be present at conference. Including, but not limited to; electrical, plumbing, HVAC, and framing contractors.
 7. Review Flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing system.
 8. Review governing regulations and requirements for insurance and certificates if applicable.
 9. Review temporary protection requirements for roofing system during and after installation.
 10. Review roof observation and repair procedures after roofing installation.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, and directions for storing and mixing with other components.
- B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.
- C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.
- D. Handle and store roofing materials and place equipment in a manner to avoid permanent deflection of deck.

1.8 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

1.9 GUARANTEE

- A. Provide manufacturer's system guarantee equal to Johns Manville's Peak Advantage No Dollar Limit Roofing System Guarantee.
 - 1. Single-Source special warranty includes roofing membrane, Flashings, roofing membrane accessories, roof insulation, fasteners, substrate board, walkway products, manufacturer's edge metal products, and other single-source components of roofing system marketed by the manufacturer.
 - 2. Warranty Period: 20 years from date of Substantial Completion.
- B. Installer's Guarantee: Submit roofing Installer's warranty, on warranty form at end of this Section, signed by Installer, covering Work of this Section, including all components of roofing system such as roofing membrane, Flashing, roof insulation, fasteners, cover boards, substrate boards, vapor retarders, roof pavers, and walkway products, for the following warranty period:
 - 1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. Basis of Design: Johns Manville Roofing Systems

2.2 THERMOPLASTIC POLYOLEFIN ROOFING MEMBRANE

- A. Fabric-Reinforced Thermoplastic Polyolefin Sheet: ASTM D 6878, uniform, flexible sheet formed from a thermoplastic polyolefin, internally fabric or scrim reinforced. Product: JM TPO
 - 1. Thickness: 60 mils nominal.

2.3 AUXILIARY MATERIALS

- A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with membrane roofing.
 - 1. Liquid-type auxiliary materials shall meet VOC limits of authorities having jurisdiction.
 - 2. Liquid-type auxiliary materials classified as No VOC.
- B. Sheet Flashing: Manufacturer's sheet flashing of same material, type, reinforcement, thickness, and color as sheet membrane. Product: JM TPO

- C. Sheet Flashing: Manufacturer's unreinforced sheet flashing of same material as sheet membrane. Product: JM TPO Detail Membrane
- D. Bonding Adhesive: Manufacturer's standard water-based bonding adhesive for membrane, and solvent-based bonding adhesive for Flashings. Product: JM TPO Membrane Adhesive (Low VOC)
- E. Slip Sheet: Manufacturer's recommended slip sheet, of type required for application.
- F. Metal Termination Bars: Manufacturer's standard predrilled stainless-steel or aluminum bars, with anchors. Product: JM Termination Systems
- G. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions in FMG 4470, designed for fastening membrane to substrate, and acceptable to membrane roofing system manufacturer. Product: High Load Fasteners and Plates
- H. Expansion Joints: Provide factory fabricated weatherproof, exterior covers for expansion joint openings consisting of flexible rubber membrane, supported by a closed cell foam to form flexible bellows, with two metal flanges, adhesively and mechanically combined to the bellows by a patented bifurcation process. Provide product manufactured and marketed by single-source membrane supplier that is included in the No Dollar Limit guarantee. Product: Expand-O-Flash
- I. Coping System: Manufacturer's factory fabricated coping consisting of a base piece and a snap-on cap. Provide product manufactured and marketed by single-source membrane supplier that is included in the No Dollar Limit guarantee. Product: Presto-Lock Coping
- J. Fascia System: Manufacturer's factory fabricated fascia consisting of a base piece and a snap-on cover. Provide product manufactured and marketed by single-source membrane supplier that is included in the No Dollar Limit guarantee. Product: Presto Lock Fascia

2.4 WALKWAYS

- A. Flexible Walkways: Factory-formed, nonporous, heavy-duty, slip-resisting, surface-textured walkway pads sourced from membrane roofing system manufacturer. Product: JM TPO Walkpad

2.5 BASE-SHEET MATERIALS

- A. Base Sheet: ASTM D 4601, Type II, UL Class G2 rated, nonperforated, asphalt-impregnated and -coated, glass-fiber sheet, dusted with fine mineral surfacing on both sides. Product: PermaPly 28

- B. Base Sheet: ASTM D 4897, Type II, venting, nonperforated, heavyweight, asphalt-impregnated and -coated, glass-fiber base sheet with coarse granular surfacing or embossed venting channels on bottom surface. Product: Ventsulation Felt

2.6 SHEATHING PAPER

- A. Sheathing Paper: Red-rosin type, minimum 3 lb/100 sq. ft. (0.16 kg/sq. m).

2.7 SUBSTRATE BOARD

- A. Substrate Board: ASTM C 1177/C 1177M, glass-mat, water-resistant gypsum substrate, 1/4 inch thick. Product: Securock or Densglas.
- B. Substrate Board: ASTM C 728, perlite board, [3/4 inch (19 mm)] [1 inch (25 mm)] thick, seal coated. Product: Fesco Board.
- C. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions in FMG 4470, designed for fastening substrate panel to roof deck. Product: UltraFast Fasteners and Plates

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with the following requirements and other conditions affecting performance of roofing system:
 - 1. Verify that roof openings and penetrations are in place and set and braced and that roof drains are securely clamped in place.
 - 2. Verify that wood cants, blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
 - 3. Verify that deck is securely fastened with no projecting fasteners and with no adjacent units in excess of 1/16 inch out of plane relative to adjoining deck.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections.
- B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 RE-ROOF PREPARATION

- A. Remove all roofing membrane, surfacing, coverboards, insulation, fasteners, asphalt, pitch, adhesives, etc.
 - 1. Remove an area no larger than can be re-roofed in one day.
- B. Tear out all Flashings, counterflashings, pitch pans, pipe flashings, vents and like components necessary for application of new membrane.
- C. Remove abandoned equipment curbs, skylights, smoke hatches, and penetrations.
 - 1. Install decking to match existing as directed by Owner's Representative.
- D. Raise, (disconnect by licensed craftsmen, if necessary) all HVAC units and other equipment supported by curbs to conform with the following:
 - 1. Modify curbs as required to provide a minimum 8" Flashing height measured from the surface of the new membrane to the top of the flashing membrane.
 - 2. Nail top of flashing and install new metal counterflashing prior to re-installation of unit.
 - 3. Perimeter nailers must be elevated to match elevation of new roof insulation.
- E. Immediately remove all debris from roof surface. Demolished roof system may not be stored on the roof surface.
- F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.4 SUBSTRATE BOARD INSTALLATION

- A. Install substrate board with long joints in continuous straight lines, perpendicular to roof slopes with end joints staggered between rows. Tightly butt substrate boards together.
 - 1. Fasten substrate board to top flanges of steel deck according to recommendations in FMG's "Approval Guide" for specified Windstorm Resistance Classification.
 - 2. Fasten substrate board to top flanges of steel deck to resist uplift pressure at corners, perimeter, and field of roof according to roofing system manufacturer's written instructions.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.5 SHEATHING PAPER INSTALLATION

- A. Loosely lay sheathing paper in a single layer over all wood deck areas, side and end lapping each sheet a minimum of 2 inches and 6 inches, respectively.
 - 1. Seal side and end laps with tape or adhesive.
 - 2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.6 BASE-SHEET INSTALLATION

- A. Install one lapped base sheet course and mechanically fasten to substrate according to roofing system manufacturer's written instructions.
 - 1. Enhance fastening rate in perimeter and corner zones according to code or manufacturer, whichever is more stringent.
- B. Comply with roofing system manufacturer's written instructions for installing roof insulation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.7 DRAINAGE BOARD INSULATION - INSTALLATION

- A. Coordinate installing roof system components so drainage insulation is not exposed to precipitation or left exposed at the end of the workday.
- B. Comply with roofing system manufacturer's written instructions for installing roof insulation.

- C. Insulation Cant Strips: Install and secure preformed 45-degree insulation cant strips at junctures of roofing membrane system with vertical surfaces or angle changes greater than 45 degrees per manufacturer's instruction.
 - D. Install tapered insulation under area of roofing to conform to slopes indicated.
 - E. Install insulation with long joints of insulation in a continuous straight line with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4 inch with insulation.
 - 1. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.
 - F. Install one or more layers of insulation under area of roofing to achieve required thickness. Where overall insulation thickness is 1.5 inches or greater, install 2 or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches in each direction.
 - G. Trim surface of insulation where necessary at roof drains so completed surface is flush and does not restrict flow of water.
 - H. Install tapered edge strips at perimeter edges of roof that do not terminate at vertical surfaces.
 - I. Preliminarily Fastened Insulation: Install insulation with fasteners at rate required by roofing system manufacturer or applicable authority, which ever is more stringent.
 - J. Mechanically Fastened with Subsequent Layers Adhered Insulation: Secure first layer of insulation to deck using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to deck type.
 - 1. Fasten first layer according to requirements in FMG's "Approval Guide" for specified Windstorm Resistance Classification.
 - 2. Fasten first layer to resist uplift pressure at corners, perimeter, and field of roof.
 - 3. Install subsequent layers in a cold fluid-applied adhesive.
 - 4. Install subsequent layers in a two-part urethane adhesive.
 - K. Proceed with installation only after unsatisfactory conditions have been corrected.
- 3.8 MECHANICALLY FASTENED ROOFING MEMBRANE INSTALLATION
- A. Install roofing membrane specification ST6RM over area to receive roofing according to roofing system manufacturer's written instructions. Unroll roofing membrane and allow to relax before installing.

- B. Start installation of roofing membrane in presence of roofing system manufacturer's technical personnel.
- C. Accurately align roofing membranes and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.
- D. Mechanically fasten roofing membrane securely at terminations, penetrations, and perimeter of roofing.
- E. Always install membrane laps perpendicular to the steel deck flutes. "Picture Frame" installation method is not permitted.
- F. Apply roofing membrane with side laps shingled with slope of roof deck where possible.
- G. Seams: Clean seam areas, overlap roofing membrane, and hot-air weld side and end laps of roofing membrane according to manufacturer's written instructions to ensure a watertight seam installation.
 - 1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of roofing membrane.
 - 2. Verify field strength of seams a minimum of twice daily and repair seam sample areas.
 - a. Remove and repair any unsatisfactory sections before proceeding with Work.
 - 3. Repair tears, voids, and lapped seams in roofing membrane that do not meet requirements.
- H. Spread sealant or mastic bed over deck drain flange at deck drains and securely seal roofing membrane in place with clamping ring.
- I. In-Splice Attachment: Secure one edge of roofing membrane using fastening plates or metal battens centered within membrane splice and mechanically fasten roofing membrane to roof deck. Field-splice seam.
- J. Through-Membrane Attachment: Secure roofing membrane using fastening plates or metal battens and mechanically fasten roofing membrane to roof deck. Cover battens and fasteners with a continuous cover strip.
- K. Install roofing membrane and auxiliary materials to tie in to existing roofing.
- L. Proceed with installation only after unsatisfactory conditions have been corrected.

3.9 FLASHING INSTALLATION

- A. Install sheet flashings and preformed flashing accessories and adhere to substrates according to membrane roofing system manufacturer's written instructions.
- B. Apply solvent-based bonding adhesive to substrate and underside of sheet flashing at required rate and allow to partially dry. Do not apply bonding adhesive to seam area of flashing.
- C. Flash penetrations and field-formed inside and outside corners with sheet flashing.

3.10 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform roof tests and inspections and to prepare test reports.
- B. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion and submit report to Architect.

3.11 PROTECTING AND CLEANING

- A. Protect membrane roofing system from damage and wear during remainder of construction period. When remaining construction will not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.
- B. Correct deficiencies in or remove membrane roofing system that does not comply with requirements, repair substrates, and repair or reinstall membrane roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.
- C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION

SECTION 076000

FLASHING AND SHEET METAL

PART 1 GENERAL

1.1 SUMMARY

- A. Related Sections
 - 1. Section 079000 - Joint Sealants: Joint sealant systems.
 - 2. Section 099000 - Painting: Field finishing painting of sheet metal flashing and trim.
 - 3. Division 22 - Plumbing: roof vents penetrations.
 - 4. Division 23 - HVAC: Mechanical and duct penetrations.
 - 5. Division 26 - Electrical: Electrical penetrations.

1.2 REFERENCES

- A. ASTM - American Society for Testing and Materials
 - 1. A653 Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated by the Hot-Dip Process.
 - 2. A666 Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
 - 3. B32 Standard Specification for Solder Metal.
 - 4. B749 Specification for Lead and Lead Alloy Strip, Sheet, and Plate Products.
- B. CBSC - California Building Standards Commission
 - 1. CBC California Building Code, 2016 Edition
- C. AWS – American Welding Society
 - 1. D1.1 Structural Welding Code - Steel
 - 2. D2.0 Welding Symbols.
- D. SMACNA - Sheet Metal and Air Conditioning Contractors National Association, Inc.
 - 1. Architectural Sheet Metal Manual.

1.3 SYSTEM DESCRIPTION

- A. Performance Requirements
 - 1. Work of this Section is to physically protect items from damage that would permit water leakage to building interior.
 - 2. Material Gauge
 - a. Minimum 24 gauge, except as specified otherwise in this Section.
 - b. Provide thicker gauges if recommended by SMACNA Manual or material fabricator.
 - c. Provide special flashing transitions and soldered closure pieces wherever necessary to achieve the intent of the specifications.

1.4 SUBMITTALS

- A. Product Data: Submit manufacture's literature completely describing products.
- B. Shop Drawings Submit drawings indicating material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.
 - 1. For items that are to be welded
 - a. Indicate welds, both shop and field, by symbols conforming to AWS D2.0.
 - b. Where welded connectors, concrete or masonry inserts are required to receive Work, indicate size and locations.
 - 2. Demonstrate relationship of flashings to adjacent materials.
 - 3. Include isometrics of corners and intersections and terminations and other items required by Work of this Section.
 - 4. Provide plans that indicate locations of each type of flashing and counter flashing and other items required by Work of this Section.

1.5 QUALITY ASSURANCE

- A. Qualifications
 - 1. Welders: Submit welders' certificates, certifying welders employed on the Work are qualified in accordance with AWS D1.1 within the previous 12 months.
- B. Regulatory Requirements
 - 1. Wind Loading: Design and size exterior items to withstand dead loads and live loads caused by pressure and suction of wind for design pressure in pounds per square foot in accordance with CBC Chapter 16 Division III Wind Design Sections 1615 thru 1620 and Section 1622 and Section 1625 in accordance with following:
 - a. Exposure: C
 - b. Wind Speed In Miles Per Hour: 70.
 - 2. Seismic Requirements: Design anchorage systems to comply with CBC Chapter 16 Division IV, Section 1632 as applicable for Seismic Zone 4 and requirements of Table 16-0, Elements Of Structures And Nonstructural Components And Equipment, Exterior And Interior Appendages 2.A.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Storage and Protection
 - 1. Deliver, store and handle packaged materials in original containers with seals unbroken and labels intact until time of use.
 - 2. Discharge materials carefully and store on clean concrete surface or raised platform in safe dry area. Do not dump onto ground.

3. Stack preformed material to prevent twisting, bending or abrasion and to provide ventilation.
4. Slope metal sheets to ensure drainage.
5. Store materials to provide ventilation and prevent bending, abrasion or twisting.
6. Prevent contact with materials which may cause discoloration, staining or damage.
7. Do not store panels or flashings with strippable film in areas exposed to sunlight.

1.7 PROJECT CONDITIONS

- A. Field Measurements
 1. Prior To Fabrication: Verify measurements in field and coordinate with related Work as required for proper and adequate fabrication and installation.
- B. Exercise care when working on or about roof surfaces to avoid damaging or puncturing membrane or flexible flashings.
- C. Place plywood, insulation boards or other suitable protection when working areas of newly installed membranes. Keep in place until completion of Work.
- D. Immediately advise the built-up roofing installer of any damage to the new membrane.

1.8 SEQUENCING AND SCHEDULING

- A. Ensure timely delivery of items to be embedded in Work of other Sections and furnish setting drawings or templates as specified in Article titled Submittals, sub-Article titled Setting Drawings or Templates in this Section.

1.9 WARRANTY

- A. Provide 2 year labor and material warranty for correcting failure of metal flashing systems to resist penetration of water.
- B. Provide 2 year extended warranty. Cover costs to replace and repair damage to building and contents due to failure of flashings and sheet metal Work to prevent water infiltration.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Sheet Materials, Typical

1. Sheet Metal: Galvanized Steel Sheet Materials: ASTM A653, lock forming quality, minimum 24 gauge, with minimum 1.25 ounce per square foot zinc coating.
- B. Special Flashing Transitions: 4 pound lead.
- C. Solder and Flux: ASTM B32 types as recommended by manufacturer of sheet metal to be soldered. Re-melted or reworked solder will not be permitted.
- D. Flashing Compound: Polyisobutylene type, non-shrinking, nondrying sealant or tape as required by installation conditions, 1 inch width by 1/16 inch minimum thickness.

2.2 ACCESSORIES

- A. Fasteners (Nails, screws, rivets, bolts and nuts)
 1. General: Same material as item being fastened, except fasteners in contact with aluminum are to be compatible stainless steel fasteners.
 2. Washers And Spacers: Neoprene.
 3. Strainers At Tops Of Downspouts: galv.steel.
 4. Fasteners
 - a. Metal to wood (unexposed) - 11gauge ring shank sufficient to penetrate 1 inch into wood, galvanized.
 - b. Metal to wood (exposed) Stainless steel, neoprene washered hex head screw #10, with length sufficient to penetrate wood 1 inch.
 - c. Metal to metal (exposed) - Stainless steel, neoprene washered hex head screw #10, with length sufficient to penetrate base metal 1/2 inch.
 - d. Rivets: ASTM B315, alloy 110, 5052, 5056, or 6061; appropriate temper, unless temper is specified.
 - e. Rivets, screws, bolts, nuts and wire: ASTM B211, alloy 1100, 5052 to 6061; appropriate temper.

2.3 FABRICATION

- A. Shop Assembly
 1. General
 - a. Design and fabricate Work in accordance: SMACNA Manual and with following requirements.
 - b. As far as practicable, form and fabricate sheet metal in shop. Where Project site fabrication is required, provide Work equal to shop quality. Additionally, identify bulk materials from which items are field fabricated by manufacturer's trademark printed or embossed at frequent intervals.
 - c. Reproduce accurately profiles and bends indicated.
 - d. Provide profiles with interactions that are sharp, even and true; with plane surfaces free from buckles and waves; and seams that follow direction of water flow.

- e. Reinforce correctly for strength and appearance.
 - f. Cut, fit, and drill sheet metal as required to accommodate related, adjacent or adjoining Work.
 - g. Exposed Edges of Sheet Metal: Fold, bend or return exposed edges of sheet metal. Raw edges will not be permitted.
 - h. Form pieces in longest practical lengths.
 - i. Sheet Metal Joints
 - 1) Flashing joints to have minimum 4 inch overlap with weld or solder or mechanical fastening with sealant.
 - 2) Join joints and miters as recommended by manufacturer.
 - 3) Where positive joining is required and where indicated on the Drawings, weld in accordance with applicable AWS D1.1 standards as applicable.
 - 4) Turn lock joints on exposed surfaces in direction of flow.
2. Soldering
- a. Neatly solder exposed surfaces.
 - b. Pre-tin edges minimum 1 1/2 inches both sides prior to soldering.
 - c. Use heavy soldering coppers of blunt design.
 - d. Immediately after applying flux, solder with well-heated coppers, thoroughly heating seams and completely sweating solder through full-width with at least 1 inch width along seams.
 - e. Solder in manner to seal metal joints and, where practical, inside surface not exposed to view.
 - f. After soldering, remove flux. Wipe and wash solder joints clean.
3. Expansion and Contraction of Sheet Metal Runs
- a. General
 - 1) Typical: Provide loose locking slip joint of maximum 8 feet from external and internal corners, maximum 24 feet length of straight runs, unless manufacturer recommends more frequent interval, and 1 at center of runs less than 20 feet, but more than 8 feet, unless specified otherwise following herein.
 - 2) Form expansion joints of intermeshing hooked flanges not less than 1 inch deep filled with mastic concealed within joints.
 - 3) Where movable non-expansion type joints are required for proper performance of Work, form metal to provide for proper installation of elastomeric sealant in compliance with SMACNA standards.
 - 4) Seams: Are to be located as indicated on Drawings or located in accordance with industry standard.
4. Provide following items of materials and minimum gauges as indicated on the Drawings.
- a. Cleats: Formed of same metal as that being anchored, with size, shape, and quantity as required to secure flashing and sheet metal in place.

2.4 FINISHES

A. Factory Finishing

1. Galvanized Sheet Metal
 - a. Finish: ASTM A653, G90 zinc coating.
 - b. After Fabrication: Touch-up abraded surfaces in accordance with Section 099000.

2.5 Parapet Scuppers: Manufactured with closure flange trim to exterior, 6-inch wide wall flanges to interior, and base extending 4 inches (100 mm) beyond cant or tapered strip into field of roof.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify following:
 1. Roof openings, pipes, sleeves, ducts or vents through roof are solidly set, and nailing strips are located.
 2. Underlayment membrane termination and base flashings are in place, sealed and secure.

- B. Do not start Work until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Preparation
 1. Coordinate Work of this Section with installation of adjoining Work.
 2. Install sheet metal Work related to roofing systems under supervision of Contractor's roofing installers.
 3. Back paint flashings with materials for permanent protection of dissimilar materials or provide inorganic membrane separation where flashings are expected to be in contact with cementitious materials or dissimilar metals.
 4. Use compatible metals for pipe clamps.
 5. Ensure membrane and flashings are installed watertight prior to sheet metal installations.

3.3 INSTALLATION

- A. Conform to procedures and methods of installation and applicable details indicated in SMACNA Manual.

- B. Where installation requires fabrication at the Project site, conform to applicable requirements of Article titled Fabrication in this Section.

- C. Install Work watertight; ensure that items are installed in true and accurate alignment with other items and related Work, that joints are accurately fitted, that corners are reinforced and that exposed surfaces are free of dents.

- D. Install standard catalog products in accordance with manufacturer's instructions, unless otherwise indicated on the Drawings.
- E. Apply flashing compound at slip joints or wherever metal-to-metal contact occurs and movement may be anticipated to occur.
- F. Fastening
 - 1. Fasten in accordance with SMACNA Manual.
 - 2. Fasten sheetmetal runs to under laying material by nailing through slotted holes in flange at 3 inches on center, unless otherwise indicated on the Drawings or required by manufacturer.
 - 3. Provide waterproof washers wherever fasteners penetrate flashings.
 - 4. Where sheetmetal occurs over other sheet metal, use nails with minimum 1 inch metal disks.
 - 5. Secure flashings in place using standard concealed type fasteners, using specified type fasteners.
 - 6. When exposed fasteners are required, they are to be of same finish as flashings.
 - 7. Use exposed fasteners in locations only as indicated on the Drawings.
- G. Counter flash mechanical and electrical items projecting through roofing.
- H. Perform field welding only where indicated on reviewed Shop Drawings, in accordance with AWS D1.1.

3.4 ADJUSTING AND CLEANING

- A. Adjusting: Replace damaged material with new.
- B. Cleaning
 - 1. Upon completion of roofing installations, clear gutters and roof drains installed under this Section of debris and obstructions.
 - 2. Leave Work areas clean, free from grease, finger marks and stains.
 - 3. Remove scrap and debris from surrounding areas and grounds at end of each Work day and at completion of the Work of this Section.

3.5 PROTECTION

- A. Protect exposed finishes as required against construction damage; remove temporary protection prior to final completion.

END OF SECTION

SECTION 079000

JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Requirements for provision of backing and sealants required to weather-proof, moisture proof or caulk joints.
- B. Related Sections
 - 1. Section 076000 – Flashing and Sheet Metal: For sealants used with sheet metal work.
 - 2. Section 092500 - Gypsum Board Systems: Acoustical sealant and acoustic accessories for gypsum wallboard
 - 3. Other sections and not limited to:
 - a. Division 22 - Plumbing: Sealant systems for Plumbing Work.
 - b. Division 23 - Mechanical: Sealant systems for Mechanical Work.
 - c. Division 26 - Electrical: Sealant systems for Electrical Work.

1.2 REFERENCES

- A. ASTM - American Society for Testing and Materials
 - 1. C920 Standard Specification for Elastomeric Joint Sealants.

1.3 DEFINITION

- A. Where the word caulk or mastic occurs on Drawings or in the Specifications, they are to be defined as the sealant system required for each specific condition.

1.4 SYSTEM DESCRIPTION

- A. Performance Requirements
 - 1. Primer and sealant are to be from single manufacturer, who is also to approve backer rod. Prime all joints unless manufacturer recommends against priming surfaces.
 - 2. Provide elastomeric sealants, back-up and related materials capable of sealing buildings or structures against water, wind and dirt and at horizontal surfaces subject to vehicular traffic, resistant to petroleum derivatives.
 - 3. Review performance requirements of conditions to be sealed, including performance of back-up materials, and inform Owner's Representative of any obvious or assumed inappropriate materials or conditions, prior to installations.
 - 4. Review Drawings for joint sealant requirements. Inform Owner's Representative of any locations not clearly indicated on the Drawings or otherwise in question. Intent is for all joints requiring waterproofing to be properly sealed.

1.5 SUBMITTALS

- A. Product Data: Submit data completely describing products, including sealant chemical characteristics; performance criteria, limitations and color availability. Include accessory items necessary for successful completion of Work and recommendations for primer.
- B. Samples: Submit color samples for Owner's Representative color selection where material will be visually exposed.
- C. Certificate of Compliance: Upon completion of the Work, submit certificate signed by the Contractor, stating that sealant and caulking application complies with contract requirements and manufacturer's recommendations, and is proper and adequate for conditions requiring sealants and caulking
- D. Manufacturer's Instructions: Include manufacturer's requirements for surface preparation, temperature and humidity, application equipment and procedures for sealants and primers.
- E. WARRANTY: Furnish a written warranty against all defects in caulking and sealant materials for 5 years and defects in workmanship for 2 years, covering the following specific conditions, without limitation:
 - 1. Water leakage through sealed joints.
 - 2. Adhesive or cohesive failure of sealant.
 - 3. Staining of adjacent surfaces caused by migration of sealant or primer.
 - 4. Sealant hardened beyond Shore A hardness indicated in approved submittals.
 - 5. Chalking or visible color changes of cured sealants.
- F. CA Green Building Code:
Comply with requirements set forth in CA Green Building Code, Section 5.504.4.1 for Adhesives, Sealants and Caulks.

1.6 QUALITY ASSURANCE

- A. Qualifications: Contractor shall engage installer with a minimum of 3 similar installations, within 3 successive years, with each required sealant condition for this Project, and such installer is to act as supervising mechanic.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original labeled and sealed containers displaying manufacturer's name, brand name, type of sealant, color designation, expiration period for use, pot life, curing time and mixing instructions for multi-component materials.
- B. Store and handle materials to prevent their deterioration or damage due to moisture, temperature changes, contaminants or other potential detrimental causes.

1.8 PROJECT CONDITIONS

- A. Environmental Requirements: Maintain temperature and humidity recommended by sealant manufacturer during and after installation.

1.9 SEQUENCING AND SCHEDULING

- A. Schedule application only after concrete and mortar has cured and the temperature is such that joints are most likely to be normal size.
- B. Coordinate the Work of this Section with other Work..
- C. Do not paint exposed polyurethane based sealants until they have completely completed off gazing.

PART 2 PRODUCTS

2.1 MATERIALS

- A. General
 - 1. Provide joint sealer systems compatible with contacting membranes, liquid waterproofing systems and pre-molded joint filler materials.
 - 2. Provide joint sealer systems designed not to stain exposed surfaces.
 - 3. Manufacturer's standard color range shall permit matching of joint sealer materials to color of contacting surfaces.
 - 4. Sealants and Caulks
 - a. Type 1: Two-component solvent free, moisture insensitive, flexible epoxy resin sealer, self-leveling.
 - 1) Color: Standard color, matching adjacent surface.
 - 2) Use: Exterior or interior, horizontal traffic joints.
 - 3) Manufacturers: Sika Model 51 SL, or equal
 - b. Type 2: FF TT-S-00227E, Type II, class A, gun-grade, with primer as required, multi-component low modulus epoxidized polyurethane sealant, with movement capability up to 50 percent in extension and compression.

- 1) Color: Manufacturer's standard, to be selected by Owner's Representative from full range of colors.
 - 2) Use: General exterior building sealing, cement plaster and similar conditions.
 - 3) Manufacturers: Tremco Model Dymeric Plus, Sika, Sonneborn or equal.
- c. Type 3: FF-TT-S-0023C, Type II, Class A, single component, gun grade nonsag, silicone sealant, with movement capability plus or minus 50 percent.
- 1) Color: As selected by Owner's Representative.
 - 2) Use: Exterior and interior building sealing, nonporous materials.
 - 3) Manufacturer: Dow Corning Model 795 Building Sealant, Tremco, Sika, Pecora, Sonneborn or equal
- d. Type 4: Single component, gun-grade, paintable, acrylic-latex, water-based sealant.
- 1) Color: As selected by Owner's Representative.
 - 2) Use: Interior building sealant.
 - 3) Manufacturer: Tremco Model Acrylic Latex 834, Sonneborn, Pecora or equal..
- e. Type 5: FF-TT-S-001543A, Single component, gun grade, silicone rubber sealant, mold and mildew resistant, with movement capability plus or minus 25 percent.
- 1) Color: White or to match adjacent surfaces.
 - 2) Use: Sanitary sealant.
 - 3) Manufacturers: Sonneborn Model Sonolastic Omniplus, Dow Corning, General Electric, Pecora or equal.
- f. Type 6: FF-TT-S-001657, Type I, butyl sealant, movement capability plus or minus 5 percent.
- 1) Color: Manufacturer's standard.
 - 2) Use: For bedding thresholds and in concealed or non-working surfaces.
 - 3) Manufacturers: Tremco, Pecora or equal

2.2 ACCESSORIES

- A. Primers, Sealers, Surface Conditioners and Solvents: Non-staining and non-injurious to exposed surfaces; solvents are to be residue-free, of types recommended by joint sealer manufacturer to suit application.
- B. Typical Back-Up Material, Fillers and Joint Backing
1. Non-staining, closed cell flexible neoprene or polyethylene, compatible with sealant material, of sizes and shapes recommended by sealant manufacturer for particular joint condition.
 2. Incompressible materials or acrylic, asphalt, oil or solvent containing materials will not be permitted.
 3. Bond Breaker: Pressure sensitive tape as recommended by joint sealer manufacturer to suit application.

- C. Cleaning Materials: Non-staining and not otherwise injurious to exposed surfaces.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces designated to receive sealants and caulks.
 - 1. Verify that surfaces are free from bituminous materials, form release agents, bond breakers, curing compounds, water repellents or other special surface treatments.
 - 2. Verify that joints and spaces requiring sealing are at correct or normal width.
 - 3. Verify that concrete or plaster surfaces have properly cured.
 - 4. Verify that aluminum surfaces are free of protective coating.
- B. Do not install sealants until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Protection: Protect elements surrounding the Work of this Section from damage or disfiguration. Use masking tape where required to prevent contact of sealant with adjoining surfaces.
- B. Surface Preparation
 - 1. Prepare and size joints in accordance with manufacturer's instructions.
 - 2. Clean out joints immediately before installing sealants, removing any loose materials and other foreign matter which might impair adhesion of sealant.
 - 3. Prime joint surfaces where recommended by joint sealant manufacturers. Apply primer to comply with joint sealant manufacturer's recommendations.
 - 4. Verify that joint backing and release tapes are compatible with sealant.
 - 5. Install packing where required to obtain manufacturer's recommended joint depths.

3.3 INSTALLATION

- A. Comply with the joint sealant manufacturer's printed installation instructions for specific materials, except where more stringent requirements apply. Comply with ASTM C962 for use of joint sealants.
- B. Backer Rod and Bond Breaker
 - 1. Measure joint dimensions and size materials to achieve required width and depth ratios.
 - 2. Install backer rod and bond breaker into joints so that proper depth-to-width ratio is maintained for the sealant. Do not allow voids between segments.

- C. Installation of Joint Sealants
 - 1. Mix components according to directions on the container label.
 - 2. Apply sealant within recommended temperature ranges. Consult manufacturer when sealant cannot be applied within recommended temperature ranges.
 - 3. Apply sealants so as to directly contact and fully wet joint substrates.
 - 4. Completely fill recesses provided for each joint configuration.
 - 5. Provide uniform, cross-sectional shapes and depths relative to joint widths, which allow optimum sealant movement capability.
 - 6. Immediately after sealant application and prior to the time skinning or curing begins, tool sealant joints to concave form smooth, uniform beads so as to eliminate air pockets, remove foreign embedded matter, ridges and sags.
 - 7. Do not use tooling agents which discolor sealants or adjacent surfaces or which are not approved by the sealant manufacturer.
 - 8. Remove masking tape immediately after tooling joints without disturbing joint seal.

3.4 ADJUSTING AND CLEANING

- A. Adjusting
 - 1. If damage or deterioration occurs, cut out and remove damaged or deteriorated sealers immediately and reseal joints with new materials to produce joint sealer installations with repaired areas indistinguishable from the original Work.
 - 2. Repair or replace defaced or disfigured finishes caused by Work of this Section.
- B. Cleaning
 - 1. Clean off excess sealants or sealant smears adjacent to joints as Work progresses by methods and with cleaning materials approved by the manufacturer.
 - 2. Clean adjacent soiled surfaces.

3.5 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating-substances or from damage resulting from construction operations of other causes so that they are without deterioration or damage at time of final completion.

END OF SECTION

SECTION 081100

HOLLOW METAL DOORS AND FRAMES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Section Includes: Requirements for:
 - 1. Provision of hollow metal non- fire-resistive rated doors and frames.
 - 2. Installation of hollow metal door and frame hardware.
- B. Related Sections
 - 1. Section 072100 - Building Insulation
 - 2. Section 079000 - Joint Sealants: Joint sealant systems.
 - 3. Section 087100 – Door Hardware
 - 4. Section 092500 - Gypsum Board Systems.
 - 5. Section 099000 – Paints and Coatings

1.2 REFERENCES

- A. ASTM - American Society for Testing and Materials
 - 1. A659 Standard Specification for Commercial Steel (CS), Sheet and Strip. Carbon (0.16 Maximum to 0.25 Maximum Percent) Hot-rolled.
 - 2. A653 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by Hot-Dip Process.
 - 3. A794 Standard Specification for Commercial Steel (CS), Sheet, Carbon 0.16 Percent Maximum to 0.25 Percent Maximum Cold Rolled.
 - 4. A924 Standard Specification for General Requirements for Sheet Steel, Metallic-Coated by the Hot-Dip Process.
- B. HMMA - Hollow Metal Manufacturers Association
 - 1. 802 Manufacturing of Hollow Metal Door and Frames.
 - 2. 810 Hollow Metal Doors.
 - 3. 820 Hollow Metal Frames.
 - 4. 830 Hardware Preparation and Location for Hollow Metal Doors and Frames.
 - 5. 840 Installation and Storage of Hollow Metal Doors and Frames.
 - 6. 860 Guide Specifications For Commercial Hollow Metal Doors and Frames.
- C. SDI - Steel Door Institute
 - 1. 108 Recommended Selection and Usage Guide for Standard Steel Doors.
 - 2. 112 Zinc Coated (Galvanized/Galvannealed) Standard Steel Doors and Frames.
 - 3. 117 Manufacturing Tolerances Standard Steel Doors and Frames.

1.3 SYSTEM DESCRIPTION

A. Performance Requirements

1. Hollow Metal Doors And Frames: Provide doors and frames that conform to requirements of HMMA 802, HMMA 810, HMMA 820, HMMA 830, HMMA 840, HMMA 861, and SDI 108.

1.4 SUBMITTALS

A. Product Data: Submit manufacture's literature completely describing products.

B. Shop Drawings: Show the following referenced to scheduled door mark and hardware group.

1. Location of door and frame type.
2. Details of fabrication, including core construction, glass lites, louvers, weatherstripping and factory finish for each door.
3. Cut-outs and reinforcements for hardware.
4. Methods of installation and anchorage to adjacent construction.

C. Manufacturer's Instructions: Submit manufacturer's installation instructions.

1.5 DELIVERY, STORAGE AND HANDLING

A. Packing and Shipping

1. Before delivery, identify type and size of each door in such a way that markings will not damage finish.
2. Preassemble door frames in shop and deliver to Project site with spreader bar at sill, or tie them in pairs to form box.
3. Protect doors and frames with resilient packaging sealed with heat shrunk plastic.

B. Storage and Protection

1. Examine doors and frames upon delivery. Promptly clean scratches and disfigurements and touch up with rust inhibitive primer.
2. Break seal on the Project site to permit ventilation and store in accordance with manufacturer's recommendations.
3. Store door and frames in dry area, under cover.
4. Place doors and frames on planking or blocking, minimum 4 inches off ground and minimum 2 inches off paving and slabs.
5. Do not stack material flat; store doors and frames in an upright position with heads uppermost.
6. Place no more than 5 single opening or 3 multi-opening frames in a group.
7. Provide, by means of wood strips, a minimum space of 1/4 inch between door and between frames to permit air circulation.
8. Do not permit packaging to become wet. Remove wet packaging immediately.

9. Remove packaging from doors prior to storing.

1.6 PROJECT CONDITIONS

- A. Field Measurements
 1. Verify that field measurements are as indicated on Shop Drawings.

1.7 SEQUENCING AND SCHEDULING

- A. Ensure timely delivery of reviewed hardware schedule and hardware templates such that no delay occurs in the Work.
- B. Coordinate the Work with door opening construction and door hardware installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Steelcraft, Curries, or equal.

2.2 MATERIALS

- A. Sheet Steel
 1. General: Face sheet material is to be of leveled steel, free of pitting or other surface defects, with no visible seams or joints on faces or vertical edges
 2. Polystyrene filled with lock and closer reinforcement, minimum 16 GA exterior doors and 18 GA interior doors.
 3. Cold Rolled: HMMA 860 ASTM A794.
 4. Hot Rolled: HMMA ASTM A659.
 5. Galvanized, Hot Rolled
 - a. SDI-112: ASTM A924 and A653, Class A60 for alloyed coatings.
 - b. HHMA 861: ASTM A653, Class A60 for alloyed coatings.
- B. Clips, Bolts, Screws and Rivets: Sized as recommended by the manufacturer.
- C. Primer: Rust-inhibitive metal primer capable of being baked and compatible with finish painting system specified in Section 09900 Painting.
- D. Touch-Up Paint: As recommended by manufacturer.
- E. Frame Accessories
 1. Steel Channel: Minimum 12 gauge.

2.3 MANUFACTURED UNITS

- A. Preparation
 - 1. Verify details; obtain copy of accepted hardware schedule, templates and other information.
 - 2. Verify size, design and fire-resistive rating of each opening.
 - 3. Coordinate details of construction with other Work supporting or adjoining frames and doors.

- B. Door Types
 - 1. General
 - a. Provide custom or stock doors complying with requirements of this Section.
 - b. Door Thickness: 1 3/4 inch.
 - 2. Flush Doors
 - a. Interior: SDI-108, Level II, Model 2 (heavy duty, seamless design, 16 gauge) or NAAMM HMMA 810 Type A and HMMA 861.
 - b. Exterior: SDI-108, Grade II, Model 2 (heavy duty, seamless design, 14 gauge) or NAAMM HMMA 810 Type A and HMMA 851.
 - 3. Manufacturing Tolerances: Conform to SDI 117 as minimum.
 - 4. Sheet Steel Usage
 - a. Cold And Hot Rolled Steel: Interior frames.
 - b. Hot Rolled Galvanized: Exterior frames and doors.

- C. Door Frames
 - 1. General
 - a. Custom or stock, integrally trimmed, double rabbeted, one-piece arc welded construction.
 - b. Make welds continuous and grind smooth.
 - c. Make profiles press brake formed as detailed, corners mitered and tight, stops butted.
 - d. Knock-down frames are not permitted.
 - 2. Interior: SDI 108 for door type specified and NAAMM HMMA 861, fully welded frames, sizes and shapes as indicated.
 - 3. Exterior: SDI 108 for door type specified and NAAMM HMMA 861, fully welded frames, sizes and shapes as indicated on the Drawings.
 - 4. Gauges
 - a. Up to 36 inches wide: 16 gauge.
 - b. Greater than 36 inches wide: 14 gauge.
 - 5. All frames at CMU walls are to grouted per details. Full grout is required. Door frames in framed walls are not to be grouted.

2.4 FABRICATION

A. Doors

1. Door Interior

- a. Reinforce inside of doors with continuous vertical 20 gauge steel channel shaped sections or interlocking z shaped steel sections spanning full thickness of interior space between door faces.
- b. Space vertical reinforcing 6 inches on center and extend full door height.
- c. Spot weld at 4 inches on center to both outer sheets OR continuous truss form inner core of 28 gauge sheet metal reinforcing may be provided in lieu of above.
- d. Reinforcement
 - 1) Door Styles: Reinforce styles of doors with rigid tubular frame. Form tubular frame with 16 gauge steel, continuously welded to outer sheets.
 - 2) Door Top And Bottom Rails: Reinforce rails of doors with continuous recessed 16 gauge horizontal steel channel welded continuously to the outer sheets. Provide hole in bottom channel of doors for escape of trapped moisture.
- e. Cores
 - 1) Interior: Provide sound insulation filler of fiberboard or steel grid or honeycomb construction.
 - 2) Exterior: Provide insulated cores where exterior doors open into conditioned spaces.
 - 3) Louvered Doors: Same as above, with galvanized steel, slat louver, as indicated on the Drawings.
- f. Edges: Bevel striking edge 1/8 inch in 2 inches.
- g. Weatherproofing: Provide doors having closed tops and bottoms as follows:
 - 1) Typical: Close with continuous recessed steel channel of minimum 16-gauge, extending full width of door and spot welded to both faces.
 - 2) At Exterior Doors: Provide additional flush closing channels welded to make tops and bottoms waterproof and provided with weep holes for escape of moisture.
- h. Clearances: Fabricate doors in manner to comply with following clearance requirements:
 - 1) Along Top Door: 1/8 inch.
 - 2) Along Hinge and Latch Jambs: 1/8 inch.
 - 3) Along Meeting Edges of Pairs of Doors: 1/8 inch.
 - 4) At Bottom Edge of Single Swing Doors: 3/8 inch.
 - 5) At Bottom Edge of Pairs of Doors: 1/4 inch.
- i. Hardware Reinforcement
 - 1) Mortise, reinforce, drill and tap at the factory for fully templated hardware only, in accord with the hardware schedule and templates provided under Section 08700 Finish Hardware.

- 2) Where surface mounted hardware is required, provide reinforcing plates only with drilling and tapping to be done by those installing hardware.
 - 3) Minimum gages for hardware reinforcing plates are to be as follows:
 - a) Hinge Reinforcement: Steel plate 3/16 inch thick by 1-1/2 inches wide by 6 inches longer than hinge; secured by not less than 6 spot welds.
 - b) Surface Mounted Closers: 12 gauge sheet steel, secured with not less than 6 spot welds.
 - c) Lock And Flush Bolt Reinforcements: 14 gauge sheet steel, secured with not less than 2 spot welds.
 - d) Surface Panic Devices Reinforcement: 14 gauge sheet steel except where through bolts are specified, secured with not less than 2 spot welds.
 - e) Other Surface Mounted Hardware Reinforcement: 16 gauge sheet steel.
2. Frames
- a. Construction
 - 1) Custom or stock, integrally trimmed, double rabbeted, one piece arc welded construction.
 - 2) Make welds continuous and grind smooth.
 - 3) Make profiles press brake formed as detailed on the Drawings, corners mitered and tight. Stops butted. Knock-down frames are not permitted.
 - 4) Finish: Exterior frames are to be galvanized.
 - b. Hardware Reinforcement
 - 1) Mortise, reinforce, drill and tap at the factory for fully templated mortised hardware only, in accord with hardware schedule and templates provided under the Section 08710 – Finish Hardware.
 - 2) Where surface-mounted hardware is to be applied, frames are to have reinforcing plates only with drilling and tapping to be done by those installing hardware.
 - 3) Minimum gages for hardware reinforcing plates shall be as follows:
 - a) Hinge: 7 gauge.
 - b) Strike: 14 gauge.
 - c) Closers: 12 gauge.
 - d) Other Surfaces Mounted Items: 14 gauge.
 - c. Anchors: Provide suitable adjustable type anchors for each respective wall condition.
 - 1) Frames up To 7 feet 6 inches high: 4 anchors.
 - 2) Frames 7 feet 6 inches to 8 feet high: 5 anchors.
 - 3) Frames 8 Feet High: 5 anchors plus one additional for each 2 feet or fraction thereof over 8 feet.
 - d. Spreaders: Furnish welded frames with removable spreader bar at sill.

- e. Silencers: Provide 3 for each single door and 2 at heads of pairs of doors on non weather stripped or gasketed frames.

2.5 FINISHES

- A. Factory Finishing
 - 1. Interior
 - a. Thoroughly clean surfaces of oil, grease and other impurities, then chemically etch.
 - b. Fill irregularities and sand to smooth finish surface.
 - c. Apply 1 coat of manufacturer's standard rust inhibitive baked on primer.
 - d. Exterior: After fabrication, touch-up abraded galvanizing, chemically etch and apply 1 baked-on prime coat.
 - 2. Finish Painting: As specified in Section 09900.

PART 3 EXECUTION

3.1 INSPECTION

- A. Examine accepted hardware schedules and verify proper coordination of hardware, doors and frames.
- B. Examine opening locations and verify the following:
 - 1. Correctness of dimensions, backing or support conditions.
 - 2. Absence of defects that would adversely affect frame or door installation.
 - 3. Check door frames for size, swing, squareness, alignment, twist and plumbness.
- C. Do not start Work until unsatisfactory conditions are corrected.

3.2 PREPARATION

- A. Protection: Protect adjacent surfaces from damage from Work of this Section.

3.3 INSTALLATION

- A. General: Install frames and doors in accordance with reviewed Shop Drawings and manufacturer's instruction.
- B. Frames
 - 1. Set frames accurately in position, plumb, aligned and attached securely to structure.
 - 2. Set frames before removing spreader bars.
 - 3. Install roll formed steel reinforcement channels between 2 abutting frames. Anchor to structure and floor.

4. At head of frames over 48 inches wide: Reinforce head with steel channel: minimum 12 gauge.
- C. Doors: Install at correct openings; insure smooth swing and proper closure with frame.
- D. Hardware: Install finish hardware for doors in accordance with Section 08710.
- E. Tolerances
 1. Manufacturing and Installation Tolerances: Conform to SDI 117 as minimum.

3.4 ADJUSTING

- A. Prime Coat Touch-Up: Immediately after installation, sand smooth and touch-up rust areas and areas where prime has been damaged with prime touch-up paint.
- B. Make adjustments as required for correct function and smooth operation and balanced door movement.

3.5 PROTECTION

- A. Protect doors and frames from damage to surface or profile.

END OF SECTION

SECTION 08 35 13

FOLDING GLASS DOORS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes furnishing and installing a floor track supported, sliding-folding, thermally broken, aluminum-framed glass panel system that includes:
 - 1. Aluminum frame
 - 2. Threshold
 - 3. Panels
 - 4. Sliding-folding and locking hardware
 - 5. Weather stripping
 - 6. Glass and glazing
 - 7. Insect screen (optional)
 - 8. Accessories as required for a complete working installation.
- B. Related Documents and Sections: Contractor to examine Contract Documents for requirements that directly affect or are affected by Work of this Section. A list of those Documents and Sections include, but is not limited to, the following:
 - 1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 General Requirements, Specification Sections, apply to this Section.
 - 2. Section 06 10 00, Rough Carpentry.
 - 3. Section 09 10 00, Metal Support Systems.

1.02 REFERENCES

- A. Reference Standards in accordance with Division 01 and current editions from the following:
 - 1. AAMA. American Architectural Manufacturers Association; www.aamanet.org
 - a. AAMA 502, Voluntary Specification for Field Testing of Newly Installed Fenestration Products
 - b. AAMA 520, Voluntary Specification for Rating the Severe Wind-Driven Rain Resistance of Windows, Doors and Unit Skylights
 - c. AAMA 611, Voluntary Specification for Anodized Architectural Aluminum
 - d. AAMA 920, Operation / Cycling Performance
 - e. AAMA 1304, Voluntary Specification for Forced Entry Resistance of Side-Hinged Door Systems
 - f. AAMA 2604, Voluntary Specifications, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels
 - g. AAMA 2605, Voluntary Specifications, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels
 - h. AAMA/WDMA/CSA 101/I.S.2/A440, NAFS, North American Fenestration Standard - Specification for Windows, Doors and Skylights
 - 2. ANSI. American National Standards Institute; www.ansi.org
 - a. ANSI Z97.1, Safety Performance Specifications and Methods of Test for Safety Glazing

Material Used in Buildings

3. ASTM. ASTM International; www.astm.org
 - a. ASTM C1036, Standard Specification for Flat Glass
 - b. ASTM C1048, Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass
 - c. ASTM E283, Test Method for Rate of Air Leakage through Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.
 - d. ASTM E330, Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.
 - e. ASTM E331 Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference
 - f. ASTM E413, Classification for Rating Sound Insulation
 - g. ASTM E547, Test Method for Water Penetration of Exterior Windows, Curtain Walls, and Doors by Cyclic Static Air Pressure Differential.
 - h. ASTM E1332, Standard Classification for Rating Outdoor-Indoor Sound Attenuation
 - i. ASTM E2268, Standard Test Method for Water Penetration of Exterior Windows, Skylights, and Doors by Rapid Pulsed Air Pressure Difference
 - j. ASTM F842, Standard Test Methods for Measuring the Forced Entry Resistance of Sliding Door Assemblies
4. CPSC. Consumer Product Safety Commission; www.cpsc.gov
 - a. CPSC 16CFR-1201, Safety Standard for Architectural Glazing Materials
5. CSA Group (Canadian Standards Association); www.csagroup.org/global/en/home
 - a. CSA A440S1 - The Canadian supplement to North American (NAFS) standards
6. DIN. "Deutsches Institut für Normung" (German institute for standardization); www.en-standard.eu/din-standards
 - a. DIN 52210-3, Testing of acoustics in buildings - Airborne and impact sound insulation - Laboratory measurements of sound insulation of building elements and field measurements between rooms
 - b. DIN 52210-4, Tests in Building Acoustics - Airborne and Impact Sound
 - c. DIN EN 1191, Windows and doors - Resistance to repeated opening and closing - Test method; German version EN 1191:2000
 - d. DIN EN ISO 12400, Windows and pedestrian doors - Mechanical durability - Requirements and classification
7. Energy Star, U.S. Environmental Protection Agency (EPA) Program; www.energystar.gov
8. FL. Florida Building Commission - Product Approval;
https://floridabuilding.org/pr/pr_app_srch.aspx
9. NFRC. National Fenestration Rating Council; www.nfrc.org
 - a. NFRC 100, Procedure for Determining Fenestration Product U-factors
 - b. NFRC 200, Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence
 - c. NFRC 400, Procedure for Determining Fenestration Product Air Leakage
 - d. NFRC 500, Procedure for Determining Fenestration Product Condensation Resistance Rating Values

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate Folding Glass Storefront system and framing R.O.
 - B. Pre-installation Meetings: See Section 01 33 00.
- 1.04 SUBMITTALS
- A. For Contractor submittal procedures see Section 01 33 00.
 - B. Product Data: Submit manufacturer's printed product literature for each Folding Glass Storefront system to be incorporated into the Work. Show performance test results and details of construction relative to materials, dimensions of individual components, profiles and colors.
 - C. Product Drawings: Indicate Folding Glass Storefront system component sizes, dimensions and framing R.O., configuration, swing panels, direction of swing, stacking layout, typical head jamb, side jambs and sill details, type of glazing material, handle height and field measurements.
 - D. Installation, Operation and Maintenance Data: Submit Owner's Manual from manufacturer. Identify with project name, location and completion date, and type and size of unit installed.
- 1.05 QUALITY ASSURANCE
- A. Manufacturer Qualifications: Manufacturer capable of providing complete, precision built, engineered, pre-fitted units with a minimum twenty-five (25) years' experience in the sale of folding-sliding door systems for large openings in the North American market.
 - B. Installer Qualifications: Installer experienced in the installation of manufacturer's products or other similar products for large openings. Installer to provide reference list of at least three (3) projects of similar scale and complexity successfully completed in the last three (3) years.
 - 1. Installer to be trained and certified by manufacturer.
 - C. Single Source Responsibility: Furnish Folding Glass Storefront system materials from one manufacturer for entire Project.
- 1.06 DELIVERY, STORAGE, AND HANDLING
- A. Comply with manufacturer's instructions and recommendations, Section 01 60 00 requirements, and as follows:
 - 1. Deliver materials to job site in sealed, unopened cartons or crates.
 - a. Upon receipt, inspect the shipment to ensure it is complete, in good condition and meets project requirements.
 - 2. Store material under cover in a clean and dry location, protecting units against weather and defacement or damage from construction activities, especially to the edges of panels.
- 1.07 FIELD CONDITIONS
- A. Field Measurements: Contractor to field verify dimensions of rough openings (R.O.) [And threshold depressions to receive sill.] Mark field measurements on product drawing submittal.
- 1.08 WARRANTY
- A. Manufacturer Warranty: Provide Folding Glass Storefront system manufacturer's standard limited warranty as per manufacturer's published warranty document in force at time of purchase, subject to change, against defects in materials and workmanship.
 - 1. Warranty Period beginning with the earliest of 120 days from Date of Delivery or Date of Substantial Completion:
 - a. Rollers and Glass Seal Failure: Ten (10) years
 - b. All Other Components Except Screens: Ten (10) years
 - 1). Exception: Five (5) years if NOT installed by manufacturer's certified trained installer.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Basis-of-Design Product by Manufacturer: **NanaWall SL70 by NANA WALL SYSTEMS, INC.**
(www.nanawall.com)

NANA WALL SYSTEMS, INC.
100 Meadow Creek Drive, Corte Madera, CA 94925
Toll Free (800) 873-5673
Telephone: (415) 383-3148
Fax: (415) 383-0312
Email: info@nanawall.com

1. Substitution Procedures: See Section 01 60 00.1

2.02 PERFORMANCE / DESIGN CRITERIA

- A. Performance Criteria (Lab Tested): **Standard Flush Sill - Inward Opening**

- B. Items below are common to all sill types, except as noted.

1. Glass Acoustical Performance (DIN 52210-3,4): **Rw (STC)**
2. Sizes and Configurations: As indicated by the Drawings for selected number and size of panels, location of swing panels, and location of tracks and stacking.
3. Unit Operation: Sliding and folding hardware with top and bottom tracks;
4. Panel Configuration:
 - a. [Straight]
5. Stack Storage Configuration:
 - a. Outswing
6. Mounting Type: **Floor track supported**
7. Panel Type: **Hinged**
 - a. Primary swing panel of paired swing panels, looking from inside, to be on the **left**
8. Panel Pairing Configuration: **See drawings.**

2.03 MATERIALS

- A. Monumental Thermally Broken Aluminum Framed Folding Glass Storefront Description: Floor track supported system designed for angle changes, segmented curves. Manufacturer's standard or post reinforced frame and panel profiles, with top track, side jambs and panels with dimensions as shown on Drawings.

1. Panels and Frames

- a. Panels

- 1). Single lite.
- 2). Panel Size (W x H): As indicated on drawings.
- 3). Rail Depth: **2-3/4 inch (70 mm)**
- 4). Top Rail and Stile Width: **2-1/4 inch (57 mm)**
- 5). Bottom Rail Width:
 - a). **2-1/4 inch (57 mm)**

- b. Frame:

- 1). Matching top track and side jambs
 - a). Top Track and Side Jambs Width: 2-9/16 inch (65 mm) .
 - 2). Sill Type:
 - a). Flush sill (thermally broken)
 - 3). Sill Finish: Aluminum with
 - a). Clear anodized finish.
 - 4). For ADA Compliance: Provide gasket to cover the channel in the sill at swing doors.
2. Aluminum Extrusion: AIMgSi0.5 alloy, 6063-T5 (F-22 - European standard)
 - a. Thickness: 0.078 inch (2.0 mm) nominal
 - b. Thermal Break: 3/4 to 15/16 inch (20 to 24 mm) wide polyamide plastic reinforced with glass fibers. Thinner or poured and de-bridged type thermal breaks not acceptable.
 3. Panel and Frame Aluminum Finish: Inside and Outside;
 - a. [Same (one-color)]
 - b. [Different (two-tone)]
 - c. Anodized (AAMA 611):
 - 1). [Clear]
- B. Glass and Glazing:
1. Safety Glazing: In compliance with ASTM C1036, ASTM C1048, ANSI Z97.1 and CPSC 16CFR 120
 - a. Glass Spacers: Manufacturer's standard
 - 1). [gray finish with capillary tubes]
 - b. IGU Surface:
 - 1). Clear]
- C. Locking Hardware and Handles:
1. Main Entry Panel(s) for Models WITH a [Pair of] Swing Panel(s): Provide manufacturer's standard lever handles on the inside and outside, and a lockset with a lockable latch, and multi-point locking with a dead bolt and rods at the top and bottom on primary panel.
 - a. Rods to be concealed and not edge mounted.
 - b. After turn of key or thumb-turn, depression of handles withdraws latch.
 - c. Lifting of handles engages rods and turn of key or thumb turn engages deadbolt and operates lock.
 - d. Secondary Swing Panel: Provide matching dummy lever handles on both sides and concealed flush bolts that operate the rods at the top and the bottom for the secondary swing panel.]
 - e. Lever Handle - Finish:
 - 1). [Satin nickel solid brass.]
 - f. Locking:
 - 1). Standard profile cylinder
- D. Sliding-Folding Hardware: Provide manufacturer's standard combination sliding and folding hardware with top and bottom tracks and threshold. All running carriages to be with sealed, self-lubrication, ball bearing multi-rollers. Surface mounted hinges and running carriages NOT

acceptable. Weight of panels borne by the bottom of the guide channel in the sill is NOT acceptable.

1. Lower Running Carriage Carrying Capacity: 440 lbs (200 kgs)
2. Upper guide carriage and lower running carriage provided with four vertical stainless-steel wheels and two horizontal polyamide wheels.
3. Vertical wheels to ride on top of stainless-steel guide track covers over the full length of the sill track and lie above the water run-off level.
4. Wheels riding below water run-off level and wheels riding on aluminum surfaces are NOT acceptable.
5. Swing Panel Hinges:
 - a. Zinc die cast with finish closest match to finish of frame and panels and stainless-steel security hinge pins with set-screws.
6. Adjustment: Provide folding-sliding hardware capable of compensation and adjustments without needing to remove panels from tracks, in width, 1/16 inch (1.5 mm) per hinge and in height, 5/64 inch (2 mm) up and down.

E. Weather stripping: Manufacturer's double layer EPDM between panels, EPDM gasket and Q-Ion gasket, or brush seal between panel and frame, or brush seals with a two-layer fiberglass reinforced polyamide fin attached at both inner and outer edge of bottom of door panels with a recessed sill or on frame for sealing between panels and between panel and frame.

F. Fasteners: Tapered pins or stainless-steel screws for connecting frame components.

2.04 FABRICATION

A. Folding Glass Wall: Extruded aluminum frame and panel profiles, corner connectors and hinges, sliding and folding hardware, locking hardware and handles, glass and glazing and weather stripping.

1. Each unit factory pre-assembled and shipped with complete system components and installation instructions.
2. Exposed work to be carefully matched to produce continuity of line and design with all joints.
3. No raw edges visible at joints.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examination and Acceptance of Conditions per Section 01 70 00 and as follows:

1. Carefully examine rough openings with Installer present, for compliance with requirements affecting Work performance.
 - a. Examine surfaces of openings and verify dimensions; verify rough openings are level, plumb, and square with no unevenness, bowing, or bumps on the floor; and other conditions as required by the manufacturer for readiness to receive Work.
 - b. Verify structural integrity of the header for deflection with live and dead loads limited to the lesser of L/720 of the span or 1/4 inch (6 mm). Provide structural support for lateral loads, and both wind load and eccentric load when the panels are stacked open.
2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. General: Install Folding Glass Storefront system in accordance with the Drawings, approved submittals, manufacturer's recommendations and installation instructions, and as follows:

1. Properly flash, waterproof and seal around opening perimeter.

2. Securely attach anchorage devices to rigidly fit frame in place, level, straight, plumb and square. Install frame in proper elevation, plane and location, and in proper alignment with other work.
3. When lower track is designed to drain, provide connections to allow for drainage.
4. Install panels, handles, lockset, screens and other accessories in accordance with manufacturer's recommendations and instructions.

3.03 FIELD QUALITY CONTROL

- A. Field Tests and Inspections per Section 01 40 00 of the following:
 1. Verify the Folding Glass Storefront system operates and functions properly. Adjust hardware for proper operation.
- B. Non-Conforming Work: Repair or replace non-conforming work as directed by the Architect; see General and Supplementary Conditions, and Division 01, General Requirements.

3.04 CLEANING AND PROTECTION

- A. Keep units closed and protect Folding Glass Storefront installation against damage from construction activities.
- B. Remove protective coatings and use manufacturer recommended methods to clean exposed surfaces.

END OF SECTION

SECTION 084100

CURTAIN WALL SYSTEM

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Section Includes: Curtain wall systems, including perimeter trims, stools, accessories, shims and anchors, and perimeter sealing of curtain wall framing, including stained glass support frame.
- B. Related Sections:
 - 1. Section 087100 Hardware
 - 2. Section 088000 Glass and Glazing

1.02 SYSTEM DESCRIPTION

- A. Curtain Wall System Performance Requirements:
 - 1. Wind loads: Provide Curtain Wall system for local wind conditions
 - 2. Air Infiltration: The test specimen shall be tested in accordance with ASTM E 283.
 - 3. Water Resistance, (static): The test specimen shall be tested in accordance with ASTM E 331.
 - 4. Water Resistance, (dynamic): The test specimen shall be tested in accordance with AAMA 501.1.
 - 5. Uniform Load: A static air design load of 40 psf (1915 Pa) shall be applied in the positive and negative direction in accordance with ASTM E 330.
 - 6. Seismic: tested to AAMA 501.4
 - 7. Incidental Water Management Option: Head member shall be capable of directing condensation within the spandrel cavity to the exterior.
 - 8. Thermal Transmittance (U-factor): - AAMA Specification 1503

1.03 SUBMITTALS

- A. DSA deferred approval is required and it is the Contractor's responsibility to prepare drawings and calculations, properly stamped submitted to DSA and to make any corrections to those drawings or calculation required to obtain DSA approval. Prepare, review, approve, and submit specified submittals in accordance with "Conditions of the Contract" and Submittals Sections. Product data, shop drawings, samples, and similar submittals are defined in "Conditions of the Contract."
- B. Quality Assurance/Control Submittals:
 - 1. Test Reports: Submit certified test reports showing compliance with specified performance characteristics.

- C. Provide structural calculations for the curtain wall system; calculations shall be furnished by a professional engineer registered in California.

1.04 WARRANTY

- A. Project Warranty: Refer to “Conditions of the Contract” for project warranty provisions.
- B. Manufacturer’s Product Warranty: Submit, for Owner’s acceptance, manufacturer’s warranty for curtain wall system as follows:
 - 1. Warranty Period: Two (2) years from Date of Substantial Completion of the project provided however that the Limited Warranty shall begin in no event later than six months from date of shipment by Kawneer.

1.05 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Installer Qualifications: Installer experienced (as determined by contractor) to perform work of this section who has specialized in the installation of work similar to that required for this project and who is acceptable to product manufacturer.
 - 2. Manufacturer Qualifications: Manufacturer capable of providing structural calculations, applicable independent product test reports, installation instructions, a review of the application method, customer approval and periodic field service representation during construction.
- B. Pre-Installation Meetings: Conduct pre-installation meeting to verify project requirements, substrate conditions, manufacturer’s installation instructions, and manufacturer’s warranty requirements.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Ordering: Comply with manufacturer's ordering instructions and lead time requirements to avoid construction delays.
- B. Packing, Shipping, Handling, and Unloading: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- C. Storage and Protection: Store materials protected from exposure to harmful weather conditions. Handle curtain wall material and components to avoid damage. Protect curtain wall material against damage from elements, construction activities, and other hazards before, during and after curtain wall installation.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

- A. Kawneer Company, Inc., or equal.
- B. Proprietary Product(s)/System(s): Kawneer Aluminum Curtain Wall Series: 1600 Wall System®

2.02 FACTORY FINISHING

- A. Exposed Aluminum: Thermo-setting acrylic, Color to be determined by Architect.
- B. Door Hardware: US26D, Satin Chromium.

2.03 MATERIALS

- A. Aluminum (Curtain Wall and Components):
 - 1. Material Standard: Extruded Aluminum, ASTM B 221, or 6063-T6 alloy and temper.
 - 2. Member Wall Thickness: Each framing member shall have a wall thickness sufficient to meet the specified structural requirements.
 - 3. Tolerances: Reference to tolerances for wall thickness and other cross-sectional dimensions of curtain wall members are nominal and in compliance with AA Aluminum Standards and Data.

2.04 ACCESSORIES

- A. Fasteners: Where exposed, shall be Stainless Steel.
- B. Gaskets: Glazing gaskets shall comply with ASTM C 864 and be extruded of a silicone compatible EPDM rubber that provides for silicone adhesion.
- C. Perimeter Anchors: Aluminum. When steel anchors are used, provide insulation between steel material and aluminum material to prevent galvanic action.
- D. Thermal Barrier: Vertical and horizontal covers shall utilize rigid PVC thermal isolator clips.
- E. Sunshade at south and west sides of building, using manufacturer's standards. Provide "Outrigger SunShade" per Kawneer or equal in an airfoil shape.

2.05 RELATED MATERIALS

- A. Sealants: Refer to Joint Treatment (Sealants) Section.
- B. Glass: Refer to Glass and Glazing Section.

2.06 FABRICATION

A. General:

1. Fabricate components per manufacturer's installation instructions and with minimum clearances and shim spacing around perimeter of assembly, yet enabling installation and dynamic movement of perimeter seal.
2. Accurately fit and secure joints and corners. Make joints flush, hairline and weatherproof.
3. Prepare components to receive anchor devices. Fabricate anchors.
4. Arrange fasteners and attachments to conceal from view.

2.07 FINISHES

A. Shop Finishing:

1. Kawneer Permanodic® AA-M12C22A44, AAMA 611, Architectural Class Building Enclosure System: When aluminum curtain wall are part of a building enclosure system, including entrances, entrance hardware, windows, storefront framing and related products, provide building enclosure system products from a single source manufacturer.

PART 3 – EXECUTION

3.01 Examination

- #### A. Site Verification of Conditions: Verify substrate conditions (which have been previously installed under other sections) are acceptable for product installation in accordance with manufacturer's instructions. Verify openings are sized to receive curtain wall system and sill plate is level in accordance with manufacturer's acceptable tolerances.
1. Field Measurements: Verify actual measurements/openings by field measurements before fabrication; show recorded measurements on shop drawings. Coordinate field measurements, fabrication schedule with construction progress to avoid construction delays.

3.02 Installation

- #### A. General: Install curtain wall systems plumb, level, and true to line, without warp or rack of frames with manufacturer's prescribed tolerances and installation instructions. Provide support and anchor in place.
1. Dissimilar Materials: Provide separation of aluminum materials from sources of corrosion or electrolytic action contact points.
 2. Weather-tight Construction: Install sill members and other members in a bed of sealant or with joint filler or gaskets, to provide weather-tight construction. Coordinate installation with wall flashings and other components of construction.

- a. Refer to Joint Treatments (Sealants) Section for installation requirements.
- B. Related Products Installation Requirements:
 1. Sealants (Perimeter): Refer to Joint Treatment (Sealants) Section.
 2. Glass: Refer to Glass and Glazing Section.

3.03 Field Quality Control

A. Field Tests: Architect shall select curtain wall units to be tested as soon as a representative portion of the project has been installed, glazed, perimeter caulked and cured. Conduct tests for air infiltration and water penetration with manufacturer's representative present. Tests not meeting specified performance requirements and units having deficiencies shall be corrected as part of the contract amount.

1. Testing: Testing shall be performed per AAMA 503 by a qualified independent testing agency.
 - a. Air Infiltration Tests: Conduct tests in accordance with ASTM E 783. Allowable air infiltration shall not exceed 1.5 times the amount indicated in the performance requirements or 0.09 cfm/ft², which ever is greater.
 - b. Water Infiltration Tests: Conduct tests in accordance with ASTM E 1105. No uncontrolled water leakage is permitted when tested at a static test pressure of two-thirds the specified water penetration pressure but not less than 8 psf (383 Pa).
- B. Manufacturer's Field Services: Upon Owner's written request, provide periodic site visit by manufacturer's field service representative.

3.04 Protection and Cleaning

- A. Protection: Protect installed product's finish surfaces from damage during construction. Protect aluminum curtain wall system from damage from grinding and polishing compounds, plaster, lime, acid, cement, or other harmful contaminants.
- B. Remove and dispose of all stickers (rubber or paper), tape, tape residue, and caulking residue on curtain wall members and glazing.
- C. Cleaning: Repair or replace damaged installed products. Clean installed products in accordance with manufacturer's instructions prior to owner's acceptance and remove construction debris from project site and legally dispose of debris.

END OF SECTION

SECTION 084133

ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 Related Documents

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

1.2 Summary

- A. This Section includes Aluminum Entrances, glass and glazing, and door hardware and components.
- B. Related Sections:
 - 1. 079000 "Joint Sealants"
 - 2. 084133 "Curtain Wall Systems"
 - 3. 087100 "Door Hardware"
 - 4. 088000 "Glass and Glazing"

1.3 Definitions

- A. Definitions: For fenestration industry standard terminology and definitions refer to American Architectural Manufacturers Association (AAMA) – AAMA Glossary (AAMA AG).

1.4 Performance Requirements

- A. General Performance: Aluminum-framed entrance system shall withstand the effects of the following performance requirements without failure due to defective manufacture, fabrication, installation, or other defects in construction.
- B. Aluminum Framed Entrance Performance Requirements:
 - 1. Wind loads: Provide entrance system; include anchorage, capable of withstanding wind load design pressures per local building department and CBC 2016 requirements.

2. Air Infiltration: For single acting offset pivot or butt hung entrances in the closed and locked position, the test specimen shall be tested in accordance with ASTM E 283 at a pressure differential of 1.57 psf (75 PA) for single and pairs of doors. A single 3'0" x 7'0" (915 mm x 2134 mm) entrance door and frame shall not exceed 1.0 cfm/ft². A pair of 6'0" x 7'0" (1830 mm x 2134 mm) entrance doors and frame shall not exceed 1.0 cfm/ft².
3. Structural Performance: Corner strength shall be tested per the Kawneer dual moment load test procedure and certified by an independent testing laboratory to ensure weld compliance and corner integrity [Testing procedure and certified test results available upon request].

1.5 Submittals

- A. Product Data: Include construction details, material descriptions, and fabrication methods, dimensions of individual components and profiles, hardware, finishes, and installation instructions for each type of aluminum-framed entrance door indicated.
- B. Shop Drawings: Include plans, elevations, sections, details, hardware, and attachments to other work, operational clearances and installation details.
- C. Samples for Initial Selection: For units with factory-applied color finishes including samples of hardware and accessories involving color selection.
- D. Samples for Verification: For aluminum-framed entrance door and components required.
- E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency for each type of aluminum-framed entrance doors.
- F. Fabrication Sample: Corner sample consisting of a door stile and rail, of full-size components and showing details of the following:
 1. Joinery, including welds.
 2. Glazing.
- G. Other Action Submittals:
 1. Entrance Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams. Coordinate final entrance door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.

1.6 Quality Assurance

- A. Installer Qualifications: An installer which has had successful experience with installation of the same or similar units required for the project and other projects of similar size and scope.
- B. Manufacturer Qualifications: A manufacturer capable of fabricating aluminum-framed entrance doors and storefronts that meet or exceed performance requirements indicated and of documenting this performance by inclusion of test reports, and calculations.

- C. Source Limitations: Obtain aluminum-framed entrance door through one source from a single manufacturer.
- D. Product Options: Drawings indicate size, profiles, and dimensional requirements of aluminum-framed entrance doors and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements". Do not modify size and dimensional requirements.
 - 1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.
- E. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Build mockup for type(s) of swing entrance door(s) indicated, in location(s) shown on Drawings.
- F. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination".

1.7 Project Conditions

- A. Field Measurements: Verify actual dimensions of aluminum-framed entrance door openings by field measurements before fabrication and indicate field measurements on Shop Drawings.

1.8 Warranty

- A. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty.
 - 1. Warranty Period: Two (2) years from Date of Substantial Completion of the project provided however that the Limited Warranty shall begin in no event later than six months from date of shipment by manufacturer.

PART 2 - PRODUCTS

2.1 Manufacturers

A. Basis-of-Design Product:

1. Kawneer Company Inc., or approved equal.
2. The door stile and rail face dimensions of the 350 entrance door.
3. Major portions of the door members to be 0.125" (3.2) nominal in thickness and glazing molding to be 0.05" (1.3) thick.
4. Glazing gaskets shall be either EPDM elastomeric extrusions or a thermoplastic elastomer.
5. Provide adjustable glass jacks to help center the glass in the door opening.

2.2 Materials

- A. Aluminum Extrusions: Alloy and temper recommended by aluminum-framed entrance door manufacturer for strength, corrosion resistance, and application of required finish and not less than 0.090" (2.3 mm) wall thickness at any location for the main frame and door leaf members.
- B. Fasteners: Aluminum, nonmagnetic stainless steel or other materials to be non-corrosive and compatible with aluminum-framed entrance door members, trim hardware, anchors, and other components.
- C. Anchors, Clips, and Accessories: Aluminum, nonmagnetic stainless steel, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions or other suitable zinc coating; provide sufficient strength to withstand design pressure indicated.
- D. Reinforcing Members: Aluminum, nonmagnetic stainless steel, or nickel/chrome-plated steel complying with ASTM B 456 for Type SC 3 severe service conditions, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions or other suitable zinc coating; provide sufficient strength to withstand design pressure indicated.
 1. Weather Seals: Provide weather stripping with integral barrier fin or fins of semi-rigid, polypropylene sheet or polypropylene-coated material. Comply with AAMA 701/702.

2.3 Storefront Framing System

A. Storefront Entrance Framing:

1. Trifab™ VG 450/451/451T or Trifab™ 451UT.
2. Thermally Broken entrance Framing - Kawneer IsoLock™ Thermal Break with a 1/4" (6.4 mm) separation consisting of a two-part chemically curing, high-density polyurethane, which is mechanically and adhesively joined to aluminum storefront sections.
 - a. Thermal Break shall be designed in accordance with AAMA TIR-A8 and tested in accordance with AAMA 505.

- B. Non-Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.
- C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials. Where exposed shall be stainless steel.
- D. Perimeter Anchors: When steel anchors are used, provide insulation between steel material and aluminum material to prevent galvanic action.
- E. Packing, Shipping, Handling and Unloading: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- F. Storage and Protection: Store materials protected from exposure to harmful weather conditions. Handle storefront material and components to avoid damage. Protect storefront material against damage from elements, construction activities, and other hazards before, during and after storefront installation.

2.4 Glazing

- A. Glazing: As specified in Division 08 Section "Glazing".
- B. Glazing Gaskets: Manufacturer's standard compression types; replaceable, extruded EPDM rubber.
- C. Spacers and Setting Blocks: Manufacturer's standard elastomeric type.

2.5 Hardware

- A. General: Provide manufacturer's standard hardware fabricated from aluminum, stainless steel, or other corrosion-resistant material compatible with aluminum; designed to smoothly operate, tightly close, and securely lock aluminum-framed entrance doors.
- B. Standard Hardware:
 - 1. Weather-stripping:
 - a. Meeting stiles on pairs of doors shall be equipped with an adjustable astragal utilizing wool pile with polymeric fin.
 - b. The door weathering on a single acting offset pivot or butt hung door and frame (single or pairs) shall be comprised of a thermoplastic elastomer weathering on a tubular shape with a semi-rigid polymeric backing.
 - 2. Sill Sweep Strips: EPDM blade gasket sweep strip in an aluminum extrusion applied to the interior exposed surface of the bottom rail with concealed fasteners (Necessary to meet specified performance tests).
 - 3. Threshold: Extruded aluminum, one piece per door opening, with ribbed surface.
 - 4. See Door Hardware section 087100.

2.6 Fabrication

- A. Fabricate aluminum-framed entrance doors in sizes indicated. Include a complete system for assembling components and anchoring doors.
- B. Fabricate aluminum-framed glass doors that are reglazable without dismantling perimeter framing.
 - 1. Door corner construction shall consist of mechanical clip fastening, SIGMA deep penetration plug welds and 1-1/8" (29 mm) long fillet welds inside and outside of all four corners. Glazing stops shall be hook-in type with EPDM glazing gaskets reinforced with non-stretchable cord.
 - 2. Accurately fit and secure joints and corners. Make joints hairline in appearance.
 - 3. Prepare components with internal reinforcement for door hardware.
 - 4. Arrange fasteners and attachments to conceal from view.
- C. Weather-stripping: Provide weather-stripping locked into extruded grooves in door panels or frames as indicated on manufacturer's drawings and details.

2.7 Aluminum Finishes

- A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- B. Factory Finishing:
 - 1. Kawneer Permanodic™ AA-M10C21A31, AAMA 611, Architectural Class II Clear Anodic Coating (Color #17 Clear) (Standard).

PART 3 - EXECUTION

3.1 Examination

- A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work. Verify rough opening dimensions, levelness of sill plate and operational clearances. Examine wall flashings, vapor retarders, water and weather barriers, and other built-in components to ensure a coordinated installation.
 - 1. Masonry Surfaces: Visibly dry and free of excess mortar, sand, and other construction debris.
 - 2. Wood Frame Walls: Dry, clean, sound, well nailed, free of voids, and without offsets at joints. Ensure that nail heads are driven flush with surfaces in opening and within 3 inches (76.2 mm) of opening.
 - 3. Metal Surfaces: Dry; clean; free of grease, oil, dirt, rust, corrosion, and welding slag; without sharp edges or offsets at joints.
 - 4. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 Installation

- A. Comply with Drawings, Shop Drawings, and manufacturer's written instructions for installing aluminum-framed entrance doors, hardware, accessories, and other components.
- B. Install aluminum-framed entrance doors level, plumb, square, true to line, without distortion or impeding thermal movement, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction.
- C. Set sill threshold in bed of sealant, as indicated, for weather tight construction.
- D. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

3.3 Field Quality Control

- A. Manufacturer's Field Services: Upon Owner's written request, provide periodic site visit by manufacturer's field service representative.

3.4 Adjusting, Cleaning, and Protection

- A. Clean aluminum surfaces immediately after installing aluminum-framed entrance doors. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.
- B. Clean glass immediately after installation. Comply with glass manufacturer's written recommendations for final cleaning and maintenance. Remove nonpermanent labels, and clean surfaces.
- C. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.

END OF SECTION

SECTION 084500

ACCESS DOORS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Section includes requirements for provision of:
 - 1. Access doors as indicated on the Drawings and as required for access to mechanical and electrical Work.

PART 2 – PRODUCTS

2.1 MANUFACTURED UNITS

- A. Non-Rated Access Door Types
 - 1. Type A, For Drywall Walls: Karp Associated, Inc.'s "Model Type DSB-123SD-MS"; Milcor Limited Partnership Model "Style M"; or equal.
 - 2. Type B, For Drywall Ceilings: Milcor Limited Partnership Model "Style ATR"; Karp Associated, Inc.'s "Model RDW", 24 x 24 inch; or equal.
 - 3. Type C, For Drywall, Masonry, or Tile Walls: Karp Associated, Inc.'s "Model Type DSC-214M Stainless Steel"; Milcor Limited Partnership Model "Style M"; or equal.
 - 4. Type D, For Plaster Walls And Ceilings: Milcor Limited Partnership Model "Style K"; or equal.
- B. Fire Rated Access Door Types
 - 1. Type 1, For Walls Type 1, For Walls: Milcor Limited Partnership Model "Fire Rated Access Doors"; Karp Associated, Inc.'s Model "Type KRP-150FR"; or equal.
 - 2. Type 2, For Ceilings: Milcor Limited Partnership Model "Fire Rated Access Doors For Ceiling Applications" Style ACFRAD; Karp Associated Inc.'s Model "Type KRP-150FR"; or equal.

2.2 FINISHING

- A. Factory Finishing Of Steel: Manufacturer's standard rust-inhibitive grey primer, to receive field finish paint prime coat.
- B. Stainless Steel: Manufacturer's standard No. 4 finish.
- C. Finish Painting: As specified in Section 099000.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine construction to receive access door and verify correctness of dimensions and other supporting or adjoining conditions.
- B. Do not install doors until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Coordinate details with other Work supporting, adjoining or requiring access doors.
- B. Verify the following:
 - 1. Dimensions, profiles and fire-resistive rating for each opening.
 - 2. Location will serve portion of Work to which access is required.
- C. Where proposed functional location conflicts with other Work, notify the Owner's Representative before installation.

3.3 INSTALLATION

- A. Install access doors in accordance with reviewed manufacturer's installation instructions, unless otherwise authorized by Owner's Representative in accordance with requirements for Work of Divisions 15 - Mechanical and 16 – Electrical.
- B. Ensure correct types and adequate sizes at proper locations.
- C. Securely attach frames to supporting Work and ensure doors and frames and their hardware operate smoothly and are free from warp, twist and distortion.

3.4 ADJUSTING AND CLEANING

- A. Adjusting: Adjust doors, frames and hardware to operate smoothly, freely and properly, without binding.
- B. Cleaning: Thoroughly clean surfaces of grease, oil or other impurities; touch up abraded prime coat and otherwise prepare for finish painting where required.

3.5 PROTECTION

- A. Protect access doors from marring, defacement and damage until final completion.

END OF SECTION

SECTION 087100

DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY:

- A. Section Includes: Finish Hardware for door openings, except as otherwise specified herein.
 - 1. Door hardware for metal doors & frames
 - 2. Door hardware for wood doors
 - 3. Door hardware for other doors indicated
 - 4. Keyed cylinders specified in other Sections
- B. Related Sections:
 - 1. Division 8: Hollow Metal Doors and Frames
 - 2. Division 8: Curtain Wall Systems
- C. References: Comply with applicable requirements of the following standards. Where these standards conflict with other specific requirements, the most restrictive shall govern.
 - 1. Builders Hardware Manufacturing Association (BHMA)
 - 2. NFPA 101 Life Safety Code
 - 3. NFPA 80 -Fire Doors and Windows
 - 4. ANSI-A156.xx- Various Performance Standards for Finish Hardware
 - 5. UL10C – Positive Pressure Fire Test of Door Assemblies
 - 6. ANSI-A117.1 – Accessible and Usable Buildings and Facilities
 - 7. DHI /ANSI A115.IG – Installation Guide for Doors and Hardware
 - 8. CBC California Building Code
- D. Intent of Hardware Groups
 - 1. Should items of hardware not definitely specified be required for completion of the Work, furnish such items of type and quality comparable to adjacent hardware and appropriate for service required.
 - 2. Where items of hardware aren't definitely or correctly specified, are required for completion of the Work, a written statement of such omission, error, or other discrepancy to Architect, prior to date specified for receipt of bids for clarification by addendum; or, furnish such items in the type and quality established by this specification, and appropriate to the service intended.

1.2 SUBSTITUTIONS:

- A. Comply with Division 1.

1.3 SUBMITTALS:

- A. Comply with Division 1.
- B. Special Submittal Requirements: Combine submittals of this Section with related Sections to ensure the "design intent" of the system/assembly is understood and can be reviewed together.
- C. Product Data: Manufacturer's specifications and technical data including the following:
 - 1. Detailed specification of construction and fabrication.
 - 2. Manufacturer's installation instructions.
 - 3. Wiring diagrams for each electric product specified. Coordinate voltage with electrical before submitting.
 - 4. Submit 5 copies of catalog cuts with hardware schedule.
- D. Shop Drawings - Hardware Schedule: Submit 5 complete reproducible copy of detailed hardware schedule. Organize vertically formatted schedule into "Hardware Sets" with index of doors and headings, indicating complete designations of every item required for each door or opening. Include following information:
 - 1. List groups and suffixes in proper sequence.
 - 2. Completely describe door and list architectural door number.
 - 3. Door and frame sizes and materials.
 - 4. Degree of opening
 - 5. Manufacturer, product name, and catalog number.
 - 6. Function, type, and style.
 - 7. Size and finish of each item.
 - 8. Fastenings and other pertinent information
 - 9. Mounting heights.
 - 10. Explanation of abbreviations and symbols used within schedule.
- E. Templates: Submit templates and "reviewed Hardware Schedule" to door and frame supplier and others as applicable to enable proper and accurate sizing and locations of cutouts and reinforcing.
- F. Samples: (If requested by the Architect)
 - 1. 1 sample of Lever and Rose/Escutcheon design, (pair).
 - 2. 3 samples of metal finishes
- G. Contract Closeout Submittals: Comply with Division 1 including specific requirements indicated.
 - 1. Operating and maintenance manuals: Submit 3 sets containing the following.
 - a. Complete information in care, maintenance, and adjustment, and data on repair and replacement parts, and information on preservation of finishes.
 - b. Catalog pages for each product.

- c. Name, address, and phone number of local representative for each manufacturer.
- d. Parts list for each product.
2. Copy of final hardware schedule, edited to reflect, "As installed".
3. Copy of final keying schedule
4. One set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.

1.4 QUALITY ASSURANCE

A. Comply with Division 1.

1. Statement of qualification for distributor and installers.
2. Statement of compliance with regulatory requirements and single source responsibility.
3. Distributor's Qualifications: Firm with 3 years experience in the distribution of commercial hardware.
 - a. Distributor to employ full time Architectural Hardware Consultants (AHC) for the purpose of scheduling and coordinating hardware and establishing keying schedule.
 - b. Hardware Schedule shall be prepared and signed by an AHC.
4. Installer's Qualifications: Firm with 3 years experienced in installation of similar hardware to that required for this Project, including specific requirements indicated.
5. Regulatory Label Requirements: Provide testing agency label or stamp on hardware for labeled openings.
 - a. Provide UL listed hardware for labeled and 20 minute openings in conformance with requirements for class of opening scheduled.
 - b. Underwriters Laboratories requirements have precedence over this specification where conflict exists.
6. Single Source Responsibility: Except where specified in hardware schedule, furnish products of only one manufacturer for each type of hardware.

B. Fire Rated Openings:

1. NFPA 80 compliant and as required by local governing agencies.
2. Electric latch retraction: Provide power supplies with fire alarm relay.
3. Hardware: UL10C/ UBC Standard 7-2 (positive pressure) compliant.
4. Provide proper latching hardware, self closing, approved bearing hinges, and seals.
5. Coordinate with wood door section on intumescent seals.
6. Provide approved gasketing at storage rooms over 100 sqft.

- C. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that meet requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.
- D. Review Project for extent of finish hardware required to complete the Work. Where there is a conflict between these Specifications and the existing hardware, notify the Architect in writing and furnish hardware in compliance with the Specification unless otherwise directed in writing by the Architect.
- E. Pre-Installation Meetings: Initiate and conduct with supplier, installer and related trades, coordinate materials and techniques, and sequence complex hardware items and systems installation. Convene at least one week prior to commencement of related work.

1.5 REGULATORY REQUIREMENTS

- A. Fire-Rated Openings: Comply with CBC Section 716 and NFPA Standard No. 80. Provide only hardware tested and listed by UL for the type and size of each door required, which complies with the requirements of the door and frame labels.
 - 1. Where exit devices are required on fire-rated doors, provide supplementary marking on door UL label indicating "Fire Door to be Equipped with Fire Exit Hardware", and provide UL Label on exit device indicating "Fire Exit Hardware".
- B. Conform to applicable requirements of the Americans with Disabilities Act Standards for Accessible Design regarding accessibility requirements for door and entrance hardware.
- C. Doors and doorways that are part of an accessible route shall comply with CBC Sections 11B-404.
- D. The clear opening width for a door shall be 32 inches minimum. For a swinging door it shall be measured between the face of the door and the stop, with the door open 90 degrees. There shall be no projections into the opening below 34 inches and 4 inches maximum projections into the opening between 34 inches and 80 inches above the finish floor or ground. Door closers and stops shall be permitted to be 78 inches minimum above the finish floor or ground. CBC Section 11B-404.2.3.
- E. Handles, pulls, latches, locks, and other operable parts on accessible doors shall comply with CBC Section 11B-309.4 and shall be operable with one hand and not require tight grasping, pinching, or twisting of the wrist. Operable parts of such hardware shall be 34 inches minimum and 44 inches maximum above the finish floor or ground. Where sliding doors are in the fully open position, operating hardware shall be exposed and usable from both sides. CBC Section 11B-404.2.7.
 - 1. Non-fixed portions of locks and other operable parts, such as keys and access cards, are not required to comply.
- F. The force for pushing or pulling open a door shall be as follows: CBC Section 11B-404.2.9.

1. Interior hinged doors, sliding or folding doors, and exterior hinged doors: 5 lbs. (22.2N) maximum.
 2. Required fire doors: the minimum opening force allowable by the DSA Authority, not to exceed 15 lbs. (67N) maximum.
 3. The force required to activate any operable parts, such as retracting latch bolts or disengaging other devices shall be 5 lbs. (22.2N) maximum to comply with CBC Section 11B-309.4.
- G. Door closing speeds shall be as follows: CBC Section 11B-404.2.8.
1. Closer shall be adjusted so that the required time to move a door from an open position of 90 degrees to a position of 12 degrees from the latch is 5 seconds minimum.
 2. Spring hinges shall be adjusted so that the required time to move a door from an open position of 70 degrees to the closed position is 1.5 seconds minimum.
- H. Thresholds shall comply with CBC Section 11B-404.2.5.
- I. Floor stops shall not be located in the path of travel and 4 inches maximum from wall, per DSA Policy 99-08.
- J. Hardware (including exit devices) shall not be provided with Night Latch (NL) function for any accessible doors or gates unless the following conditions are met per DSA Interpretation 10-08 DSA / AC (External), revised 4B-L/28/09. Such conditions must be clearly demonstrated and indicated in the specifications:
1. Such hardware has a dogging feature.
 2. It is dogged during the time the facility is open.
 3. Such dogging operation is performed only by employees as their job function (non-public use).
- K. Pair of doors: Limit swing of one leaf to 90 degrees so that a clear floor space is provided beyond the arc of the swing for the wall-mounted tactile sign. CBC Section 11B-703.4.2.1.
1. Where there is no wall space at the latch side of a single door or at the right side of double doors, signs shall be located on the nearest adjacent wall.
- L. Exit device touchpad shall be compliant with State Fire Marshall Standard 12-10-3, Section 12-10-302.
- 1.6 DELIVERY, STORAGE, AND HANDLING
- A. Packing and Shipping: Comply with Division 1.

1. Deliver products in original unopened packaging with legible manufacturer's identification.
2. Package hardware to prevent damage during transit and storage.
3. Mark hardware to correspond with "reviewed hardware schedule".
4. Deliver hardware to door and frame manufacturer upon request.

B. Storage and Protection: Comply with manufacturer's recommendations.

1.7 PROJECT CONDITIONS:

- A. Coordinate hardware with other work. Furnish hardware items of proper design for use on doors and frames of the thickness, profile, swing, security and similar requirements indicated, as necessary for the proper installation and function, regardless of omissions or conflicts in the information on the Contract Documents.
- B. Review Shop Drawings for doors and entrances to confirm that adequate provisions will be made for the proper installation of hardware.

1.8 WARRANTY:

A. Refer to Conditions of the Contract

B. Manufacturer's Warranty:

1. Closers: Lifetime (mechanical)
2. Exit Devices: Three years mechanical, one year electrical.
3. Locksets & Cylinders: Three years
4. All other Hardware: One year

1.9 OWNER'S INSTRUCTION:

A. Instruct Owner's personnel in operation and maintenance of hardware units.

1.10 MAINTENANCE:

- A. Extra Service Materials: Deliver to Owner extra materials from same production run as products installed. Package products with protective covering and identify with descriptive labels. Comply with Division 1 Closeout Submittals Section.
1. Special Tools: Provide special wrenches and tools applicable to each different or special hardware component.
 2. Maintenance Tools: Provide maintenance tools and accessories supplied by hardware component manufacturer.
 3. Delivery, Storage and Protection: Comply with Owner's requirements for delivery, storage and protection of extra service materials.
- B. Maintenance Service: Submit for Owner's consideration maintenance service agreement for electronic products installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

- A. The following manufacturers are approved subject to compliance with requirements of the Contract Documents. Approval of manufacturers other than those listed shall be in accordance with Division 1.

<u>Item:</u>	<u>Manufacturer:</u>	<u>Approved:</u>
Hinges	Stanley	McKinney
Locksets	Marks	
Cylinders	Sargent	
Exit Devices	Von Duprin	Precision
Closers	Stanley Comm Hardware	LCN, Sargent
Door Stops	Trimco	Don Jo, Rockwood
Flat Goods	Trimco	Don Jo, Rockwood
Threshold & Gasketing	NGP	Reese, Zero

2.2 MATERIALS:

A. Fasteners:

1. 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.
 - a. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed unless it is the only means of securely attaching the door hardware. Where through bolts are used on hollow door and frame construction, provide sleeves for each through bolt.
 - b. Fire-Rated Applications:
 - 1) Wood or Machine Screws: For the following:
 - a) Hinges mortised to doors or frames; use threaded-to-the-head wood screws for wood doors and frames.
 - b) Strike plates to frames.
 - c) Closers to doors and frames.
 - 2) Steel Through Bolts: For the following unless door blocking is provided:
 - a) Surface hinges to doors.
 - b) Closers to doors and frames.
 - c) Surface-mounted exit devices.
2. Spacers or Sex Bolts: For through bolting of hollow-metal doors.

3. Fasteners for Wood Doors: Comply with requirements in DHI WDHS.2, "Recommended Fasteners for Wood Doors."
4. Provide surface-concealed fasteners where additional overlapping hardware is required.
5. Combination machine screws and expansion shields shall be used for attaching hardware to concrete or masonry
6. Fasteners exposed to the weather or corrosive environments in the finished work shall be completely non ferrous; made of brass, bronze, or stainless steel.
7. Dissimilar Metals: Provide fasteners and base materials that prevent extreme galvanic corrosion based on their environment. Rain, dew, snow, high humidity, and ocean salt spray must all be taken into account of their reactivity of the metals being joined.

B. Hinges:

1. Template screw hole locations
2. Minimum of 2 permanently lubricated non-detachable bearings
3. Equip with easily seated, non-rising pins
4. Sufficient size to allow 180-degree swing of door
5. Furnish hinges with five knuckles and flush concealed bearings
6. Provide hinge type as listed in schedule.
7. Furnish 3 hinges per leaf to 7 foot 6 inch height. Add one for each additional 30 inches in height or fraction thereof.
8. Tested and approved by BHMA for all applicable ANSI Standards for type, size, function and finish
9. UL10C listed for Fire
10. Provide electric hinge wires with junction box (JB-2R series) to protect wires from mortar filled frames as required.

C. Cylindrical Type Locks and Latchsets:

1. Tested and approved by BHMA for ANSI A156.2, Grade 1
2. UL10C / UL10B / UBC 7-2 Positive Pressure Rated
3. UL Listed for 3 hours
4. Standard Clutching Mechanism
5. Concealed Mounting Screws
6. Thru Bolted design and heavy duty spring tension
7. 2-3/4 inch backset
8. 1/2" throw latchbolt / 3/4" throw latchbolt at rated pairs.
9. ASA Strike
10. Secure strike plates with 2 inch minimum long screws at wood stud walls
11. Core face must be the same finish as the lockset
12. Functions and design as indicated in the hardware groups

D. Exit Devices shall:

1. Tested and approved by BHMA for ANSI 156.3, Grade 1

2. Provide a deadlocking latchbolt
3. Non-fire rated exit devices shall have cylinder dogging.
4. Touchpad shall be "T" style with beveled end caps
5. Lever design shall match lockset lever design
6. Provide strikes as required by application.
7. Fire exit devices to be listed for UL10C
8. UL listed for Accident Hazard
9. Shall consist of a cross bar or push pad, the actuating portion of which extends across, shall not be less than one half the width of the door leaf.
10. Provide vandal resistant or breakaway trim
11. Sex bolts only at fire doors unless specified for non-rated doors.
12. Full cover end caps with robust end cap mounting bracket

E. Cylinders:

1. Provide cylinder housings, collars, rings & springs as recommended by the manufacturer for proper installation.
2. Provide cylinder cams or tail piece as required to operate all locksets and other keyed hardware items listed in the hardware sets.
3. Provide cylinder guards for all exposed cylinders at exterior perimeter doors.
4. Coordinate and provide as required for related sections.

F. Door Closers shall:

1. Tested and approved by BHMA for ANSI 156.4, Grade 1
2. UL10C certified
3. Closer shall have extra-duty arms and knuckles where required
4. Conform to ANSI 117.1
5. Maximum 2 7/16 inch case projection with non-ferrous cover
6. Separate adjusting valves for closing and latching speed, and backcheck
7. Provide adapter plates, shim spacers and blade stop spacers as required by frame and door conditions
8. Full rack and pinion type closer with 1½" minimum bore
9. Mount closers on non-public side of door, unless otherwise noted in specification
10. Closers shall be non-handed, non-sized and multi-sized 1 through 6
11. Provide BF or barrier free at non rated doors as required per code

G. Overhead Stops: Non ferrous base material. Non-plastic mechanisms and finished metal end caps. Field-changeable hold-open, friction and stop-only functions.

H. Door Stops:

1. Wall stop and floor stop shall be wrought bronze, brass or stainless steel.
2. Provide fastener suitable for wall construction.
3. Coordinate reinforcement of walls where wall stop is specified.
4. Provide dome stops where wall stops are not practical. Provide spacers or carpet riser for floor conditions encountered

I. Push Plates: Provide with four beveled edges ANSI J301, .050 thickness, size as indicated in hardware set. Furnish oval-head countersunk screws to match finish.

- J. Pulls with plates: Provide with four beveled edges ANSI J301, .050 thickness Plate s with ANSI J401 Pull as listed in hardware set. Provide proper fasteners for door construction.
- K. Kick Plates: Provide with four beveled edges ANSI J102, 10 inches high by width less 2 inches on single doors and 1 inch on pairs of doors. Furnish oval-head countersunk screws to match finish.
- L. Mop Plates: Provide with four beveled edges ANSI J103, 6 inches high by width less 1 inch on single doors and 1 inch on pairs of doors. Furnish oval-head countersunk screws to match finish.
- M. Seals: All seals shall be finished to match adjacent frame color. Seals shall be furnished as listed in schedule. Material shall be UL listed for labeled openings.
- N. Door Bottoms: Surface mounted or concealed door bottom where listed in the hardware sets.
 - 1. Door seal shall be resilient seal of (Neoprene, Polyurethane, Nylon Brush, Silicone)
 - 2. UL10C Positive Pressure rated seal set when required.
 - 3. Coordinate door bottom with threshold height and door undercut such that door bottom provides accurate seal with threshold without binding door or preventing positive latching.
 - 4. Notch as required for adjacent hardware.
- O. Thresholds: Thresholds shall be aluminum or bronze type for conformance with ADA requirements. Furnish as specified and/or per details. Provide fasteners and screws suitable for floor conditions.
 - 1. Refer to Door Schedule and Drawing details for type and configuration required. Additionally, where combustible flooring passes under doors, provide fire door thresholds in accordance with applicable regulatory requirements.
 - 2. Saddle, offset, and bumper seal type thresholds as required for applications.
- P. Silencers: Furnish silencers on all interior frames, 3 for single doors, 2 for pairs. Omit where any type of seals occur.
- Q. Knox Co, 3200 Series: Subject to compliance with requirements provide as required.
 - 1. Recessed mount, UL-listed, heavy-duty unit; fabricate from 1/4-inch-thick steel plate.
 - 2. Provide with restricted keying as required by Local Fire Department.
 - 3. Provide one box at each main entry from each parking area designated with a fire emergency lane.
 - 4. Provide tamper alarm switch with each box.
 - 5. Provide outlet boxes, conduit, wiring, and connections as specified in appropriate Division 25-28 Sections.
 - 6. Coordinate finish as required with Architect

2.3 FINISH:

- A. Designations used in Schedule of Finish Hardware - 3.5, and elsewhere to indicate hardware finishes are those listed in ANSI/BHMA A156.18 including coordination with traditional U.S. finishes shown by certain manufacturers for their products
- B. Powder coat door closers to match other hardware, unless otherwise noted.
- C. Aluminum items shall be finished to match predominant adjacent material. Seals to coordinate with frame color.

2.4 KEYS AND KEYING:

- A. Non-I.C. construction keying: furnish type as required by Facility Lockshop. At substantial completion, demonstrate consequent non-operability of construction key.
- B. Cylinders: Fixed core system: Existing Sargent [Patented]
 - 1. Provide keys and keying into existing system. For estimate furnish keys as indicated below.
- C. Permanent keys and cores: Provide as required by Facility Lockshop
- D. Transmit Grand Masterkeys, Masterkeys and other Security keys to Owner by Registered Mail, return receipt requested.
- E. For Estimate furnish keys in the following quantities:
 - 1. 1 each Grand Masterkeys
 - 2. 4 each Masterkeys
 - 3. 4 each Change keys each keyed core
 - 4. 15 each Construction masterkeys
- F. Bitting List: use secured shipment direct from point of origination to Owner upon completion.
- G. The Owner, or the Owner's agent, will convert construction cores to permanent cores.
- H. Keying Schedule: Arrange for a keying meeting, and programming meeting with Architect Owner and hardware supplier, and other involved parties to ensure locksets and locking hardware, are functionally correct and keying and programming complies with project requirements. Furnish 3 typed copies of keying and programming schedule to Architect.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verification of conditions: Examine doors, frames, related items and conditions under which Work is to be performed and identify conditions detrimental to proper and or timely completion.

1. Do not proceed until unsatisfactory conditions have been corrected.

3.2 HARDWARE LOCATIONS:

- A. Mount hardware units at heights indicated in the following publications except as specifically indicated or required to comply with the governing regulations or facility standards.
 1. Recommended Locations for Builder's Hardware for Standard Steel Doors and Frames, by the Door and Hardware Institute (DHI).
 2. NWWDA Industry Standard I.S.1.7, Hardware Locations for Wood Flush Doors.

3.3 INSTALLATION:

- A. Install each hardware item per manufacturer's instructions and recommendations. Do not install surface mounted items until finishes have been completed on the substrate. Set units level, plumb and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.
- B. Conform to local governing agency security ordinance.
- C. ADA Standard: Conform to ANSI A117.1 for positioning requirements for disabled.
- D. Installed hardware using the manufacturers fasteners provided. Drill and tap all screw holes located in metallic materials. Do not use "Riv-Nuts" or similar products.
- E. Install Conforming to ICC/ANSI A117.1 Accessible and Usable Building and Facilities.
 1. Adjust door closer sweep period so that from an open position of 90 degrees, the time required to move the door from to a position of 12 degrees from the latch is 5 seconds minimum.
- F. Closers: Coordinate installation of closer for maximum degree of hold open or opening. Hold open arms to stop door from hitting wall. Closers typically mount on interior side of room.
- G. Thresholds: Set thresholds for exterior doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants." Securely and permanently anchor exterior thresholds using countersunk non-ferrous screws to match color of threshold. Stainless steel screws at aluminum thresholds. Set thresholds at interior acoustical rated openings with acoustical sealant.
- H. Gaskets: install jamb-applied gaskets before closers, overhead stops, rim strikes, etc; fasten hardware over and through these seals where possible. Install sweeps across bottoms of doors before astragals, cope sweeps around bottom pivots, trim astragals to tops of sweeps.
- I. Replace fasteners damaged by power-driven tools.
- J. Silencers: Set in place before adjusting strikes.

- K. Locksets: Install locks with keyways in proper position. Install levers, roses, and escutcheons firmly affixed.
- L. Raindrips: Set in waterproof sealant and fasten as recommended by manufacturer.
- M. Floor Stops: Floor stops shall be installed a maximum of 4 inches from adjacent walls.
- N. Auto Door Bottom shall not be adjusted until substantial completion. Door bottoms are to be raised to highest position while construction occurs (so to not have rubber seal torn or damaged by debris under the door). At substantial completion, adjust door bottom to fully engage and touch the floor for proper sound dampening.

3.4 FIELD QUALITY CONTROL AND FINAL ADJUSTMENT

- A. Contractor/Installers, Field Services: After installation is complete, contractor shall inspect completed door openings on site to verify installation of hardware is complete and properly adjusted, in accordance with both the Contract Documents and final shop drawings.
 - 1. Check and adjust closers to ensure proper operation.
 - a. Adjust "Backcheck" according to manufacturer's instructions.
 - b. Set exterior doors closers to have 5 lbs maximum pressure to open, interior non-rated at 5 lbs, rated openings at 15 lbs subject to DSA approval.
 - 2. Check latchset, lockset, and exit devices are properly installed and adjusted to ensure proper operation.
 - a. Verify levers are free from binding.
 - b. Ensure latchbolts and dead bolts are engaged into strike and hardware is functioning.
 - 3. Report findings, in writing, to architect and hardware supplier outlining corrective actions and recommendations.

3.5 HARDWARE SETS

(NOTE: REFER TO DOOR SCHEDULE IN DRAWING SET FOR HARDWARE SETS AND ASSIGNMENTS TO DOORS)

- A. The hardware sets represent the product design intent and direction of the owner and architect. They should not be considered a detailed hardware schedule. Detailed or omitted items not included in the following hardware set(s) should be scheduled and submitted with the appropriate additional hardware required for proper application and functionality.
- B. Manufacturer's Abbreviations:
 - 1. ST Stanley
 - 2. PR Precision
 - 3. NA National Guard Products

- 4. TR Trimco
- 5. DJ Don Jo
- 6. SA Sargent
- 7. SH Stanley Door Closers
- 8. AB ABH Manufacturing
- 9. MA Marks
- 10. VO Von Duprin

END OF SECTION

SECTION 088000

GLASS AND GLAZING

PART 1 - GENERAL

1.01 DESCRIPTION: Division 1 applies to this section. Provide glass and glazing, complete.

A. Work Specified In This Section:

1. Glass and glazing, shop glazed and field glazed.
2. Tempered glass
3. Restroom Mirrors

B. Related Work Not In This Section:

1. Curtainwall framing.
2. Windows, storefront, and framed entrance doors.
3. Hollow metal frames.

1.02 QUALITY ASSURANCE

A. Quality Standards: In addition to code, glass installations shall comply with ANSI Z97.1, as applicable, and Federal Safety Standard 16 CFR 1201.

B. Applicator's Qualifications: Applicator for the work of this section shall have not less than 10 years satisfactory experience in glazing projects of equivalent size and difficulty to this project.

1.03 SUBMITTALS:

A. Submit shop drawings showing details of each type glazing system indicating sizes, shapes, material and quantity. Show details indicating sealant thickness and profile, bite on glass, glass edge clearance, depth of rabbet and thickness of glass. Identify gasket materials, side spacer blocks, and setting blocks. Show weepage system in glass pockets. Details shall be full size.

B. Product Data: Submit manufacturer's technical data on the following:

1. Glass except clear float.
2. Glazing channels.
3. Glazing beads and compounds.
4. Glazing tape.

C. Samples: Submit the following:

1. Glass, each type, not smaller than 2" by 12" with smooth edges. Submittals shall identify thickness and type of glass. For exterior glass, indicate on the label the maximum design wind load it can accommodate based upon the maximum sizes required for that

glass type. At least one sample of glass shall bear required markings, such as tempered glass indicators, manufacturer's name, and code required marks.

2. Glazing channels, gaskets, spacers, setting blocks, each type.
3. Sealants: Two 4" long beads, 1/4" to 3/8" diameter. Provide each type and color required in the project. Identify areas of use.
4. Glazing tape: Two 12" long pieces.

D. Certificates:

1. Submit from manufacturer stating the quality, thickness, and type of unlabeled glass delivered to the site for field cutting.
2. Provide certification that the glazing used conforms to the referenced standards.
3. Provide certification of applicator's qualifications.

E. Regulatory Approval: Submit copies of research reports or equivalent documentation demonstrating approval for fire-rated glass.

1.04 DELIVERY, STORAGE, AND HANDLING: Deliver products to the site in unopened containers, labeled plainly with manufacturers' names and brands. Store glass and setting materials in safe, dry locations and do not unpack until needed for installation. Handle and install materials in a manner that will protect them from damage.

1.05 JOB CONDITIONS: Protect glazing until completion and final acceptance. Repair or replace damaged or defective glazing to the original specified condition, at no additional contract cost. Damaged or defective glazing includes glass that cannot be properly cleaned.

1.06 WARRANTY: Furnish written warranties covering products and workmanship under this section as follows:

- A. Exterior glazing: Against loosening, air or water leakage, glass pop-outs, and other defects for 5 years.
- B. Glazing gaskets and channels: Against defective material or deterioration including without limitation, shrinkage, loss of seal, exposure to ozone, elements, smog and other air pollution, and commercial glass cleaners for 5 years.
- C. Low E-coated glass: Coating against peeling or deterioration for 10 years.
- D. Insulated glass: against development of material obstruction to vision (such as dust or film formation on the inner glass surfaces) caused by failure of the hermetic seal, other than through glass breakage, for 10 years.
- E. Laminated glass: against delamination or degradation of appearance by bubbling or other defect for a period of 10 years.

PART 2 - PRODUCTS

2.01 GENERAL: Glass furnished for the project shall match approved samples, be uniform in appearance, free from irregularities and differences in appearance when viewed from exterior as approved. Glass not complying with this requirement to be replaced with conforming glass without additional contract cost.

2.02 ACCEPTABLE MANUFACTURERS AND FABRICATORS: To maximum extent possible provide domestically manufactured and fabricated glass, and provide glass from one manufacturer. Specific types of glass specified or indicated shall be of manufacturers noted.

A. Primary Glass Manufacturers:

Oldcastle Glass Inc./ 9550 W. Higgins Road, Suite 390, Rosemont, IL60018
(800) 653-2278

Pilkington LOF/ 2800 28th Street, Suite 133, Santa Monica, CA 90405
(800) 522-9430.

PPG Glass Technology One PPG Place, 31N Pittsburgh, PA 15272
(800)434-2858

B. Glass Fabricators:

Viracon/ 800 Park Drive, Owatonna, MN 55060
(800) 533-2080

Southwest Technologies 1029 Corporation/ Way Palo Alto, CA 94303
(800) 365-8974

ACI Distribution/ 10234 4th Street, Rancho
Cucamonga, CA 91730
(800) 303-4224

- C. Glass Canopy per Kalwall's DeaMor Company – Narrow line system, or equal
1. Finish aluminum with an anodized coating
 2. Glass is sloped and engineered to prevent water ponding and create a straight leading edge

2.03 GLASS

A. MATERIALS:

1. Domestic manufacture, conforming to ASTM C1036 and ASTM C1048, except as otherwise noted, and except total distortion tolerances in this section shall govern, Conform to ANSI Z97.1. Label factory cut panes and do not remove labels until directed. Do not cut unlabeled glass delivered to site as material for field cutting until approval of material is obtained.

2. Furnish glass with straight smooth-finished edges where edges remain exposed.

- B. Float Glass: Type I, (transparent glass flat), Class 1 (clear), Quality q3, (glazing select), unless otherwise shown or specified, use 1/4 inch thick glass.

- C. Tinted Float Glass: Type I, Class 2 (tinted heat absorbing and light reducing), quality q3, manufactured by PPG or LOF, color as selected, 6 mm (1/4 inch) thick unless otherwise indicated or specified.
- D. Tempered Glass: Condition A, Type I or II, Class 1, Quality q3, Kind FT, match color of clear or tinted glass as applicable; fully thermal tempered, heat strengthening is not acceptable. Perform tempering by horizontal oscillating roller hearth or high speed roller hearth process. Do not use processes making gripper or tong marks. Handle and size glass according to manufacturer's instructions. Tempered glass is an important part of the artistic effect of the building design. Lights showing excessive distortion will not be permitted. Glass shall conform to the standard or quality established by the approved full-size sample installations.
- E. Clear laminated glass: Conform to ASTM C 1172, glass assembly as shown, of clear float glass with 0.060" thick high strength polyvinyl butyral laminating sheet. Edges of laminated glass shall be treated with Ardis "500", or equal, edge protection to prevent contact of laminating sheet with sealants.
- F. Insulating Glass: One inch thick, consisting of one light of clear float glass and one light of tinted float glass, one or both lights fully tempered where required, and 1/2 inch air space. Glass assembly shall consist of a non ferrous spacer, dual seals and an dehydrated evacuated space. Spacer shall be roll-formed of aluminum or stainless steel with bent or tightly welded joints. Primary seal shall be polyisobutylene or polyurethane and outer seal shall be silicone. Interstitial space shall be evacuated, dehydrated and provided with permanent dessicant. Sizes shall be within tolerances specified in SIGMA A 1202. Units shall conform to ASTM E 774, Class A.
- G. Low Emissivity Glass (Low E Glass): Conform to ASTM C 1376 as applicable. Fabricate as specified above for insulating glass. Insulating glass units except provide magnetic sputter vacuum deposited metallic high-transmittance coating applied to the number 2 surface of the unit. The U-value for the IGU shall be no greater than 0.34, unless otherwise indicated.
- H. Wire Glass: Type II (patterned and wired glass, flat). Class 1 (translucent), Quality q8 (glazing), Form 1 (wired, polished both sides), mesh m2 (square). Wire glass for fire rated openings shall bear an identifying UL label or the label of a recognized testing agency, and shall be rated for fire resistance indicated.
- I. Framed Mirror:
 - 1. Fabricated of one-piece Type 304 stainless steel angle frame, 3/4" by 3/4", with continuous integral stiffener on sides and beveled front to hold frame tightly against mirror. Corners shall be heliarc welded, ground and polished smooth.
 - 2, Exposed surfaces shall have satin finish with vertical grain. Mirror shall be fabricated of 1/4" mirror glazing quality float glass, free from tong marks. Edges shall be protected by plastic filler strips. Backs of mirrors shall be protected by full-size, shock-absorbing, water-resisting, non-abrasive 1/8" thick polyethylene padding.

3. Mirrors shall be provided with 24 gauge galvanized steel back with integral hanging brackets for mounting on concealed, rectangular wall hangers, and shall be secured with concealed Philips head locking screws on bottom of frame. Mirrors manufactured by Bobrick will be acceptable, providing sizes shown are maintained.

2.05 SETTING AND SEALING MATERIALS:

- A. Provide as specified in the GANA GM, SIGMA TM-3000, SIGMA TB-3001, and manufacturer's recommendations, unless specified otherwise herein. Do not use metal sash putty, nonskinning compounds, nonresilient preformed sealers, or impregnated preformed gaskets. Materials exposed to view and unpainted shall be gray or neutral color.
- B. Elastomeric Sealant: ASTM C920, Type S or M, Grade NS, Class 12.5, Use G. Use for channel or stop glazing wood and metal sash. Sealant shall be chemically compatible with setting blocks, edge blocks, and sealing tapes, with sealants used in manufacture of insulating glass units and with plastic sheet. Color of sealant shall match frames.
- C. Preformed Channels: Neoprene, vinyl, or rubber, as recommended by the glass manufacturer for the particular condition.
- D. Sealing Tapes: Preformed, semisolid, polymeric-based material of proper size and compressibility for the particular condition. Use only where glazing rabbet is designed for tape and tape is recommended by the glass or sealant manufacturer. Provide spacer shims for use with compressible tapes. Tapes shall be chemically compatible with the product being set.
- E Setting Blocks and Edge Blocks: Neoprene of 70 to 90 Shore "A" durometer hardness, chemically compatible with sealants used, and of sizes recommended by IGMA and the glass manufacturer. Setting blocks for insulated glass shall conform to AAMA 101.
- F. Accessories: Provide as required for a complete installation, including glazing points, clips, shims, angles, beads, and spacer strips. Provide noncorroding metal accessories. Provide primer-sealers and cleaners as recommended by the glass and sealant manufacturers.

PART 3 - EXECUTION

3.01 PREPARATION:

- A. Clean joints, gutters and glass pockets, to remove foreign matter such as dirt, oil, grease, fireproofing, surface dust and debris.
- B. Remove loose particles present or resulting from cleaning. Remove protective coatings and fabrication oils and residue on metallic surfaces with solvents that leave no residue. Do

not allow solvent to air dry without wiping. Use only clean lint free towels for wiping of surfaces.

C. Do not glaze when the ambient temperature and weather conditions cause frost or moisture or condensation on framing, or during damp weather unless approved measures to eliminate these conditions are used.

D. Cut glass accurately to sizes required to the openings and in such a way that edges are smooth and straight. Clean glass free from dust, oil, etc., and wipe clean immediately before installation.

E. Set, remove and later reset glazing stops so as to avoid marking or defacing any portion of the frames, stops, settings, etc. Prime surfaces of openings properly where recommended by the sealant manufacturer.

F. Glazed openings shall be checked prior to glazing to ensure that openings are square, plumb, and secure in order that uniform face and edge clearances can be maintained. Inspect framing joint intersections to ensure that the offset in the jointery will not inflect undue edge pressure on the glass.

G. Maintain minimum face distances on both sides of glass as per GANA guidelines.

3.02 GLASS SETTING:

A. Shop glaze or field glaze items to be glazed using glass of the quality and thickness specified or indicated. Glazing, unless otherwise specified or approved, shall conform to applicable recommendations in the GANA GM, GANA SM, SIGMA TB-3001, SIGMA TM-3000, and manufacturer's recommendations.

B. Aluminum windows, curtainwall and storefront may be glazed in conformance with glazing method described in the standards under which they are produced, except that face puttying with no bedding will not be permitted. Handle and install glazing materials in accordance with manufacturer's instructions. Use beads or stops which are furnished with items to be glazed to secure the glass in place. Use tape glazing or elastomeric wet glazing method as recommended by sash manufacturer.

C. Insulating Glass Units:

1. Do not grind, nip, or cut edges or corners of units after the units have left the factory. Springing, forcing, or twisting of units during setting will not be permitted. Handle units so as not to strike frames or other objects. Installation shall conform to applicable recommendations of SIGMA TB-3001 and SIGMA TM-3000.

2. Glaze using tape and wet seal method. Apply a heel bead of tape around the stationary leg of the sash. Set the glass unit on setting blocks at the quarter points. Press the unit firmly against the tape, then place tap on the stops. Apply the stops to the sash and the unit, using a toe bead of glazing compound. When the stops are in place apply wet seal to the saash, beveling it away from the glass.

D. Wire Glass: Install glass for fire doors in accordance with installation requirements of NFPA 80.

E Laminated Glass: Sashes which are to receive laminated glass shall be weeped to the outside to allow water drainage into the channel.

F. Set glass with glass markings, such as manufacturer's name, tempered glass designations, or code required indicators, right side up, level and straight. Locate markings in accordance with approved submittals, or in lower left-hand corner as directed.

3.03 PROTECTION AND CLEANING

A. Protect exterior glass from breakage immediately upon installation by use of crossed streamers attached to framing and held away from glass. Do not apply markers to surfaces of glass. Remove nonpermanent labels and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove immediately by method recommended by glass manufacturer.

C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less often than once a month, for build-up of dirt, scum, alkali deposits or staining. When examination reveals presence of these forms of residue, remove by method recommended by glass manufacturer.

D. Remove and replace glass which is broken, chipped, cracked abraded or damaged in other ways during construction period, including natural causes, accidents and vandalism.

E. Wash glass on both faces not more than 4 days prior to date scheduled for final acceptance of project. Wash glass by method recommended by glass manufacturer. Do not use any harsh cleaning agents, caustics, abrasives, or acids for cleaning. Polish glass both sides and leave free of soiling, streaks, and labels.

END OF SECTION

SECTION 089000

METAL WALL LOUVERS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Section includes requirements for provision of metal wall louvers.

1.2 SYSTEM DESCRIPTION

- A. Performance Requirements: Fabricate louvers to permit specified free area.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. The Airolite Co.'s ; or approved equal.

2.2 MANUFACTURED UNITS

A. General

1. Louvers shall bear AMCA Licensed Ratings Seals for air performance and water penetration.
2. Manufacturer shall submit AMCA Licensed data on a 4 by 4 feet louver showing it provides a minimum free area as specified following in this Article.
3. Water penetration shall be no more than 0.09-inches of water per square foot of free area at air flow of 500 FPM free area velocity when tested for 15 minutes per AMCA 500.

B. Louvers Type A

1. Performance Characteristics
 - a. Free Area (Nominal): 55 percent.
 - b. Square Feet of Free Area: 8.87 minimum.
 - c. Maximum Recommended Air Flow Through Free Area (FPM): 740 (based on minimal water penetration)
 - 1) Air Flow (CFM):6,564.
 - d. Type: Visible mullion, drainable blade louvers
 - e. Depth: Four inches, unless otherwise indicated.
 - f. Material Thickness: Minimum 0.081 inches, unless manufacturer recommends greater thickness do to size of louvers required.
 - g. Sizes: As indicated.
 - h. Manufacturer And Product: Airolite "Visible Mullion Louver Series CB666"; or equal.

2.3 ACCESSORIES

- A. Bird Screen and Frame
 - 1. Bird Screen: 1/4-inch square mesh wire, 0.048-inch diameter, mill finish aluminum, manufacturer's standard, having minimum free area of 71 percent.
 - 2. Frame: Same material louver.
- B. Flashings: Of same material as louver frame to include corner cover.

2.4 FABRICATION

- A. Factory Assembly
 - 1. Louvers
 - a. Material: Fabricated of aluminum
 - b. Construction: Provide drainable blades fixed and spaced at manufacturer's standard angle and spacing.
 - c. Mullions: Of same material as louver frame profiled to suit louver frame.
 - d. Screens: Permanently install screen mesh in shaped frame with reinforced corner construction.
 - 2. Factory Finishing
 - a. Protection of Dissimilar Materials: Apply bituminous coating at least two coats, minimum 5 mils total thickness to concealed aluminum and steel surfaces in contact with cementitious or dissimilar materials.
 - b. Concealed Steel Items: Galvanize in accordance with ASTM A123 to 2.0.
 - c. Typical Aluminum Surfaces, Except As Specified Otherwise In This Article: Organic Coating complying with following requirements:
 - 1) Type: High performance fluorocarbon, resin-based finish conforming to requirements of AAMA 605.2 and consisting of thermo-cured inhibitive primer and color topcoat, all for factory application in accordance with approved coating manufacturer's specifications.
 - 2) Colors: As selected from manufacturer's standard color range.
 - 3) Manufacturers: Standard three coat system. Penwalt "Kynar 500"; Ausimont USA Inc.'s "Hylar 5000 PURS"; or equal.
 - d. Screens And Frames: Matte black enamel finish, manufacturer's standard.

PART 3 EXECUTION

3.1 INSPECTION

- A. Examination
 - 1. Verify that prepared openings and flashings are ready to receive louvers.
 - 2. Work and opening dimensions are as indicated on Shop Drawings.
- B. Do not install louvers until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Protection
 - 1. Protect adjacent surfaces from damage from Work of this Section.

3.3 INSTALLATION

- A. Install louver assemblies in accordance with manufacturer's instructions and reviewed Shop Drawings.
- B. Install louvers level and plumb.
- C. Secure louvers in opening framing with concealed fasteners.
- D. Install flashings and align louver assembly to ensure moisture shed from flashings and diversion of moisture to exterior. Install perimeter sealant system.

3.4 ADJUSTING AND CLEANING

- A. Adjusting
 - 1. Repair or replace any damaged louver assemblies to the satisfaction of the Owner and Architect.
- B. Cleaning
 - 1. Clean surfaces and components.
 - 2. Leave areas designated to receive louver assemblies free of stains, blemishes and other foreign material.

3.5 PROTECTION

- A. Protect louver assemblies from damage or defacement until final completion.

END OF SECTION

SECTION 091000

METAL SUPPORT SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Section includes requirements for provision of
 1. Metal studs for exterior and interior wall framing, furring, and suspension systems for support of gypsum wallboard walls, ceilings and soffits.
 2. Backing for items adjoining or fastening to these systems unless otherwise noted.

1.2 SYSTEM DESCRIPTION

- A. Design Requirements
 1. Provide fire-rated gypsum board systems conforming to minimum fire ratings as indicated on the drawings.
 2. Performance Requirements: Install metal support systems complying with following requirements:
 - a. That are plumb, true, straight, and rigid framing for support of collateral materials, and that accommodate construction tolerances, deflection of building structural members, and clearances of intended openings.
 - b. That accommodate construction tolerances, deflection of building structural members, and clearances of intended openings.
 - c. Provide gypsum board surfaces that have no variations which exceed 1/8 inch in 10 feet when a straight edge is laid on the surface in any direction, and that have no measurable variation in any two foot direction. Provide corners that are square, straight and plumb.
 - d. Surfaces not meeting these performance requirements shall be deemed uneven and defective and shall be replaced or repaired to the Architect's satisfaction at no increase in cost to the Contract.
- B. Regulatory Requirements
 1. Fire-Resistive Requirements: Provide fire-rated materials and systems complying with requirements of authorities having jurisdiction.
 2. Metal Framing Systems
 - a. Framing: Provide framing that is plumb, true, straight, and rigid framing for support of collateral materials and comply with requirements of CBSC CBC Chapter 25, Sections as follows:
 - b. Vertical Assemblies: 2504.
 - c. Horizontal Assemblies: 2504.

3. Seismic Requirements: Design anchorage systems to comply with CBC Chapter 16A Section 1616A.1.17 and ASCE 7 – 10 Chapter 13, as applicable for Seismic Zone 4 and requirements of 2016 CBC Section 1616A.1.21.

PART 2 PRODUCTS

2.1 MATERIALS FOR METAL SUPPORT SYSTEMS

A. Runner Tracks

1. Typical: Provide tracks of same gauge, thickness and finish as studs, unless indicated otherwise or specified otherwise in this Section

B. Stud Types

1. Type A1, Typical: 16 gauge studs, with 14 gauge top and bottom tracks, C-shaped sections, having yield strength of 50,000 psi, galvanized finish conforming to ASTM A525 for exterior framing, Unimast Inc.'s "ST Stud"; or equal.
2. Type A, Typical: 25 gauge, C-shaped sections, ASTM C625, having yield strength of 33,000 psi, galvanized finish conforming to ASTM A525. Unimast Inc.'s "ST Stud"; or equal.
3. Type B, Typical, Non-Load Bearing; C-shaped sections, with punched webs and plain steel flanges to receive screws; fabricated from 20 gauge steel conforming to ASTM A568, and having hot-dip galvanized coating conforming to ASTM A525, manufacturer's standard.
4. Type C, Typical At Door Framing, Load Bearing Studs; C-shaped sections, cold-formed with punched webs and plain flanges to receive screws; fabricated from 16 gauge galvanized steel conforming to ASTM A446, Grade D, having minimum yield point of 50,000 psi.

C. Channels, Typical for Framing, Furring and Carrying Channels: Cold-rolled steel coated with rust-inhibitive material, with following minimum weights per 1000 lineal feet, subject to standard mill weight tolerances:

Size Inches	Gauge	Pounds
3/4	16	300
1-1/2	16	475
2	16	590

D. Adjustable Wall Furring Channels: Formed from 20 gauge galvanized steel with either plain or perforated flanges to receive screws.

E. Resilient Channel System

1. Resilient Channels: Galvanized steel channels, minimum 25 gauge. Uni-Mast "RC-1"; Cemco "RC-1", Dale/Incor "RFC-1"; or equal.
2. Fasteners: U.S. Gypsum Co.'s following; or equal.

- a. Typical: Use one-inch type S Bugle head dry wall screws.
 - b. For Fire Resistive Ceilings: Use 1-1/4-inch screws.
- F. Bracing Members, Stiffeners or Bridging, And Metal Backing:
1. Bracing Members: Of same material and finish as studs, thickness to suit purpose.
 2. Partition Stiffeners or Bridging: Cold-rolled channel or manufacturer's standard bridging for approved stud.
 3. Metal Backing Plate Systems:
 - a. Type A
 - 1) Use: For surface-mounted mirrors, waste receptacles, towel dispensers and similar type items having maximum weight of 50 pounds.
 - 2) Provide double Type A studs at sides of opening as indicated.
 - 3) Provide backing plate consisting of 16 gauge track notched as indicated.
 - 4) Secure track to studs with screws type and size as indicated.
 - 5) Secure items to backing plate with screws as indicated.
 - b. Type B
 - 1) Use: Backing for upper wall-hung cabinets (up to 2 shelves), base cabinets, full-height cabinets, handrails, guardrails, grab bars and wall- hung equipment and similar-type items having maximum weight of 100 pounds per foot.
 - 2) Provide double Type B studs of size and at sides of opening as indicated.
 - 3) Provide backing plate as indicated consisting of 16 gauge track notched to studs as indicated.
 - 4) Secure track to studs by welding as indicated.
 - 5) Secure items to backing plate with screws as indicated.
 - c. Type C
 - 1) Use backing for upper wall-hung cabinets (over 2 shelves), and wall-mounted equipment up to 200 pounds per foot.
 - 2) Provide double Type B studs of size and at opening as indicated.
 - 3) Provide continuous backing plate of size as indicated consisting of 14 gauge steel plate.
 - 4) Secure backing plate to studs with screws as indicated.
 - 5) Provide track channel stiffeners size and shape as indicated welded to continuous backing plate as indicated.
 - 6) Secure items to backing plate with screws as indicated.
- G. Galvanized Finish Touch-Up Coating: Liquid zinc compound that bonds electrochemically to iron, steel and aluminum. As manufactured by ZRC Chemical Products, "ZRC Cold Galvanizing Compound"; or equal.

- H. Rust Inhibitive Touch-Up Coating: As manufactured by ICI Dulux "Dveflex 4020 DTM Flat Interior/Exterior Waterborne Primer & Finish (85xx)"; or equal.

2.2 FASTENERS AND ATTACHMENTS

- A. For Metal Support Framing Systems:
 - 1. Welding Electrodes: AWS low hydrogen, rod number and diameter as recommended by the manufacturer.
 - 2. Powder-Driven Fasteners: Tempered steel pins with special corrosive-resistant plating or coating. Pins shall have guide washers to accurately control penetration, maximum 3/4-inch. Fastening shall be accomplished by low-velocity piston-driven power-actuated tool. Pins and tool shall be as manufactured by Hilti Fastening Systems; Impex Tool Corp., or equal. When installing in concrete, use care and caution to avoid cutting or damaging the existing reinforcing bars. Do not use on curb or edge of slab.
 - 3. Metal Screws: ASTM C1002, specifically designed for attachment of metal to metal, with self-tapping point and manufacturer's standard rust-inhibiting coating.
 - 4. Concrete Screws: Heat-treated screws with unique Hi-Lo thread design that cuts threads in pre-drilled holes in concrete. As manufactured by Buildex, "Tapcon Anchors", or equal.
 - 5. Wedge Anchors: FS-FF-S-325, Group II, Type 4, size as indicated. As manufactured by Hilti Fastening Systems "Kwik-Bolt" and "HDI Anchor"; Ramset Fastening Systems "Trubolts", or equal. Allowable capacity shall not exceed 80 percent of the allowable load listed in the ICC Research Committee recommendation for the specific anchor. When installing in concrete use care and caution to avoid cutting or damaging the existing reinforcing bars.
 - 6. Machine Bolts, Nuts and Washers: Low carbon steel standard fasteners, externally and internally threaded, ASTM A307; malleable washers.
 - 7. Hanger, Bracing and Tie Wire: Galvanized soft carbon steel. ASTM A641, Class I, coating, soft temper, of following minimum gauges, unless otherwise specified:
 - a. Single-Strand Tie Wire: 16.
 - b. Double-Strand Tie Wire: 18.

2.3 FINISHES

- A. Galvanized Surfaces: Where galvanizing is removed by welding or other assembly procedures, clean area of any foreign matter by wire-brushing and/or metal conditioner recommended by galvanized finish touch-up manufacturer. Apply galvanized touch-up coating by brush or spray with a minimum coverage of 1.4 mils, dry-film.

- B. Rust-Inhibitive Coated Surfaces: Where coating is removed by welding or other assembly procedures, clean area of any foreign matter and apply rust-inhibitive touch-up coating.

PART 3 EXECUTION

3.1 INSTALLATION

- A. General Requirements for Metal Support Systems
 - 1. Install studs and furring in accordance with following unless otherwise indicated:
 - a. Studs and Furring: Install in accordance with MLA Specifications and Bulletins.
 - 2. Securely fasten framing members together and to walls, floors and other structural supports.
 - 3. Wire-Tying:
 - a. For Members Perpendicular To Each Other: Saddle Tie.
 - 1) For Horizontal Stiffener Channels Placed At Intersecting Legs of Channel Brackets: Figure-eight tie unless otherwise indicated.
 - 2) For Splices: Double-wrap tie.
 - 4. Welding:
 - a. Perform welding by welder previously qualified for horizontal, vertical and overhead positions in accordance with AWS D1.1.
 - b. Use one inch seam welds unless specifically noted otherwise.
 - 5. Cutting:
 - a. General: Cut framing components squarely or on an angle as may be required to fit tightly with proper bearing against abutting members. Maintain members firmly in position until permanently fastened.
 - b. Cutting of Studs: If stud web is cut more than 50 percent or stud flange is cut to any degree restore stud to original strength to the Architect's satisfaction by wire-tying, screwing or welding on steel reinforcement.
 - 6. Deflection Allowance at Non-Loadbearing Conditions
 - a. Where partitions abut underside of rigid construction, cut studs short and install additional continuous track size as indicated.
 - b. Where partitions abut steel, concrete, or masonry vertical surfaces, set end stud free of abutting surface and secure ends of horizontal stiffeners in partition to abutting surface.
 - 7. Installation Tolerances of Metal Support Systems Comply with requirements of Article titled "System Description, subArticle titled "Performance Requirements in this Section.
 - a. Maximum Variation From True Position: 1/8-inch.
 - b. Maximum Variation of any Member from Plane: 1/8-inch.

8. Stud Partitions Typical
 - a. Coordinate installation of bucks, anchors, and blocking with electrical and mechanical work to be placed in or behind stud framing.
 - b. Refer to Drawings for indication of partitions extending to ceiling only and for partitions extending through ceiling to structure above.
 - c. Coordinate placement of insulation in multiple stud spaces made inaccessible after stud framing erection.
 - d. Runner Track
 - 1) Use same runner track type and stud type for partitions unless otherwise noted
 - 2) Install runner track running continuous at top and bottom of wall framing unless otherwise indicated; and accurately align floor and ceiling runner track and securely attach at maximum 24 inches on center and at each end.
 - 3) Do not miter runner track at corners.
 - e. Studs
 - 1) Use single-length studs for each run with no splices.
 - 2) Space studs maximum 16-inches on center unless otherwise noted.
 - 3) Securely attach studs to runner track by welding as indicated.
 - 4) Locate studs maximum 2-inches from opening jambs abutting partitions or other construction.
 - 5) At partition corners, position stud to form outside corner and locate another stud within 2-inches from inside corner along each partition.
 - f. Partition Stiffeners, Horizontal
 - 1) Stiffen partitions with 3/4-inch horizontally placed channels at vertical mid-point.
 - 2) Wire-tie stiffeners to inside of studs, or secure as recommended by stud manufacturer.
 - g. Framing of Openings
 - 1) General: Completely frame openings. Provide vertical-cut studs over openings as indicated.
 - 2) Vertical Framing Of Door Openings: Typical unless otherwise indicated.
 - 3) Secure 2 Type C studs together to form box and seam weld minimum 1 inch at 24 inches on center and install at each jamb continuous from floor to structure above as indicated. Where ductwork or other obstruction interferes with straight studs, head the studs and either offset frame or brace to structure above.
 - 4) Weld, bolt or screw jamb frame anchors to Type C studs. Secure 1 Type A typical stud to box formed by Type C studs for attachment of collateral material.
 - 5) Continuous typical partition framing each side of opening.

- h. Framing Over Openings:
 - 1) Secure 2 Type C, studs together as indicated to form box and seam weld minimum 1-inch at 24-inches on center and install continuous from jamb to jamb. Weld, bolt or screw header box to jamb frame box.
 - 2) Provide horizontal Type B stud above box formed by Type C studs as indicated and weld bolt or screw to jamb frame box studs.
 - 3) Install cut to length jack studs between horizontal stud of opening and ceiling channel.
 - 4) At Doors Wider Than 36 Inches: Reinforce jack studs with 3/4 inch furring channel installed maximum 6 inches above opening. Extend channel minimum 2 stud spaces each side of opening. Wire-tie channel to inside of all studs and supports.
- i. Backing in Stud Partitions or Furring:
 - 1) Typical: Securely screw typical metal backing to at least 3 stud supports, leaving flat surface of metal backing to receive attachment of object to be secured.
 - 2) Attachment: Verify that any pre-drilling of backing and attachment of spacers to prevent crushing of collateral material is done prior to application of collateral material.
 - 3) If it is determined by the Architect that backing was not provided for any items as required, the Contractor shall remove the finish material and install backing. The Contractor shall patch and refinish surface to match adjacent area and surface.
 - 4) Typical Backing System: Use metal backing track or plate and secure with screws as indicated.
 - 5) For Grab Bars: As specified in Section 108100
- j. Vertical and Horizontal Contact Furring:
 - 1) Install furring channels vertically at 16 inch centers, unless otherwise indicated.
 - 2) Install intermediate bracing at spaces sufficient to provide substantial foundation for collateral materials or other supported items.
 - 3) Completely frame openings with channels.

9. Resilient Channel Construction

- a. Attaching Resilient Channels
 - 1) Attach channels at 24-inch center-to-center spacing perpendicular to joists, assuming joists are 16 inches apart.
 - 2) If joists are 24-inches apart, install channels at spacing of 16-inches on center,
 - 3) Use 1-inch S-Bugle Head dry wall (or similar screws.
 - 4) Drive screws through holes in channel mounting flange.
 - 5) Attach channels with mounting flanges facing in only one direction

- 6) Hold back ends of channels 1/2 inch from intersecting surfaces.
- 7) Splice channels only at joist and overlap butt ends no more than 1-1/2-inch. Drive screws through both flanges.
- 8) Add additional framing if necessary so that channels are cantilevered no more than 6-inches.

END OF SECTION

SECTION 092500

GYPSUM BOARD SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Section includes requirements for provision of
 1. Metal studs, furring, and suspension systems for support of gypsum wallboard walls, ceilings and soffits.
 2. Backing for items adjoining or fastening to these systems unless otherwise noted.
 3. Gypsum board surfaces.
 4. Cementitious backer board backing for other finishes.
 5. Joint treatment for gypsum board and accessories.
 6. Exterior gypsum sheathing.

PART 2 - PRODUCTS

2.1 MATERIALS FOR METAL SUPPORT SYSTEMS

- A. Runner Tracks
Typical: Provide tracks of same gauge, thickness and finish as studs, unless indicated otherwise or specified otherwise in this Section
- B. Stud Types
 1. Type A, Typical: 25 gauge, C-shaped sections, ASTM C625, having yield strength of 33,000 psi, galvanized finish conforming to ASTM A525. Unimast Inc.'s "ST Stud"; or equal.
 2. Type B, Typical, Non-Load Bearing; C-shaped sections, with punched webs and plain steel flanges to receive screws; fabricated from 20 gauge steel conforming to ASTM A568, and having hot-dip galvanized coating conforming to ASTM A525, manufacturer's standard.
 3. Type C, Typical At Door Framing, Load Bearing Studs; C-shaped sections, cold-formed with punched webs and plain flanges to receive screws; fabricated from 16 gauge galvanized steel conforming to ASTM A446, Grade D, having minimum yield point of 50,000 psi.
- C Channels, Typical for Framing, Furring and Carrying Channels: Cold-rolled steel coated with rust-inhibitive material, with following minimum weights per 1000 lineal feet, subject to standard mill weight tolerances:

Size Inches	Gauge	Pounds
3/4	16	300
1-1/2	16	475
2	16	590

- D. Channels, Typical For Suspended Gypsum Board Ceilings
 - 1. Main Runners: 1-2 inch, 1.12 pounds per foot, hot-rolled channels.
 - 2. Furring (Hat) Channels: Formed from 25 gauge galvanized steel with knurl-surfaced face to receive screws.

- E Adjustable Wall Furring Channels: Formed from 20 gauge galvanized steel with either plain or perforated flanges to receive screws.

- F Resilient channels: 25 gauge galvanized, Uni-Mast RC-1; or equal.

2.2 MATERIALS FOR GYPSUM BOARD SYSTEMS

- A. Board Types
 - 1. Type 1, Board: Fire-rated board, ASTM C36, Type X, thickness as indicated on the Drawings and edges as follows:
 - a. Typical At Single-Layer Board And Finish Face Board Of Multi-Layer nstallations: Tapered rounded edges.
 - b. Backer Layers At Multi-Layer Installations: Square or tapered rounded edges.
 - 2. Type 2, Board: Non-rated board, ASTM C36, thickness as indicated on the Drawings and edges as follows:
 - a. Typical At Single Layer Board And Finish Face Board Of Multi-Layer Installations: Tapered rounded edges.
 - b. Backer Layers At Multi-Layer Installations: Square or tapered rounded edges
 - 3. Type 3: Moisture Resistant Gypsum Board: ASTM C630; standard and UL rated with Type X fire resistant core; 5/8 inch thick; maximum permissible length; ends square cut, tapered edges.
 - 4. Type 4, Abuse-Resistant Gypsum, Fire Rated: ASTM C36, Type X, thickness as indicated on the drawings, with tapered edge, with mesh back. USG Corp.'s "Abuse Resistant Gypsum Fiber Panel Fiberock Heavy Duty Impact"; with" board manufacturer's "Structo-Base Gypsum Plaster and Imperial "Brand Finish Plaster";or equal
 - 5. Type 5, Gypsum Sheathing: Georgia Pacific's "Dens Glas External Sheathing"; or equal.

2.3 FINISHES

- A. Finish And Texture Requirements
 - 1. Finish: GA214, Level 4.
 - 2. Texture: Typical smooth finish throughout
 - 3. Finish painting requirements are as specified in Section 099000.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive metal support systems and verify following:

1. That suspension components indicated to be inserted or attached to wood work are in place.
2. That rough-in utilities indicated to be located within metal support framing are in proper location.
3. Examine areas and surfaces scheduled to receive gypsum board and verify the following:
 - a. Proper alignment and spacing of support systems.
 - b. Metal frames are set for thickness of board to be used.
 - c. Complete installation of blocking, backing, and bracing members in support system.
4. Complete installation of mechanical, electrical or other such items to be enclosed in partitions that cannot be installed after installation of board, without causing cutting or board removal.

B. Do not start installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation for Metal Support Systems:

1. Coordinate details and requirements of other work which supports, adjoins, or fastens to metal studs, channels or furring and requires backing or special support framing specified in this Section.
2. Items requiring backing or support include but are not necessarily limited to handrail brackets, manufactured casework, wall-mounted finish hardware, miscellaneous specialties, items and similar type.
3. Install suspension components required to be inserted or attached.
4. Obtain the Architect's acceptance of backing method proposed to satisfy requirements of this Section which differs from methods indicated.

B. Surface Preparation For Gypsum Board Systems

1. Coordinate details with other work supporting, adjoining or fastening to gypsum board.

3.3 INSTALLATION

A. General Requirements for Metal Support Systems

1. Install studs and furring in accordance with following unless otherwise indicated:
 - a. Studs and Furring: Install in accordance with MLA Specifications and Bulletins.
2. Securely fasten framing members together and to walls, floors and other structural supports.
 - a. Wire-Tying:
 - 1) For Members Perpendicular To Each Other: Saddle Tie.
 - 2) For Horizontal Stiffener Channels Placed At Intersecting Legs of Channel Brackets: Figure-eight tie unless otherwise indicated.
 - 3) For Splices: Double-wrap tie.
 - b. Welding:

- 1) Perform welding by welder previously qualified for horizontal, vertical and overhead positions in accordance with AWS D1.1.
 - 2) Use one inch seam welds unless specifically noted otherwise.
 - c. Cutting:
 - 1) General: Cut framing components squarely or on an angle as may be required to fit tightly with proper bearing against abutting members. Maintain members firmly in position until permanently fastened.
 - 2) Cutting of Studs: If stud web is cut more than 50 percent or stud flange is cut to any degree restore stud to original strength to the Architect's satisfaction by wire-tying, screwing or welding on steel reinforcement.
 - d. Deflection Allowance at Non-Loadbearing Conditions
 - 1) Where partitions abut underside of rigid construction, cut studs short and install additional continuous track size as indicated.
 - 2) Where partitions abut steel, concrete, or masonry vertical surfaces, set end stud free of abutting surface and secure ends of horizontal stiffeners in partition to abutting surface.
 - e. Installation Tolerances of Metal Support Systems Comply with requirements of Article titled "System Description, subArticle titled "Performance Requirement in this Section."
 - 1) Maximum Variation From True Position: 1/8-inch.
 - 2) Maximum Variation of any Member from Plane: 1/8-inch.
 3. Installation Tolerances of Metal Support Systems Comply with requirements of Article titled "System Description, subArticle titled "Performance Requirements in this Section."
 - a. Maximum Variation From True Position: 1/8-inch.
 - b. Maximum Variation of any Member from Plane: 1/8-inch.
- B. General Requirements For Gypsum Board Systems
1. Install gypsum board in accordance with GA-216 unless specifically noted otherwise.
 2. Cut gypsum board by scoring and breaking or sawing from face side. Smooth cut edges and ends of gypsum board as necessary in order to obtain neat jointing.
 3. Use board of maximum lengths to minimize joints.
 4. Abut board without forcing into place. Neatly fit ends and edges of board.
 5. Joints
 - a. General: Lay out joints at openings so that no end joint aligns with edges of openings.
 - b. End Joints: Stagger end joints and arrange joints on opposite sides of partitions to occur on different studs.
 - c. External Corners: Butt and fit base to provide solid edge.
 - d. End Joints Between Framing Members: Taper and back-block or apply metal-backed tape.
 6. Where Gypsum Board is Carried Full Height To Structure Above: Provide for deflection of structure by undercutting board nominal 1/2-inch, unless otherwise indicated, and caulk top edge of board to structure in continuous bead to form elastic closure.

7. At Junction of Board with Floor and Curb: Hold gypsum board nominal 1/4-inch above floor or curb.
8. Gypsum Board Gussets: Provide board gussets at double walls where studs are less than 3-5/8 inches thick.
9. Stud Partitions Typical
 - a. Coordinate installation of bucks, anchors, and blocking with electrical and mechanical work to be placed in or behind stud framing.
 - b. Refer to Drawings for indication of partitions extending to ceiling only and for partitions extending through ceiling to structure above.
 - c. Coordinate placement of insulation in multiple stud spaces made inaccessible after stud framing erection.
 - d. Runner Track
 - 1) Use same runner track type and stud type for partitions unless otherwise noted
 - 2) Install runner track running continuous at top and bottom of wall framing unless otherwise indicated; and accurately align floor and ceiling runner track and securely attach at maximum 24 inches on center and at each end.
 - 3) Do not miter runner track at corners.
 - e. Studs
 - 1) Use single-length studs for each run with no splices.
 - 2) Space studs maximum 16-inches on center unless otherwise noted.
 - 3) Securely attach studs to runner track by welding as indicated.
 - 4) Locate studs maximum 2-inches from opening jambs abutting partitions or other construction.
 - 5) At partition corners, position stud to form outside corner and locate another stud within 2-inches from inside corner along each partition.
 - f. Partition Stiffeners, Horizontal
 - 1) Stiffen partitions with 3/4-inch horizontally placed channels as indicated on the Drawings..
 - 2) Wire-tie stiffeners to inside of studs, or secure as recommended by stud manufacturer.
 - g. Framing of Door, Window And Duct Openings
 - 1) General
 - a) Completely frame openings.
 - b) Provide vertical-cut studs over openings as indicated.
 - c) Secure framing by welding or screwing as indicated.
 - d) Secure typical wall stud to box formed by studs at openings for attachment of collateral material.
 - e) Continue typical partition framing each side of opening.
 - 2) At Doors Wider Than 36 Inches: Reinforce jack studs with 3/4 inch furring channel installed maximum 6 inches above opening. Extend channel minimum 2 stud spaces each side of opening. Wire-tie channel to inside of all studs and supports.

C. Backing in Stud Partitions or Furring:

1. Typical: Securely screw typical metal backing to at least 3 stud supports, leaving flat surface of metal backing to receive attachment of object to be secured.
 2. Attachment: Verify that any pre-drilling of backing and attachment of spacers to prevent crushing of collateral material is done prior to application of collateral material.
 3. If it is determined by the Owner or Architect that backing was not provided for any items as required, the Contractor shall remove the finish material and install backing. The Contractor shall patch and refinish surface to match adjacent area and surface.
 4. Typical Backing System: Use metal backing plate systems secured as specified in this Section and as indicated.
 5. For Grab Bars: As specified in Section 108100.
- D. Vertical and Horizontal Contact Furring
1. Install furring channels vertically at 16 inch centers, unless otherwise indicated.
 2. Install intermediate bracing at spaces sufficient to provide substantial foundation for collateral materials or other supported items.
 3. Completely frame openings with channels.

3.4 BOARD APPLICATION

- A. Apply in either vertical or horizontal direction with ends and edges falling on supports, except where edge joints are at right angles to support.
- B. In vertical applications, gypsum board shall be of length required to reach full height of vertical surfaces in one continuous piece.
- C. Bring ends and edges into contact with adjoining board, but do not force into place.
- D. Fastenings
1. Attach gypsum board to furring or framing with screw types and sizes as recommended by manufacturer as follows:
 - a. Metal And Wood Framing: Use screws.
 2. Attach gypsum board from center to edges and ends, pressing firmly against supports. Place fasteners approximately 3/8-inch from edges, flush with surface; but do not break paper.
 3. Provide spacing on center in field and along abutting edges as follows, except if modified by fire resistive requirements:
 4. Walls, Screw Spacing For Board Installed As Follows
 - a. Horizontally: Maximum 12 inches.
 - b. Vertically: Maximum 16 inches.
- E. Scribe ceiling board neatly in casing bead where it meets surfaces of different materials in other planes.
- F. Metal Accessories

1. Provide gypsum board systems isolated from building structural elements, except floors, metal accessories or control joints.
2. Provide control joints located as follows unless otherwise indicated:
3. At changes in type of substrate.
4. At control or expansion joints occurring in building construction.
5. In partitions exceeding 30 feet in length, provide joints at maximum spacing of 30 feet. Where board abuts wall or ceiling or dissimilar construction.
6. At large openings and long and narrow openings where normal stresses would tend to crack board at corners, such as door frames and similar type items. Provide control joints extending from head at each jamb to the ceiling.
7. Provide metal accessories as follows:
 - a. Provide corner beads at vertical and horizontal external corners.
 - b. Provide metal casing bead at exposed edges of gypsum board at intersection of board and surface of exterior walls, including board construction, window frames or exposed structure elements, and at ceiling perimeters and penetrations.
 - c. Set accessories tightly against base and firmly secure at maximum spacing of 12 inches center.
 - d. After metal accessories and control joints are installed, correct surface damage and defects.

G. Joint Treatment

1. General: Apply joint treatment materials in accordance with gypsum board manufacturer's directions.
2. Board With Eased Edges
 - a. Prefill grooves formed by abutting rounded edges of board flush with prefill joint compound; remove excess compound, and leave clear depression to receive tape.
 - b. Permit prefill joint compound to harden prior to application of tape.
 - c. Reinforce joints between board panels and joints at metal accessory trim with joint tape and embedding type joint compound and conceal with applications of finishing compound, and allow to dry.
 - d. Treat and conceal fastening head dimples.
 - e. Treatment Requirements: : Comply with GA-214 as follows
 - 1) Drywall Ceilings And Walls: Level 4.

H. Suspended Gypsum Board Ceiling and Soffit Surfaces

1. Install in accordance with CBC Chapter 25, Section 2504.
2. Hanger Wires
 - a. At Concrete: Use drilled in or shot-in anchors with eye bolts or ceiling clips and anchors for hanger wires.
 - b. At Concrete Filled Metal Deck
 - 1) Use clips and drilled in or shot-in wedge anchors and clips as indicated..
 - c. At Unfilled Metal Deck
 - 1) Install No 3 concrete reinforcing bar in metal deck at each hanger wire location.
 - 2) Tie hanger wire to No. 3 reinforcing bar with three warps around bar and one wrap around wire.

- d. For Attachment To Wood
 - 1) Wood Joists Or Blocking: Secure wires with three staples J-nails with hook to outside of upper part of loop.
 - 2) For Attachment To Truss-Joists And Prefabricated Trusses:
 - a) Use eye bolts as follows:
 - b) Preparation: Drill pilot holes in truss-joists and prefabricated trusses for eye bolts prior to their installation.
 - c) Do not exceed allowable pull out force per CBSC CBC Chapter 23.
 - d) Fully embed screw eye shank in direction of wire with minimum of four tight turns.
 - e. Space hangers maximum 4 feet on center along carrying channels spaced maximum 4 feet on center.
 - f. Do not penetrate duct work with hangers.
 - g. Saddle-tie hanger wires around main runners to develop full strength of hangers.
3. Bracing Wires: Shot-in anchors are not permitted for bracing wires.
- a. At Concrete
 - 1) Use clips and drilled in anchors as indicated.
 - b. At Concrete Filled Metal Deck
 - 1) Use clips and drilled in anchors as indicated.
 - c. At Unfilled Metal Deck
 - 1) Secure 3-inch wide by 4-inch long by 18 gauge steel strap to metal deck with two No. 8 by 1/2-inch metal self tapping screws at each bracing wire location.
 - 2) Install bracing wire thru steel strap and secure with four tight turns on bracing wire within 1-1/2-inches.
 - d. Attachment To Wood Joists Or Blocking: Secure each bracing wire with one of following methods.
 - 1) Secure wires with three staples J-nails with hook to outside of upper part of loop.

OR

 - 2) Fully imbed screw eye shank in direction of wire with minimum of four tight turns.
 - e. Provide one assembly, unless otherwise indicated, of four No. 12 wires splayed at 45 degrees from the ceiling plane and 90 degrees from each other per 144 square feet (12 by 12 feet of ceiling area) secured to main runner with four tight twists in 1-1/2 inches and within two inches of cross runner intersection. Additionally, provide aforementioned bracing system points at distance of not more than one-half of the aforementioned spacing distance from surrounding walls.
 - f. Provide lateral force bracing members spaced minimum six inches from all horizontal piping or ductwork that is not provided with bracing restraints for horizontal forces.
 - g. Provide strut fastened to carrying channels at convergence of splayed wires shall be extended to and be fastened to structure framing deemed acceptable to the enforcement agency as indicated.

- h. Install self-tapping screws to prevent slipping of diagonal bracing wires.
 - i. Provide additional carrying channels, etc., to clear interfering elements in furred area.
 - j. Where main runners are spliced, ends are to be overlapped minimum of 12 inches with flanges of channels interlocked and securely tied near each end splice with wire looped twice around channel.
 - k. Provide one assembly of four No. 12 wires splayed at 45 degrees from ceiling plane and 90 degrees from each other per 144 square feet (12 by 12 feet of ceiling area), unless otherwise indicated, secured to main runner with four tight twists in 1-1/2 inches and within two inches of cross runner intersection. Additionally, provide aforementioned bracing system points at distance of not more than one-half of the aforementioned spacing distance from surrounding walls.
 - l. Install self-tapping screws to prevent slipping of diagonal bracing wires.
4. Furring Channels
- a. Attach furring channels to carrying channels at maximum 16 inches on center.
 - b. Securely attach cross-furring (hat channels) to main runner by saddle tying with not less on strand of No. 16 or 2 strands of No. 18 U.S. gauge tie wire or approved equivalent attachments.
5. Entire suspension system, including all intersections, splices, and perimeter joints, shall be capable of meeting seismic requirements of Article titled "Regulatory Requirements", sub-Articles titled "Metal Components, sub-sub-Article titled "Horizontal Assemblies" and Article titled "Seismic Requirements" in this Section.
6. Scribe ceiling board neatly in casing bead where it meets surfaces of different materials in other planes.
- I. Fire-Rated Conditions
1. General
- a. Install gypsum board as listed in fire test reports.
 - b. Preserve continuity of fire ratings.
 - c. Provide fire-rated enclosures for objects such as electrical outlets and junction boxes, except for electrical boxes that comply with requirements of CBC 2016 Chapter 7, Section 709.4, Exception 1; recessed cabinets and fixtures; and items of similar nature which penetrate fire-rated systems. Support enclosures from structural system; do not support enclosures from penetrating objects nor from board panels.
 - d. Where adjacent interior spaces have furred ceilings of different heights, extend separating partition finish on both faces of studs to at least 4 inches above higher ceiling finish.
 - e. Conform to applicable codes and authorities having jurisdiction for requirements of taping and cementing joints and fastener heads.
2. Erect single layer fire rated gypsum board vertically, with edges and ends occurring over firm bearing.

J. Sound-Rated Conditions

1. Partitions

- a. Prior to gypsum board installations, install acoustical pads on outside surfaces of electric rough-in boxes at interior sound insulated walls.
- b. Construct partitions in accordance with details indicated and as herein specified.
- c. Provide air-tight closures at objects such as outlet and junction boxes, pipes, ductwork, and items of similar nature which penetrate sound-rated walls and ceilings, by neatly cutting gypsum board to clear penetrations by approximately 1/4-inch; seal void with acoustical caulking, and apply joint tape to both gypsum board and penetrating object.
- d. Hold board face and base layer minimum 1/4-inch clear from abutting surfaces such as floors, walls and ceiling. Seal with acoustical caulking and tape, except tape may be omitted at floor.

3.5 CLEANING

- A. Remove gypsum wallboard scraps to a central location on a daily basis during wallboard installation.
- B. During application of taping and finishing materials, scrape floors and sweep broom-clean within 24 hours of final application of gypsum drywall finishing material, on a room-by-room basis.

3.6 ADJUSTING

- A. Repair evidence of popping or ridging of fasteners.

END OF SECTION

SECTION 093000

TILING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes: Provision of tile surfaces complete with, setting beds, bond coats, grouts, and accessories as required for complete tile installations.
- B. Related Sections
 - 1. Section 079000 - Joint Sealants: Joint sealant systems.
 - 2. Section 092500 - Gypsum Board Systems: Metal support framing and backing and backerboard substrate for tile.

1.2 REFERENCES

- A. Ceramic Tile Flooring shall be stable, firm, and slip resistant per CBC Section 11B-302.1.
- B. ANSI - American National Standards Institute
 - 1. A108.1A – Installation of Ceramic Tile in the Wet-Set Method with Portland Cement Mortar.
 - 2. A108.5 - Ceramic Tile Installed with Dry-Set Portland Cement Mortar or Latex-Portland Cement Mortar.
 - 3. A108.6. – Installation of Ceramic Tile with Chemical RESISTANT, Water Cleanable Title-Setting and Grouting Epoxy.
 - 4. A108.10 - Installation of Grout in Tilework.
 - 5. A118.4 - Latex-Portland Cement Mortar.
 - 6. A118.6 - Ceramic Tile Grouts.
 - 7. A118.7 - Polymer Modified Tile Grouts for Tile Installation.
 - 8. A118.9 – Cementitious Backer Units.
- C. ASTM - American Society for Testing and Materials.
 - 1. C1028 - Test Method for Evaluating the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull Meter Method.
- D. TCA - Tile Council of America.
 - 1. Handbook for Ceramic Tile Installation.
 - 2. 137.1 - Specifications for Ceramic Tile.

1.3 SYSTEM DESCRIPTION

- A. Performance Requirements
 - 1. Except as modified by the requirements herein, Work under this Section shall be installed to conform to the applicable requirements of the TCA Handbook for Ceramic Tile Installation.
 - 2. Static coefficient of friction for floor tile shall not be less than 0.05 by ASTM C1028.

1.4 SUBMITTALS

- A. Product Data: Submit data completely describing products.
- B. Samples: Submit following:
 - 1. Samples for each type of tile.
 - 2. Samples of grout for color selection.
- C. Manufacturer's Instructions: Submit manufacturers' instructions for using mortars, bond coats and grouts.

1.5 QUALITY ASSURANCE

- A. Certifications
 - 1. Master Grade Certificate: Provide certificate conforming to ANSI 137.1, for tile. Certificate shall include kind of tile, identification marks for tile packages, name and location of Project, and be issued and signed by manufacturer when tile is shipped.
- B. Mock-Ups
 - 1. Provide one mock-up, a room. Construct sample in place with colored grout.
 - 2. Locate where directed by Owner's Representative.
 - 3. Accepted samples may remain as part of the Work.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use.
- B. Prevent damage or contamination to materials by water, freezing, foreign matter or other causes.

1.7 PROJECT CONDITIONS

- A. Environmental Conditions: Provide sufficient heat and ventilation in areas where work of this section is being performed, so as to allow ceramic tile to properly set. Take all precautionary measures necessary to ensure that excessive temperature changes do not occur.

1.8 MAINTENANCE

- A. Maintenance Data: Submit manufacturer's recommended maintenance instructions including materials and methods for each type of tile installed.
- B. Extra Materials: Furnish the District's rep with minimum two percent of each different size, type, and color of tile, trim shapes and base. Provide in original unbroken containers plainly marked with type and quantity of contents, and area of installation.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Ceramic Tile Flooring
 - 1. American Olean, Daltile, or equal.
 - 2. Type: Floor tile, non-slip finish. American Olean, Daltile, or equal.
 - 3. Size: As selected by Architect.
 - 4. Two Colors and Type: As selected by Architect
- B. Ceramic Wall Tile
 - 1. Type: American Olean, Daltile, or equal.
 - 2. Size: As selected by Architect.
 - 3. Two Colors and Type: As selected by Architect
 - 4. Pattern: Contractor shall make provisions for a basic pattern layout consisting of a continuous accent trim with field color tile.
- C. Trim: Same type, two colors, thickness, face size and finish as wall tile specified.
 - 1. Inside Corners: 90 degrees (straight)
 - 2. Outside Corners: Surface bullnose.

2.2 SETTING AND GROUTING MATERIALS

- A. Mortar Bed Materials
 - 1. Portland Cement: ASTM C150, Type 1.
 - 2. Lime: ASTM C206, Type S or ASTM C207, Type S.
 - 3. Sand: ASTM C144.

4. Reinforcing 108.1A. Article A-2.1.7.
- B. Mortar Bed Bond Coat: Portland cement slurry.
- C. Bond Coats
 1. Tile Latex Portland Cement Bond Coat ANSI A118.4; factory preblended dry set mortar gauged with latex admixture; gray color.
 - a. Latex Admixture: Custom Building Products Acrylic Mortar Admixture; or equal.
 2. Epoxy Bond Coat:: Conform to ANSI A118.3.
- D. Grouts
 1. Ceramic Tile Grout, Typical: Conforming to ANSI A118.7; cementitious type; resistant to shrinking; unsanded for joints to 1/8 inch wide, sanded for joints 1/8 inch and wider. Custom Building Products Polyblend Colored Tile Grout; or equal.
 2. Epoxy Tile Grout: Conform to ANSI A118.3.
 3. Grout Colors: As selected by Architect.

2.3 ACCESSORIES

- A. Water: Clean and potable, free from impurities detrimental to tile Work.
- B. Expansion Joint Materials: As specified in Section 07900.
- C. Finishing and Sealing Materials: As recommended by tile manufacturer.
- D. Waterproof Membrane Systems
 1. Membranes
 - a. Type 1, For Thin-Set Installations: Minimum thickness, 0.030 mil, composed of non-plasticized chlorinated polyethylene, synthetic elastomer laminated to non-woven polyester on both sides.
 - 1) Manufacturers: The Noble Co. Model No. Nobel Seal TS Thin Set Waterproofing & Crack Isolation Sheet, TEC, or equal.
 2. Solvent: Manufacturer's recommended solvent, for welding seams by chemical fusion.
 3. Sealant: As recommended by waterproof membrane manufacturer.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Floor Tile

1. Type F1, Typical: At Concrete Substrates: Installation of Floor Tile Over Concrete Subfloor, Mortar Bed, With Type 1 Latex Portland Cement Bond Coat. TCA Handbook Installation Method Cement Mortar Bonded Method F112-03.
 - a. Tile: ANSI A108.1B
 - b. Grout: ANSI A108.10.
 2. Type F2: At Concrete Substrates: Installation of Floor Tile Over Concrete Subfloor, With Type 1 Latex Portland Cement Bond Coat. TCA Handbook Installation Method Cement Mortar Bonded Method F113-03.
 - a. Tile: ANSI A108.4
 - b. Grout: ANSI A108.10.
- B. Wall Tile, Typical
1. Type W1: At Mold Resistant Tile Backer Board Substrates. Installation of Wall Tile Over Metal Studs As Indicated, Mold Resistant Tile Backer Board, With Type 1 Bond Coat. TCA Handbook Installation Method Coated Glass Mat Backer, Thin Set W245-03.
 - a. Coated Glass Mat Water Resistant Gypsum Backing Board: ASTM C1178.
 - b. Tile: ANSI A108.5.
 - c. Grout: ANSI A108.10.
 2. Type W2: At Cementitious Backer Unit Substrates: Installation of Wall Tile Over Metal Studs As Indicated, Cementitious Backer Unit Underlayment With Type 1 Bond Coat. TCA Handbook Installation Method At Cementitious Backer Unit Underlayment Thin Set W244-03.
 - a. Cementitious Backer Units: ANSI A118.9.
 - b. Tile: ANSI A108.5.
 - c. Grout: ANSI A108.10.

END OF SECTION

SECTION 095000

ACOUSTICAL CEILING SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes
 - 1. Suspended metal grid ceiling systems and acoustical panels and boards.
 - 2. Perimeter trim.
- B. Related Sections
 - 1. Section 092500 - Gypsum Board Systems: Metal support framing and backing and gypsum board wall sheathing.
 - 2. Division 22 - Plumbing
 - 3. Division 26 - Electrical

1.2 REFERENCES

- A. ASTM - American Society for Testing and Materials
 - 1. A525 - Specification for General Requirements for Steel Sheet, Zinc Coated (Galvanized) by Hot-Dip Process.
 - 2. A586 - Specification for Zinc Coated Parallel and Helical Steel Wire Structural Strand.
 - 3. A641 - Specification for Zinc Coated (Galvanized) Steel Wire.
 - 4. C635 - Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings.
 - 5. E84 - Surface Burning Characteristics of Building Materials.
 - 6. E1264 - Classification of Acoustical Ceiling Products.
- B. CBSC - California Building Standards Commission.
 - 1. CBC California Building Code, 2016 Edition
- C. FS - Federal Specifications
 - 1. FF-S-325 INT AMD 3 - Shield, Expansion; Nail, Expansion; and Nail, Drive Screw (Devices, Anchoring, Masonry).

1.3 SYSTEM DESCRIPTION

- A. Design Requirements:
 - 1. Architectural reflective ceiling plan drawings govern over mechanical and electrical drawings.

1.4 SUBMITTALS

- A. Product Data: Submit manufacture's literature completely describing metal grid system components and acoustic panels.
- B. Shop Drawings
 - 1. Submit drawings showing complete reflected ceiling layout at 1/4-inch equals one foot scale, showing all elements penetrating or contacting the ceiling, including but not limited to, the following:
 - a. Lighting fixtures.
 - b. Mechanical registers.
 - c. Speakers.
 - d. Sprinkler heads.
 - e. Ceiling-mounted equipment and supports, and other similar items attached to or penetrating the ceiling.
 - 2. Follow reflected ceiling plan for layout.
- C. Samples
 - 1. Acoustical Material: Submit samples, minimum 6 x 10 inches in size, illustrating material, edge condition, and finish of acoustic panels.
 - 2. Suspension System Components: One foot long segments of each component.
- D. Structural Calculations And Details: If required by requirements as specified in Article titled Quality Assurance, Regulatory Requirements in this Section signed by Structural Engineer Registered in the State of California.

1.5 QUALITY ASSURANCE

- A. Qualifications
 - 1. Manufacturer: Company specializing in manufacture of ceiling suspension system and ceiling panels with three years minimum experience.
 - 2. Installer: Company with three years minimum experience and approved by manufacturer.
- B. Regulatory Requirements
 - 1. Seismic Requirements: Provide suspended acoustical ceiling systems that comply CBC Chapter 16A, 1616A.1.21.
 - 2. Grid: Comply with CBSC CBC Chapter 25, Section 2501.
 - 3. Fire Performance Characteristics: Identify acoustical ceiling components with appropriate markings of applicable testing and inspecting organization.
 - a. Surface Burning Characteristics: As follows, tested per ASTM E 84 and complying with ASTM E 1264 Classification.
 - b. Fire Resistance: As follows tested per ASTM E119 and listed in the appropriate floor or roof design in the Underwriters Laboratories Fire Resistance Directory

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver acoustical products only after glazing has been completed, exterior openings closed in, and wet work completed and dried out.
- B. Deliver and store packaged products in original containers with seals unbroken and labels intact until time of use.

1.7 PROJECT CONDITIONS

- A. Environmental Requirements
 - 1. Maintain uniform temperature of minimum 60 degrees F and humidity of 20 to 40 percent prior to, during, and after installation.

1.8 SEQUENCING AND SCHEDULING

- A. Do not install acoustical ceilings until dust generating activities have terminated, and overhead work is completed, tested, and approved.
- B. Schedule installation of acoustic panels after interior wet work is dry.
- C. Coordinate acoustical treatment work with mechanical, electrical or other equipment, materials or work which could conflict with the installation of this work.

1.9 EXTRA STOCK

- A. Provide one carton of each type of panel or board used.

PART 2 PRODUCTS

2.1 SUSPENSION SYSTEM MATERIALS

- A. General
 - 1. Grid: ASTM C635, Heavy duty, type complying with following requirements:
 - 2. Fire Resistive Characteristics: Non-fire rated.
 - 3. Grid System: Provide exposed grid system, pre-painted steel.
 - 4. Finish: Exposed surfaces, factory finished.
- B. Trapeze Framing: 12 gauge framing channel; 1-5/8 x 1-5/8 inch size; galvanized finish; P1000 as manufactured by Unistrut Corporation, or equal.
- C. Hanger And Bracing Wire: ASTM A641, Class 1 Coating, soft temper; minimum 12 gauge.
- D. Suspension System Fasteners
 - 1. Wedge Anchors: FS-FF-S-325. Group II, Type 4, size as indicated. Hilti Fastening Systems "KWIK-Bolt Concrete Expansion Anchors"; Wej-IT Concrete Anchors"; Ramset Division of Olin Corp's "Thrubolt Wedge

- Anchors". Allowable capacity shall not exceed 80 percent of the allowable load listed in ICC Research Committee Recommendations for the specific anchor.
2. Expansion Eye Bolts: Sizes as indicated. FS FF-S-325, Group II, Type 4; Wej-It Expansion Products "Wej-It Non-Removable Eye Bolts"; or equal, meeting minimum allowable capacities noted for expansion bolts above.
 3. Powder Driven Fasteners:" Tempered steel pins with special corrosive-resistant plating and coating. Pins shall have guide washers to accurately control penetration, maximum 3/4-inch. Fastening shall be accomplished by low-velocity piston-driven powder-actuated tool. Pins and tool Hilti Fastening Systems; Impex Tool Corp; or equal
 4. Ceiling Clips
 - a. Type 1: Minimum 13 gauge by 3/4 inch wide: Hilti "Ceiling Clip"; or equal.
 - b. Type 2: Steel strap size and shape as indicated or Hilti "Ceiling Clip" as indicated.
 5. Attachment Devices
 - a. For Light Fixtures: Provide devices having capacity of 100 percent of lighting fixture weight acting in any direction.
 - b. For Mechanical Services: Capable of providing positive attachment to ceiling suspension system with same carrying capacity as main runners.
 6. Compression Struts: Hot or cold rolled metal studs complying with ASTM A586; formed from steel with minimum 33,000 psi yield galvanized finish per ASTM A525:
 - a. Up To Seven Feet: "Cee" shape; 20 gauge; 1-5/8 inch deep web; 1-1/4 and 1-3/8 inch flanges; 1/4 inch returns; minimum radius of gyration about y-axis of 0.436; L/R ratio of 200 maximum; Angeles Metal Systems 20HDS158, or equal.
 - b. For Long Spans Over Seven Feet: Back to back 3-5/8-inch by 20 gauge metal studs, having 1-1/4-inch flange and 1/4-inch return. Same maximum radius of gyration and L/R as for under 7-foot conditions.

2.2 ACOUSTICAL CEILING MATERIALS

- A. Typical installation:
 1. Armstrong #2910, Random fissured perforations
 2. Unit Sizes: 24 by 48 inches
 3. Thickness: 5/8-inch.
 4. Type: Square, lay-in
 5. Light Reflectance: 0.88.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive acoustical treatment and verify that:
 - 1. Installation of building components located in ceiling plenums is complete.
 - 2. Spacing, direction, and details of grid members and supports to accommodate installation of light fixtures, diffusers, and other items as shown on Reflected Ceiling Plan are correct.
 - 3. Areas are clean and free of materials or rubble that could damage acoustical surfaces.
 - 4. Obtain acceptance of the Owner's Representative before installing acoustical surfaces.

- B. Do not start installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION SUSPENSION SYSTEM

- A. General
 - 1. Install in accordance with CBSC CBC Chapter 25, Section 2501.
 - 2. Install suspension systems in accordance with CBSC CBC Chapter 25 and DSA IR 25-2.13.
 - 3. Use of scrap or short-cut members is not permitted.
 - 4. Completely frame openings with channels.
 - 5. Remove excess hanger and bracing wire after turns have been made.
 - 6. Clip off wire between 3 and 4 inches of last turn.
 - 7. Do not splice hanger or bracing wire.

- B. Hanger Wires
 - 1. Hanger Wires
 - a. At Concrete: Use drilled in or shot-in anchors with eye bolts or ceiling clips and anchors for hanger wires.
 - b. At Concrete Filled Metal Deck
 - 1) Use clips and drilled in or shot-in wedge anchors and clips as indicated.
 - c. At Unfilled Metal Deck
 - 1) Install No 3 concrete reinforcing bar in metal deck at each hanger wire location.
 - 2) Tie hanger wire to No. 3 reinforcing bar with three warps around bar and one wrap around wire.
 - d. For Attachment To Wood
 - 1) Wood Joists Or Blocking: Secure wires with three staples J-nails with hook to outside of upper part of loop.
 - 2) For Attachment To Truss-Joists And Prefabricated Trusses:
 - a) Use eye bolts as follows:
 - b) Preparation: Drill pilot holes in truss-joists and prefabricated trusses for eye bolts prior to their installation.

- c) Do not exceed allowable pull out force per CBSC CBC Chapter 23.
 - d) Fully embed screw eye shank in direction of wire with minimum of four tight turns.
 - 2. Plumb hanger wires and install in manner such that they do not press against conduits, duct, pipes or their covering material.
 - 3. If hangers must be splayed, offset the resulting horizontal force by bracing, counter splaying or other acceptable means.
 - 4. Attach each vertical wire to suspension system member with minimum of three tight turns within 1-1/2-inches.
 - 5. Provide suspension wires that do not hang more than 1 in 6 out of plumb unless counter sloping wires provided.
 - 6. Wires shall not be attached to or be bent around interfering material or equipment. A trapeze or equivalent device shall be used where obstructions preclude direct suspension. Provide trapeze suspensions consisting of minimum of back to back 1-1/4-inch cold-rolled channels for spans exceeding 48-inches. Provide special attachment devices that support carrying channels or main runners are to be approved to support five times design load.
- C. Lateral Force Design: Comply with requirements of CBSC CBC Chapter 16A, Section 1616A.1.21 and Chapter 25, Sections 2501.
 - 1. Lateral Force Bracing System
 - a. General: Attachment of restraint wires to structure above shall be adequate for load imposed.
 - 2. Bracing Wires: Shot-in anchors are not permitted for bracing wires.
 - a. At Concrete
 - 1) Use clips and drilled in anchors as indicated.
 - b. At Concrete Filled Metal Deck
 - 1) Use clips and drilled in anchors as indicated. Shot-in anchors are not permitted for bracing wires.
 - c. At Unfilled Metal Deck
 - 1) Secure 3-inch wide by 4-inch long by 18 gauge steel strap to metal deck with two No. 8 by 1/2-inch metal self tapping screws at each bracing wire location.
 - 2) Install bracing wire thru steel strap and secure with four tight turns on bracing wire within 1-1/2-inches.
 - d. Attachment To Wood Joists Or Blocking: Secure each bracing wire with one of following methods.
 - 1) Secure wires with three staples J-nails with hook to outside of upper part of loop.
 - OR
 - 2) Fully imbed screw eye shank in direction of wire with minimum of four tight turns.
 - e. Provide one assembly of four No. 12 wires splayed at 45 degrees from the ceiling plane and 90 degrees from each other per 144 square feet (12 by 12 feet of ceiling area) secured to main runner with four tight twists in 1-1/2 inches and within two inches of cross runner intersection. Additionally, provide aforementioned bracing

- system points at distance of not more than one-half of the
aforementioned spacing distance from surrounding walls.
- f. Provide lateral force bracing members spaced minimum six inches from all horizontal piping or ductwork that is not provided with bracing restraints for horizontal forces.
 - g. Bracing wires are to be attached to grid and to the structure in such a manner that they can support a design load of not less than 200 pounds or actual design load, whichever is greater, with safety factor of 2 without yielding.
 - h. Provide strut fastened to main runner at convergence of splayed wires shall be extended to and be fastened to solid blocking installed between truss-joists and prefabricated trusses or to such other framing deemed acceptable to the enforcement agency as indicated.
- D. Perimeter Members
1. Ends of main runners and cross members more than 12 inches in length shall be tied together to prevent their spreading.
 2. Perimeter Hangers: Terminal ends of each main and cross runners are to be supported independently at maximum of eight inches from each wall or ceiling discontinuity with No. 12 gauge wire or approved wall support.
 3. Attachment Of Perimeter Members: Main and cross runners may be attached to the perimeter member at two adjacent walls with clearance between wall and runners maintained at other two walls or as otherwise shown or described for approved system.
- E. Lighting Fixtures
1. Positively attach lighting fixtures to suspended ceiling system.
 2. Provide hanger wire supports for all recessed light fixtures as required for total support independent of acoustical ceiling systems.
 3. Comply with other applicable requirements of CBSC CBC State Chapter 25, Section 2501.
- F. Mechanical Services
1. Ceiling-mounted air terminals or services shall be positively attached to the ceiling suspension main runners or cross runners with same carrying capacity as main runners.
 2. Terminals or services weighting not more than 56 pounds shall have two No. 12 gauge hangers connected from the terminal or service to structure above. These wires may be slack.
 3. Terminals or services weighting more than 56 pounds shall be supported directly from structure above by approved hangers.
- G. Level grid assembly in each area after installation of mechanical and electrical equipment.
- H. Entire suspension system including intersections, splices, and perimeter joints is to comply with requirements as specified in Article titled "Regulatory Requirements", sub-Article titled "Seismic Requirements" in this Section.

- I. Trim
 - 1. Install at intersections with perpendicular surfaces as shown.
 - 2. Miter joints where trim pieces meet all wall angles. Do not bend trim around corners.

3.3 INSTALLATION OF ACOUSTICAL CEILING MATERIALS

- A. Install acoustic ceiling materials in accordance with manufacturer's installation instructions.
- B. Fit panels in place, free from damaged edges or other defects detrimental to appearance and function.
- C. Install ceiling materials level, in uniform plane, and free from twist, warp and dents.
- D. To minimize cutting, lay work out symmetrically about centers of rooms and provide symmetrical borders not less than half size of board or tile specified.
- E. Cut panels to fit irregular grid and perimeter edge trim.

3.4 ERECTION TOLERANCES

- A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet.

3.5 FIELD QUALITY CONTROL

- A. Tests
 - 1. General: The Agency having ultimate jurisdiction may require tests to determine compliance with CBSC CBC Chapter 25, Section 2503.

3.6 ADJUSTING

- A. Remove damaged or soiled material and replace with new prior to the final acceptance of project.

3.7 CLEANING

- A. Clean suspended acoustical ceiling systems in strict accordance with manufacturer's instructions and comply with following:
 - 1. Ensure that cleaned surfaces do not differ from un-cleaned portions. Any difference will be considered unsatisfactory work.

3.8 PROTECTION

- A. Provide protection to prevent damage to completed installations until final acceptance.

END OF SECTION

SECTION 096500

RESILIENT FLOORING

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes: Requirements for the provision of:
 - 1. Resilient Flooring
- B. Related Sections:
 - 1. Section 033000 – Cast-In-Place Concrete: Provision of cast-in-place concrete.
 - 2. Section 072600 – Water Vapor Testing and Control: For vapor emission treatment systems.

1.2 REFERENCES

- A. Resilient Flooring shall be stable, firm, and slip resistant, per CBC Section 11B-302.1
- B. ASTM – American Society for Testing and Materials
 - 1. D2240 – Standard Test Method for Rubber Property – Durometer Hardness.
 - 2. F710 – Practice for Preparing Concrete Floors and Other Monolithic Floors to Receive Resilient Flooring.
 - 3. F1303 – Standard Specification for Sheet Vinyl Floor Covering.
 - 4. F1344 – Standard Specification for Rubber Floor Tile.
- C. FS – Federal Specifications
 - 1. SS-W-40A – Wall Base; Rubber, and Vinyl Plastic.

1.3 SUBMITTALS

- A. Product Data: Submit 3 copies of manufacturer's technical data and installation instructions for each type of resilient flooring and accessory.
- B. Samples: Submit 3 sets of samples of each type, color and finish of resilient flooring and accessory required, indication full range of color and pattern variation. Provide 18" square samples of tile flooring and 6" long samples of accessories.
- C. Closeout Submittals: Submit 3 copies of the following:
 - 1. Maintenance and operations data includes—methods for maintaining installed products, and precautions against cleaning materials and methods detrimental to finishes and performance.
 - 2. Warranty: Warranty documents specified herein.

- D. Flame Spread Certification: Submit manufacturer's certification that resilient flooring furnished for areas indicated to comply with required flame spread rating has been tested and meets or exceeds indicated standard.
- E. Replacement Material: After completion of work, deliver to project site replacement materials from same manufactured lot as materials installed, and as follows:
 - 1. Sheet Flooring: Not less than 50 square feet for each type, pattern, color installed.
 - 2. Resilient Base: Not less than 10 linear feet for each 500 linear feet or fraction thereof of each different type and color installed.

1.4 QUALITY ASSURANCE

- A. Manufacturer: Whenever possible, provide each type of resilient flooring and accessories as provided by a single manufacturer, including recommended primers, adhesives, sealants, and leveling compounds.
- B. Flooring Contractor Qualifications:
 - 1. The Awarded Contractor shall be an established firm, experienced in the installation of the specified product and shall have access to all manufacturer's required technical, maintenance, specifications and related documents.
 - 2. The Flooring Contractor shall have completed at least three projects of similar magnitude, material and complexity, and must provide project reference details including contact names and telephone numbers.
- C. Installer Qualifications: Installer experienced in performing work of this section who as specialized in installation of work similar to that required for this project.
- D. Regulatory Requirements:
 - 1. Provide products with the following fire-test response characteristics as determined by testing identical products per test method indicated below by a testing and inspecting agency acceptable to authorities have jurisdiction.
 - 2. Comply with requirements set forth in CA Green Building Code, Section 5.504.4 for Finish Material Pollution Control.
- E. Standard of Quality: For the purpose of evaluating the quality of workmanship, a mock up installation of the specified floorcovering shall be provided by the Flooring Contractor in an area designated by the architect. Upon approval, this test installation shall then be considered the standard of quality and basis of comparison for the balance of the project. Areas found to be deficient by specification standards or application procedures shall be repaired/replaced at contractor's expense.

1.5 WARRANTY

- A. Manufacturer's Warranty: Submit manufacturers standard warranty document.

1. Warranty Period: Five (5) year limited warranty commencing on Date of Substantial completion.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- B. Storage and Protection: Store materials protected for exposure to harmful weather conditions and at a temperature and humidity conditions recommended by manufacturer.
 1. Materials should be stored in areas that are fully enclosed, weather tight with the permanent HVAC system set at a uniform temperature of at least 68 degrees F (20 degrees C) for 72 hours prior to, during and after installation.
 2. Move resilient flooring and installation accessories into spaces where they will be installed at least 48 hours before installation, unless longer conditioning periods are recommended in writing by the manufacturer.

1.7 PROJECT CONDITIONS

- A. Substrate Conditions: Use the method described below to determine the dryness as required to insure initial and long term success
 1. F1869-98 Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride:
 - a. This test method covers the quantitative determination of the rate of moisture vapor emitted from below-grade, on-grade, and above-grade (suspended) concrete floors.
 3. The General Contractor shall be responsible for conducting one calcium chloride test for every 1,000 square feet (minimum 3 tests) to insure concrete moisture emissions do not exceed 5.0 lbs per 1,000 square feet within a 24-hour period.
 4. Contingency for High Moisture Readings: If at the time of testing the moisture readings are in excess of 5.0lbs the Owner's Representative will initiate testing using petrographic analysis to determine if the Water Cement Ratio and sufficient hydration has taken place. If the Specifications were not followed in their entirety, water/cement ratio (as specified), and or the concrete surface has been inadequately hydrated the Contractor responsible for the placement of the cement shall be responsible for the costs associated with the petrographic analysis and subsequent remediation requirements.
- B. The Flooring Contractor shall verify in writing to the Owner, a minimum of thirty (30) days prior to scheduled resilient flooring installation, the following substrate conditions:
 1. Moisture: Initial emission rate, as tested with a calcium chloride test kit, Per ASTM F1869-89 requirements.

2. Alkalinity: Maximum pH of 10
- C. Environmental Requirements/Conditions: In accordance with manufacturer's recommendations. Areas to receive flooring shall be clean, fully enclosed, weather tight with the permanent HVAC set at a uniform temperature of at least 68 degrees F (20 degrees C). The flooring material should be conditioned in the same manner.
- D. Temperature Requirements: Maintain air temperature in spaces where products will be installed for time period before, during, and after installation as recommended by manufacturer.
 1. Temperature Conditions: 68 degrees F (20 degrees C) for 72 hours prior to and during and for not less than 48 hours after installation.
- E. Close spaces to traffic during resilient flooring installation and for time period after installation recommended in writing by the manufacturer.
- F. Install resilient flooring material and accessories after other finishing operations, including painting, have been completed.
- G. Where demountable partitions and other items are indicated for installation on top of sheet resilient flooring material, install flooring material before these items are installed.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include but are not limited to, the following:
 1. Flooring: Armstrong Imperial Texture 51858 (or equal)
 2. Color: Sand Drift White
- B. Rubber Wall Base: To establish a standard of quality, design and performance, Burke Mercer Flooring Products has been selected. Alternative material shall be considered acceptable provided they meet or exceed the specification criteria as detailed herein. The Owner's Representative shall be solely responsible for the determination as to equivalency.
 1. Burke Mercer Flooring Products or equal.

2.2 MATERIALS

- A. Colors and Patterns: per above
- B. Upon request by Owner's Representative, Flooring manufacturing to provide independent testing labs verification of all applicable test results.

2.3 ACCESSORIES

- A. Adhesive: per manufacturer's recommendations
- B. Resilient Edge Strips: 1/8" thick, homogeneous vinyl or rubber composition, tapered or bull nose edge, color to match flooring, or as selected by Owner's Representative from standard colors available, no less than 1" wide.
- C. Metal Edge Strips: Of width shown and of required thickness to protect exposed edge of resilient flooring. Provide units of maximum available length, to minimize number of joints.
- D. Leveling and Patching Compounds: Portland Cement types as recommended by flooring manufacturer.

PART 3—EXECUTION

3.1 INSPECTION

- A. Installer must examine areas and conditions under which resilient flooring and accessories are to be installed and must notify General Contractor in writing of conditions detrimental to proper and timely completion of work. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Owner's Representative.

3.2 PREPARATION

- A. Surface Preparation:
 - 1. General: Broom clean or vacuum surfaces to be covered and inspect subfloor. Start of flooring installation indicates acceptance of subfloor conditions and full responsibility for completed work.
 - 2. Floor Substrate: Prepare floor substrate to be smooth, rigid, flat, level, permanently dry, clean and free of foreign materials such as dirt, paint, grease, oils, solvent, curing and hardening compounds, sealers, asphalt and old adhesive residue.

3.3 INSTALLATION

- A. Adhesive Flooring Installation: Refer to Manufacturers recommendations Apply adhesive using 1/16" x 1/16" x 1/16" square notch trowel and lay flooring into wet adhesive and roll with a 100 pound roller.
 - 1. Adhesive Material Installation: Use trowel as recommended by flooring manufacturer for specific adhesive. Spread at a rate of approximately 150 sq. ft/ gallon as recommended by flooring manufacturer.
- B. Installation Techniques:
 - 1. Do not reverse sheets for seaming.
 - 2. Install one sheet at a time
 - 3. Install rolls and cuts in consecutive order

4. Where demountable partitions and other items are indicated for installation on top of finished flooring, install flooring before these items are installed.
 5. Scribe, cut, fit flooring to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture, including pipes, outlets, edgings, thresholds, nosing and cabinets.
 6. Extend flooring into toe spaces, floor reveals, closets and similar openings.
 7. Install flooring on covers for telephone and electrical ducts, and similar items occurring within finish floor areas. Maintain overall continuity of color and pattern with pieces of flooring installed on these covers.
 8. Do not install resilient flooring over expansion joints. Use expansion joint covers manufactured for use with resilient flooring. Refer to other specification sections for expansion joint covers.
 9. Adhere resilient flooring to substrate without producing open cracks, voids, raising and puckering at joints, telegraphing to adhesive spreader marks, or other surface imperfections in completed installation
 - a. Use adhesive applied to substrate in compliance with flooring manufacturer's recommendations, including those for trowel notching, adhesive mixing and adhesive open and working times.
- C. Heat Welded Seams: To provide a seamless and watertight installation, seams are to be heat welded using color matched welding rod (4 mm. Diameter) as manufactured by Forbo as indicated.
- D. Finish Flooring Patterns: As selected by Owner's Representative.
- E. Provide seam layout drawings to Owner's Representative for review and approval.

3.4 CLEANING

- A. Materials: Contractor shall provide and apply initial maintenance products as per details and procedures per manufacturer's recommendations.
- B. Cleaning: Remove temporary coverings and protection of adjacent work areas. Repair or replace damaged installed products. Clean installed products in accordance with manufacturer's instructions, prior to Owner's Representative acceptance. Remove construction site debris from project site and legally dispose of debris.
1. Remove visible adhesive and other surface blemishes using cleaning methods recommended by flooring manufacturer.
 2. Sweep vacuum floor after installation.
 3. Do not wash floor until after time period recommended by flooring manufacturer.
 4. Damp mop flooring to remove black marks and soil.

3.5 PROTECTION

- A. Protection: Protect installed product and finish surfaces from damage during construction. Remove and legally dispose of protective covering at time of Substantial Completion

END OF SECTION

SECTION 096800

CARPET

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes: Provision of commercial carpeting with integral pad and installation for long term medium and heavy indoor usage. Installation shall be by direct glue down of carpet rolls and carpet tile as noted on finish schedule.
- B. Related Sections
 - 1. Section 033000 - Cast-In-Place Concrete
 - 2. Section 099700 - Concrete Floor Sealer

1.2 REFERENCES

- A. Carpet shall be securely attached and shall have a firm cushion, pad, or backing or no cushion or pad. It shall have a level loop, textured loop, level cut pile, or level cut/uncut pile texture. Pile height shall be ½" maximum, per CBC Section 11B-302.2.
- B. Exposed edges shall be fastened to floor surfaces and shall have trim on the entire length. Carpet edges shall comply with CBC Section 11B-303. CBC Section 11B-302.2.
- C. ASTM - American Society for Testing and Materials
 - 1. E648 - Test Method Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source.
 - 2. F710 - Practice for Preparing Concrete Floors and Other Monolithic Floors to Receive Resilient Flooring.
- D. CRI - Carpet and Rug Institute
 - 1. 104 - Standard for Installation of Commercial Textile Floorcovering Materials.
- E. DOC - Department of Commerce
 - 1. FF 1-70 - Methenamine Pill Test.
- F. NFPA - National Fire Protection Association
 - 1. 253 - Test Method for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source.

1.3 SUBMITTALS

- A. Product Data: Submit manufacturer's product data for each type of carpet material and installation accessory required. Submit written data on physical characteristics, durability, resistance to fading, and flame resistance characteristics.

- B. Shop Drawings: Submit shop drawings showing layout. Indicate pile or pattern direction and locations and types of edge strips. Indicate columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet. Show installation details at special conditions.
- C. Samples:
 - 1. Submit three samples of each carpet type illustrating color, weave, texture and pattern – 12” squares, minimum size.
 - 2. Submit manufacturer's full range of color selections for carpet edge strips.

1.4 QUALITY ASSURANCE

- A. Qualifications
 - 1. Manufacturer: Firm whose carpet materials comply with "Use of Materials Bulletin UM-44C" published by U.S. Department of Housing and Urban Development (HUD) and are currently listed in HUD "Certified Products Directory" and so identified by imprint on back of carpet.
- B. Regulatory Requirements
 - 1. Carpet and padding floor coverings shall have minimum critical radiant flux limit of 0.22 watts/cm² when tested in accordance with NFPA 253. Such rating shall be maintained for distance of 5 feet on all sides of fire door except as otherwise prohibited by building design and construction.
 - 2. Carpet Surface Burning Characteristics: Provide carpet identical to that tested for the following fire performance characteristics, per test method indicated below, by UL or other testing and inspecting organizations acceptable to authorities having jurisdiction. Identify carpet with appropriate markings of applicable testing and inspecting organization.
 - a. Test Method: DOC FF 1-70.
 - b. Rating: Pass.
 - 3. NBS Smoke Chamber Test: Exceed test requirements with maximum specific optical density of 350 or less in the flaming mode.
 - 4. Striping for Visually Impaired: Conform to ADA requirements for strip of clearly contrasting color at least 2 inches wide placed parallel to and not more than 1 inch from nose of upper approach and lower tread of each stair.
 - 5. Carpet pile height shall meet requirements of ADA.
 - 6. Hazard Communications: If hazardous/toxic chemical or chemical compounds are to be used in this project, provide current and complete sets of all Material Safety Data Sheets (MSDSs) for Owner employee training purposes prior to project start.
 - 7. Comply with requirements set forth in CA Green Building Code, Section 5.504.4.1 for Adhesives, Sealants and Caulks.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Acceptance at Site: Deliver materials to Project site in original factory wrappings and containers, labeled with identification of manufacturer, brand name, and lot number.
- B. Storage and Protection: Store materials in original undamaged packages and containers, inside well-ventilated area protected from weather, moisture, soilage, extreme temperatures, and humidity. Lay flat, blocked off ground. Maintain minimum temperature of 68 degrees Fahrenheit at least 3 days prior to and during installation in area where materials are stored.

1.6 PROJECT CONDITIONS

- A. Substrate Conditions: No condensation within 48 hours on underside of 4 feet by 4 feet polyethylene sheet, fully taped at perimeter to substrate.
- B. Substrate Conditions: pH of 9 or less when substrate wetted with potable water and pHydriion paper applied.
- C. Ventilate carpet prior to installation.

1.7 WARRANTY

- A. Unless otherwise noted, manufacturer's 10 years written warranty shall be submitted to the Owner against product failure covering both labor and material in the following areas:
 - 1. Edge ravel.
 - 2. Secondary back adhesion.
 - 3. Average 20 pounds tuft bind.
 - 4. No more than 10 percent face yarn loss.

1.8 MAINTENANCE

- A. Extra Materials
 - 1. Deliver extra materials to the Owner. Furnish extra materials matching products installed as described below, packaged with protective covering for storage and identified with labels describing contents.
 - 2. Carpet: Before installation begins, furnish quantity for each type of material equal to 5 percent of amount installed.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturer: types based on Shaw Contract Group
 - 1. Type: Tile
Collection: Hand Drawn
Style: Stipple
Size: 18" x 36"
Color: TBD

- Type: multi-level pattern loop
Use Lokdots for adhesive
2. Type: Tile
Collection: No Rules
Style: Diffuse+Disperse
Size: 24" x 24"
Color: TBD
Type: multi-level pattern loop
Use Lokdots for adhesive
 3. Type: Tile
Collection: Places
Style: Central Line
Size: 24" x 24"
Color: TBD
Type: multi-level pattern loop
Use Lokdots for adhesive
 4. Type: Broadloom
Collection: Hand Drawn
Style: Scribe
Size: rolled goods
Color: TBD
Adhesive: Shaw 1200
 5. Type: Broadloom
Collection: Shade
Style: Gradient
Size: rolled goods
Color: TBD
Adhesive: Shaw 1200

2.2 MATERIALS

A. Carpet

1. Warranties: Minimum of non-prorated, 10 year warranty covering material and labor against edge ravel, backing delamination, wet or dry, static protection, face yarn loss no more than 10 percent or 20 lb. tuft bind.
2. Odor Emissions: Carpet shall be void of 4--phenylcyclohezene, a by product of SBR latex.
3. Carpet shall economically maximize the following appearance retention characteristics:
 - a. Minimize crushing and matting.
 - b. Manage dry soil concerns and ease of maintenance.
 - c. Manage staining.
 - d. Eliminate seam failure and unraveling.
 - e. Eliminate moisture exposure concerns.
 - f. Minimize loss of coloration and fading.

- g. Color: to be determined at time of submittals
- h. Carpet Pad: manufacturer's integral carpet pad

2.3 ACCESSORIES

- A. Transition Strips
- B. Adhesives: Water resistant, mildew resistant, nonstaining type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet and that is recommended by carpet pad manufacturer.
- C. Crack Filler: Latex base type as recommended by the carpet manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet performance. Verify that substrates and conditions are satisfactory for carpet installation and comply with requirements specified.
- B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F710 and the following:
 - 1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by the Carpet manufacturer.
 - 2. Subfloor finishes comply with requirements specified in Division 3 Section "Cast-in-Place Concrete" for slabs receiving carpet.
 - 3. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.

3.2 PREPARATION

- A. General: Comply with CRI 104, Section 6.2, "Site Conditions; Floor Preparation", and carpet manufacturer's written installation instructions for preparing substrates indicated to receive carpet installation.
- B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, and depressions in substrates.
- C. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone,

without using solvents. Use mechanical methods recommended in writing by the carpet manufacturer.

- D. Broom and vacuum clean substrates to be covered immediately before installing carpet. After cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust. Proceed with installation only after unsatisfactory conditions have been corrected.
- E. Test concrete for vapor emission as specified in Section 09650 and treat with vapor emission treatment systems specified in Section 09980, as required.

3.3 INSTALLATION

- A. Carpet with Attached-Cushion Installation: Comply with CRI 104, Section 10, "Attached Cushion".
- B. Extend carpet under removable flanges and furnishings and into alcoves and closets of each space.
- C. Provide cutouts where required, and bind cut edges where not concealed by protective edge guards or overlapping flanges.
- D. Install carpet edge guard where edge of carpet is exposed; anchor guards to substrate.
- E. Install with pattern parallel to walls and borders unless otherwise indicated on the Drawings.
- F. Install carpet by trimming edges, butting cuts with seaming cement, and taping and/or sewing seams to provide sufficient strength for stretching and continued stresses during life of carpet.

3.4 CLEANING

- A. Remove adhesive from carpet surface with manufacturer's recommended cleaning agent.
- B. Remove and dispose of debris and unusable scraps. Vacuum with commercial machine with face-beater element. Remove soil. Replace carpet where soil cannot be removed. Remove protruding face yarn.
- C. Vacuum carpet.

3.5 PROTECTION

- A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and installer, to ensure carpet is not damaged or deteriorated at time of Substantial Completion.

END OF SECTION

SECTION 099000

PAINT

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes: Requirements for the provision of:
 - 1. Surface preparation, painting and finishing of exposed items and surfaces.
 - 2. Refer to drawings for scope of work requiring paint in Phase 1A
- B. Related Sections:
 - 1. Section 051200 - Structural Steel
 - 2. Section 092500 – Gypsum Board Systems

1.2 REFERENCES

- A. ASTM - American Society for Testing and Materials:
 - 1. ASTM D 16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications.
- B. SSPC - Steel Structures Painting Council

1.3 DEFINITIONS

- A. "Paint": As used herein, means coating systems materials including primers, emulsions, epoxy, enamels, sealers, fillers, and other applied materials whether used as prime, intermediate or finish coats.

1.4 SYSTEM DESCRIPTION

- A. Performance Requirements
 - 1. Paint exposed surfaces whether or not colors are designated in the schedules, except where a surface or material is specifically indicated not to be painted or is to remain natural. Where an item or surface is not specifically mentioned, paint the same as similar adjacent materials or surfaces. If color or finish is not designated, the Architect will select from standard colors or finishes available.
 - 2. Painting is not required on pre-finished items, finished metal surfaces, concealed surfaces, operating parts and labels.
 - 3. Do not paint over UL, FM or other code required labels or equipment name, identification, performance rating or nomenclature plates.

1.5 SUBMITTALS

- A. Product Data: Submit manufacturer's product data for each paint system specified, including primers.
 - 1. Provide manufacturer's technical information including label analysis and instructions for handling, storage and application of each material proposed for use.
 - 2. List each material and cross reference the specific coating, finish system and application. Identify each material by the manufacturer's catalog number and general classification.

- B. Samples
 - 1. Following the selection of colors and glosses by the Owner, submit samples for the Owner's review.
 - a. Provide 3 samples of each color and each gloss for each material on which the finish is specified to be applied.
 - b. Make samples approximately 8 inches by 10 inches in size, except as otherwise directed by the Owner.
 - c. If so directed by the Owner, provide field mock-ups during progress of the Work in the form of actual application of the materials on actual surfaces to be painted for approval by the Owner. Areas shall be 10 feet by 10 feet.
 - 2. Revise and resubmit each sample or field mock-up as requested until the required gloss, color and texture are achieved. Such samples or field mock-ups, when approved, will become standards of color and finish for accepting or rejecting the work of this Section.
 - 3. Do not commence finish painting until approved samples are on file at the job site.

- E. Quality Control Submittals
 - 1. Certificates: Provide certification by the manufacturer that products supplied do not contain or use volatile organic compounds (VOCs).

- F. Finish Schedule and Color Boards: Submit for review by the Owner each color scheme and coordinate with other finish materials.

- G. Comply with requirements set forth in the CA Green Building Code, Section 5.504.4.3 for Paints and Coatings.

1.6 QUALITY ASSURANCE

- A. Qualifications
 - 1. Applicator: Engage an experienced applicator who has completed painting system applications similar in material and extent to that indicated for this Project with a minimum of 5 years of experience and a record of successful in-service performance.

- B. Provide primers and undercoat paint produced by the same manufacturer as finish coats.
 - 1. Review other Sections of these Specifications as required, verifying the prime coats to be used and assuring compatibility of the total coating system for the various substrates.
 - 2. Upon request, furnish information on the characteristics of the specific finish materials to assure that compatible prime coats are used.
 - 3. Provide barrier coats over non-compatible primers, or remove the primer and re-prime as required.
 - 4. Notify the Owner in writing of anticipated problems in using the specified coating systems over prime coatings supplied under other Sections.

1.7 SEQUENCING AND SCHEDULING

- A. Painting to be completed at least 7 days before carpeting or setting of acoustical panels.
- B. After painting, fully ventilate building with maximum outside air before installing carpet and acoustical panels. Maintain required temperature and humidity within the building.

1.8 MAINTENANCE

- A. Upon completion of the work of this Section, deliver to the Owner an extra stock equaling 4 gallons (1 box) or one 5 gallon pail of each color, type and gloss of paint used in the Work; tightly sealing each container, and clearly labeling the Project name and contents and location where used and with color swatch painted on top of the container.
 - 1. supply extra paints from same production lots or color runs as used in the work, in factory sealed and labeled containers and which are properly resealed after adding colorants and mixing.
 - 2. Deliver material to the Owner's on-site designated storage place, unload and position in place in accordance with Architect's instructions.
 - 3. Provide the Owner with a signed receipt indicating materials and quantities upon delivery.
 - 4. Provide maintenance manufacturers cleaning instructions for painted surfaces.
 - 5. Provide a final paint schedule listing, for each type of paint material used, the manufacturer, product name and/or number color name and/or number and locations installed.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers: Sherman Williams, Kelly-Moore Paint Company, or equal, preferable from local distributors.

2.2 PAINT MATERIALS

- A. Paint Materials, General: Provide primers, finish coat materials, and related materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by the manufacturer, based on testing and field experience.
- B. Material Quality: Provide manufacturer's best quality trade sale paint material of the various coating types specified. Paint material containers not displaying manufacturer's product identification will not be acceptable.
- C. Colors: To be selected from manufacturer's custom colors (based on Sherman Williams):
 - 1. The Architect will select accent colors and provide a paint color schedule during submittals with the Owner's concurrence.
 - 2. There will be one primary paint color of the surfaces with three (3) accent colors.
 - 3. The new brick color should be similar to Pacific Clay Coastal series Calico or Belden Buff-461463 Smooth
 - 4. Exterior color to be Dakota Wheat SW 9023

2.3 APPLICATION EQUIPMENT

- A. For application of the approved paint, use only such equipment as is recommended for application of the particular paint by the manufacturer of the particular paint, and as approved by the Owner.
- B. Prior to use of application equipment, verify that the proposed equipment is actually compatible with the material to be applied, and that integrity of the finish will not be jeopardized by use of the proposed equipment.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with the Applicator present, under which painting will be performed for compliance with paint application requirements.
 - 1. Do not begin to apply paint until unsatisfactory conditions have been corrected and surfaces receiving paint are thoroughly dry.
 - 2. Start of painting will be construed as the Applicator's acceptance of surfaces and conditions within a particular area.
- B. Coordination of Work: Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates. On request,

furnish information on characteristics of finish materials to ensure use of compatible primers.

3.2 PREPARATION

- A. Surface Preparation: Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition and as specified.
- B. At existing areas: Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible because of the size or weight of the item, provide surface-applied protection before surface preparation and painting.
 - 1. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.
 - 2. Cleaning: Before applying paint or other surface treatments, clean the substrates of substances that could impair the bond of the various coatings. Remove oil and grease before cleaning.
 - 3. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.
- C. Cementitious Materials: Prepare concrete, concrete masonry block and cement plaster surfaces to be painted. Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents. Roughen as required to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation.
 - 1. Use abrasive blast-cleaning methods if recommended by paint manufacturer.
 - 2. Determine alkalinity and moisture content of surfaces by performing appropriate tests. If surfaces are sufficiently alkaline to cause the finish paint to blister and burn, correct this condition before application. Do not paint surfaces where moisture content exceeds that permitted in manufacturer's written instructions.
- D. Gypsum Board Substrates: Do not begin paint application until finishing compound is dry and sanded smooth. Touch-up minor defects with spackle and sand smooth and flush. Before painting, confirm that the gypsum board surface is prepared as prescribed in Section 09250. Paint finished gypsum board surface egg shell finish.
- E. Wood: Clean surfaces of dirt, oil, and other foreign substances with scrapers, mineral spirits, and sandpaper, as required. Sand surfaces exposed to view smooth and dust off.
 - 1. Scrape and clean small, dry, seasoned knots, and apply a thin coat of white shellac or other recommended knot sealer before applying primer. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood filler. Sand smooth when dried.

- a. Prime, stain, or seal wood to be painted immediately on delivery. Prime edges, ends, faces, undersides, and backsides of wood, including cabinets, counters, cases, and paneling.
 - b. When transparent finish is required, backprime with spar varnish.
 - c. Backprime paneling on interior partitions where masonry, plaster, or other wet wall construction occurs on backside.
 - d. Seal tops, bottoms, and cutouts of unprimed wood doors with a heavy coat of varnish or sealer immediately on delivery.
- F. Ferrous Metals: Clean ungalvanized ferrous-metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with the Steel Structures Painting Council's (SSPC) recommendations.
1. Blast steel surfaces clean as recommended by paint system manufacturer and according to requirements of SSPC SP-10.
 - a. Treat bare and sandblasted or pickled clean metal with a metal treatment wash coat before priming.
 - b. Touch up bare areas and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by paint manufacturer, and touch up with the same primer as the shop coat.
- G. Galvanized Surfaces: Clean galvanized surfaces with nonpetroleum-based solvents so surface is free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods.
- H. Materials Preparation: Mix and prepare paint materials according to manufacturer's written instructions.
1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
 2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.
 3. Use only thinners approved by paint manufacturer and only within recommended limits.
- I. Tinting: Tint each undercoat a lighter shade to simplify identification of each coat when multiple coats of the same material are applied. Tint undercoats to match the color of the finish coat, but provide sufficient differences in shade of undercoats to distinguish each separate coat.

3.3 PAINT APPLICATION

- A. General
1. Touch-up shop-applied prime coats which have been damaged, and touch-up bare areas prior to start of finish coats application.
 2. Slightly vary the color of succeeding coats.

- a. Do not apply additional coats until the completed coat has been inspected and approved.
 - b. Only the inspected and approved coats of paint will be considered in determining the number of coats applied.
 3. Sand and dust between coats to remove defects visible to the unaided eye from a distance of 5 feet.
 4. On removable panels and hinged panels, paint the back sides to match the exposed sides.
- B. Drying
 1. Allow sufficient drying time between coats, modifying the period as recommended by the material manufacturer to suite adverse weather conditions.
 2. Consider oil base and oleo-resinous solvent-type paint as dry for re-coating when the paint feels firm; does not deform or feel sticky under moderate pressure of the thumb, and when the application of another coat of paint does not cause lifting or loss of adhesion of the undercoat.
- C. Brush Applications
 1. Brush out and work the brush coats onto the surface in an even film.
 2. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness and other surface imperfections will not be acceptable.
- D. Spray Application
 1. Except as specifically otherwise approved by the Architect, confine spray application to metal framework and similar surfaces where hand brush work would be inferior.
 2. Where spray application is used, apply each coat to provide the hiding equivalent of brush coats.
 3. Do not double back with spray equipment to build up film thickness of 2 coats in 1 pass.
- E. For completed work, match the approved samples as to texture, color and coverage. Remove, refinish or repaint work not in compliance with the specified requirements.
- F. Miscellaneous Surfaces and Procedures
 1. Exposed mechanical items:
 - a. Finish electric panels, access doors, conduits, pipes, ducts, grilles, registers, vents and items of similar nature to match the adjacent wall and ceiling surfaces, or as directed.
 - b. Paint visible duct surfaces behind vents, registers, and grilles flat black.
 - c. Wash metal with solvent, prime and apply 2 coats of alkyd enamel.
 2. Exposed pipe and duct insulation:
 - a. Apply 1 coat of latex paint on insulation which has been sized or primed under other Sections; apply 2 coats on such surfaces when unprepared.

- b. Match color of adjacent surfaces.
- c. Remove band before painting, and replace after painting.
3. Hardware:
 - a. Paint prime coated hardware to match adjacent surfaces;
 - b. Paint metal portions of head seals, jamb seals, and astragal seals to match the color of the door frame unless otherwise directed by the Owner.
4. Wet areas:
 - a. For oil base paints, use 1 percent phencimercuric or 4 percent tetrachlorophenol.
 - b. For water emulsion and glue size surfaces, use 4 percent sodium tetrachlorophenate.
5. Exposed Vents: Apply 2 coats of heat resistant paint approved by the Owner.

3.4 INTERIOR PAINT SCHEDULE

- A. Wood Designated to Receive Opaque Finish
 1. Semigloss, Acrylic-Enamel Finish: 2 finish coats over a wood undercoater.
 - a. Undercoat
 - 1) Alkyd- or acrylic-latex-based, interior wood undercoater, as recommended by the manufacturer for this substrate, applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.2 mils.
 - 2) Product: ICI Dulux - 1120 Ultra-Hide, or equal.
 - b. First and Second Coats
 - 1) Semigloss, acrylic-latex, interior enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 2.6 mils.
 - 2) Product: ICI Dulux - 1407 Dulux Ultra, or equal.
- C. Ferrous Metal
 1. Semigloss, Acrylic Enamel Finish: 1 finish coat over an enamel undercoat and a primer. Primer is not required on shop-primed items.
 - a. Primer
 - 1) Quick drying, rust-inhibitive alkyd based or epoxy metal primer, as recommended by the manufacturer for this substrate, applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.5 mils.
 - 2) Product: ICI Dulux - 4160 Ultra-Hide, Benjamin Moore & Co., or equal.
 - b. Undercoat
 - 1) Alkyd, interior enamel undercoat or semigloss, acrylic latex, interior enamel, as recommended by the manufacturer for

this substrate, applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.3 mils.

- 2) Product: ICI Dulux - 1120 Ultra-Hide, Benjamin Moore & Co., or equal.

c. Finish Coat

- 1) Semigloss, acrylic latex, interior enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.3 mils.
- 2) Product: ICI Dulux - 1407 Dulux Ultra, Benjamin Moore & Co., or equal.

E. Galvanized Metal

1. Semigloss, Acrylic Enamel Finish: 2 finish coats over a primer.

a. Primer

- 1) Galvanized metal primer applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.2 mils.
- 2) Product: ICI Dulux - 4020 Devflex, Benjamin Moore & Co., or equal.

b. First and Second Coats

- 1) Semigloss, acrylic latex interior enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 2.6 mils.
- 2) Product: ICI Dulux - 1407 Dulux Ultra, Benjamin Moore & Co., or equal.

END OF SECTION

SECTION 099700
CONCRETE FLOOR SEALER

PART 1 - GENERAL

1.01 DESCRIPTION: Division 1 applies to this Section. Provide concrete floor sealer on exposed interior concrete floors which are not designated to receive another finish, complete, as shown and specified.

1.02 QUALITY ASSURANCE:

A. Qualification of Applicator: The applicator shall be qualified and certified by the sealer manufacturer.

1.03 SUBMITTALS:

A. Samples and Data: Submit samples of sealer accompanied by manufacturer's technical data, application instructions and recommended coverage rates for types of surfaces to be treated.

B. Certificate and Summary Statement: Prior to completion of Work, submit a certificate stating that sealers applied conform to approved submittals and all requirements specified; in the certificate include a summary statement giving following information:

1. Number of square feet of each surface treated with sealer, classified as to the kind of material treated, and open pore or closed pore type.
2. The quantity of sealer, per coat, actually applied to the surface.

1.04 COMPLIANCE WITH REGULATIONS:

1. All materials shall comply with the current rules and regulations of the local air quality management district, with the rules regarding volatile organic compounds, and with FDA rules and regulations for dangerous materials in sealers.

2. Comply with requirements set forth in CA Green Building Code, Section 5.504.4.3 for Paints and Coatings.

1.05 PRODUCT DELIVERY: Deliver all sealer materials to the site in containers bearing name and batch number of manufacturer, with seals intact.

1.06 SUBMITTAL

A. Product Data: Submit manufacturer's product data

PART 2 – PRODUCTS

2.01 MANUFACTURERS:

ProSoCo
3741 Greenway Circle
Kansas City, KS 66046
(800) 225-4255 FAX
(785) 830-9797

Thoro
889 Valley Park Drive
Shakopee MN 55379
(800)433-9517

2. COATING TYPES:

A. General: Sealer shall be water based, SCAQMD approved, clear modified alkyl alkoxysilane coating, ProSoCo "SLX Water and Oil Repellent" or equivalent by Thoro, designed for use on interior and exterior traffic surfaces. Sealer shall be designed to penetrate the pore surface of the concrete and inhibit moisture migration.

2.03 SHEEN: Completed sealer shall have semi-gloss sheen, as defined in Section 099000.

PART 3 - EXECUTION

3.01 PREPARATION:

A. Coordinate work of Division 3 to provide water curing only for slabs to receive floor sealer.

B. Prepare surfaces in accordance with the coating manufacturer's printed instructions. Remove contaminants including loose mortar, rust and other products of corrosion, disintegrated concrete, and other substances that could interfere with adhesion of the coating system to the substrate.

3.04 APPLICATION: By experienced mechanics using methods and spray or roller equipment recommended by coating manufacturer, after surfaces to be treated are dry.

A. Apply floor sealer in accordance with manufacturer's recommendations. Apply evenly over the surface in 2 coats at approximately 400 square feet per gallon per coat. Apply the second coat immediately after the first coat has penetrated.

B. Keep traffic from treated surfaces until the material is thoroughly dry.

END OF SECTION

SECTION 101400

SIGNAGE

PART 1 - GENERAL

- 1.01 DESCRIPTION: Division 1 applies to this section. Provide complete signage.
- A. Work Specified in this Section:
 - 1. Accessible facilities signs.
 - B. Related Work Specified Elsewhere:
 - 1. Section 091000 - Metal Support Systems
 - 2. Section 092500 Gypsum Board Systems
- 1.02 SUBMITTALS:
- A. Manufacturer's Literature. Provide brochures showing signs, including general specifications, materials and construction.
 - B. Shop and Layout Drawings: Provide complete drawings showing details of fabrication and erection; color type and style of letters, background; and setting details.
 - C. Maintenance Instructions: Provide manufacturer's recommended procedures for care of finished surfaces.
 - D. Certificates. Manufacturer's certification that materials meet Specification requirements.
- 1.03 QUALITY CONTROL
- A. Qualifications of Manufacturer: Signs shall be products of a manufacturer having not less than 2 years experience in the manufacture of signage comparable to that required herein.
- 1.04 EXTENT OF SIGNAGE:
- A. If signs are not indicated on drawings, obtain from Owner an exact list and lettering of signs required.
- 1.05 DELIVERY AND STORAGE:
- A. Materials shall be wrapped for shipment and storage, delivered to the jobsite in manufacturer's original packaging, and stored in a clean, dry area in accordance with manufacturer's instructions.

1.06 REGULATORY REQUIREMENTS:

- A. Raised characters shall comply with CBC Section 11B-703.2:
1. Depth: It shall be 1/32 inch (0.8 mm) minimum above their background and shall be sans serif uppercase and be duplicated in Braille.
 2. Height: It shall be 5/8 inch (15.9 mm) minimum and 2 inches (51 mm) maximum based on the height of the uppercase letter "I". CBC Section 11B-703.2.5
 3. Finish and contrast: Characters and their background shall have a non-glare finish. Character shall contrast with their background with either light characters on a dark background or dark characters on a light background. CBC Section 11B-703.5.1
 4. Proportions: It shall be selected from fonts where the width of the uppercase letter "O" is 60 % minimum and 110 % maximum of the height of the uppercase letter "I". Stroke thickness of the uppercase letter "I" shall be 15 % maximum of the height of the character. CBC Sections 11B-703.4 and 11B-703.6
 5. Character Spacing: Spacing between individual tactile characters shall comply with CBC Section 11B-703.2.7 and 11B-703.2.8
 6. Braille: It shall be contracted (Grade 2) and shall comply with CBC Sections 11B-703.3 and 11B-703.4. Braille dots shall have a domed and rounded shape and shall comply with CBC Table and Figure 11B-703.3.1.
 7. Mounting height: A tactile sign shall be located 48" minimum to the baseline of the lowest Braille cells and 60" maximum to the baseline of the highest line of raised characters above the finish floor or ground surface.
 8. Mounting location: A tactile sign shall be located on the approach side, as one enters or exits rooms or space, and be reached within 0" of the required clear floor space per CBC Section and Figure 11B -703.4.2 as follows:
 - a. a clear floor space of 18' x 18" minimum, centered on the tactile characters, shall be provided beyond the arc of any door swings between the closed position and 45 degree open position.
 - b. on the wall at the latch side of a single door.
 - c. on the inactive leaf of a double door with one active leaf
 - d. on the wall at the right side of a double door with two active leaves.
 - e. on the nearest adjacent wall where there is no wall space at the latch side of a single door or no space at the right side of a double door with two active leaves.
 9. Visual characters shall comply with CBC Section 11B-703.5 and shall be 40" minimum above finish floor or ground.
 10. Pictograms shall comply with CBC Section 11B-703.6.
 11. Symbol of accessibility shall comply with CBC Section 11B-703.7.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS:

- A. Sign manufacturer shall have local fabrication or distribution system, so that additional signs may be ordered as the need arises. Acceptable manufacturers include the following:

Architectural Signing, Inc.
5849 Uplander Way, Culver City, CA 90230 (310)645-1400

Vomar Products, Inc. 15850 Strathem St. Van Nuys, CA 91406 (818)894-7174

2.02 BASIC MATERIALS:

A. Exterior Signage:

1. Aluminum Extrusions: Alloy 6063-T5, minimum thickness 1/8" profiles as indicated or as required for each condition.

2. Sheet: Alloy 5005-H5, minimum thickness 0.090"

B. Sand Carved technique for all classroom and room signs

C. Steel pipe: ASTM A53, Grade B.

D. Anchors and Fasteners: Exposed anchor and fastener materials shall be compatible with metal to which applied and shall match in color and finish.

2.03 COLORS:

- A. As selected from manufacturer's standard colors, or as indicated on drawings.

2.04 SHOP FABRICATION AND MANUFACTURE

A. Workmanship: Holes for bolts and screws shall be drilled or punched. Drilling and punching shall produce clean, true lines and surfaces. Welding shall be continuous along the entire area of contact. Exposed welds shall be ground smooth. Exposed surfaces of signs shall have a smooth finish and exposed riveting shall be flush. Fastenings shall be concealed where practicable. Items specified to be galvanized shall be by hot-dip process after fabrication if practicable. Galvanizing shall be in accordance with ASTM A 123 and ASTM A 525, as applicable. Joints exposed to the weather shall be formed to exclude water. Drainage and weep holes shall be included as required to prevent condensation buildup.

B. Dissimilar Materials: Where dissimilar metals are in contact, or where aluminum is in contact with concrete, mortar, masonry or absorptive materials subject to wetting, the surfaces shall be protected with a coat of asphalt varnish or a coat of zinc-molybdate primer to prevent galvanic or corrosive action.

C. Shop Painting: Surfaces of miscellaneous metal work, except nonferrous metal shall be given one coat of zinc-molybdate primer or an approved rust-resisting treatment and metallic primer in accordance with manufacturer's standard

practice. Surfaces of items to be embedded in concrete shall not be painted.
Upon completion of work, damaged surfaces shall be recoated.

PART 3 - EXECUTION

3.01 INSPECTION:

- A. Substrate: Examine foundations, walls, and other areas scheduled to receive signs for conditions that would affect quality and execution of work.
- B. Defects: Do not proceed with installation until defects are corrected.

3.02 INSTALLATION:

- A. General: Signs shall be installed in accordance with approved manufacturer's instructions at locations shown on the drawings. Signs shall be installed plumb and true at mounting heights indicated, and by method shown or specified. Signs on walls and other surfaces shall not be installed until finishes on such surfaces have been installed.
- B. Comply with ADA requirements for mounting heights of signs.
- C. Installation: Install level, plumb, and at the proper height. Comply with ADA requirements for mounting heights of signs. Cooperate with work of other sections for installation of sign units to finish surfaces.

3.03 PROTECTION AND CLEANING:

- A. The work shall be protected against damage during construction. Hardware shall be adjusted for proper operation. Frames and sign surfaces shall be cleaned in accordance with the manufacturer's approved instructions.

END OF SECTION

SECTION 101700

TOILET PARTITIONS

PART 1 - GENERAL

1.01 Work Includes

- A. Toilet Compartments
- B. Urinal Screens
- C. Institutional Hardware for all components.

1.02 Related Sections

- A. Section 091000 – Metal Support Systems
- B. Section 108100 - Toilet Room Accessories

1.03 References

- A. National Fire Protection Association 101 Life Safety Code 2000 Edition, Chapters 5, 6, 8-30.
- B. ANSI A117.1-1998 Specifications for Making Buildings and Facilities Accessible to and Usable by Physically Handicapped People.
- C. 2016 California Building Code; CBC and Amendments
- D. ADA, Accessibility Guidelines for Buildings and Facilities, Federal Register Volume 56, Number 144, Rules and Regulations.
- E. American Society for Testing and Materials Standards:
 - 1. ASTM E84-01 Standard Test Method for Surface Burning Characteristics of Building Material.
 - 2. ASTM D2794-93(1999)e1 Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).
 - 3. ASTM D2197-98(2002) Standard Test Method for Adhesion of Organic Coatings by Scrape Adhesion.
 - 4. ASTM D6578-00 Standard Practice for Determination of Graffiti Resistance.

1.04 Performance Requirements

- A. Graffiti Resistance: Partition material shall have the following graffiti removal characteristics when tested in accordance with ASTM D6578-00 Standard Practice for Determination of Graffiti Resistance in accordance with Section 9, "Graffiti Removal Procedure Using Manual Solvent Rubs":
 - 1. Clean-ability: Five (5) required staining agents shall be cleaned off material.

- B. Scratch Resistance: Partition material shall have the following characteristics when tested in accordance with ASTM D2197-98(2002) Standard Test Method for Adhesion of Organic Coating by Scrape Adhesion, using Gardner Stock #PA-2197/ST pointed stylus attachment on scrape tester:
 - 1. Scratch Resistance: Maximum Load Value shall exceed 10 kilograms.
- C. Impact Resistance: Partition material shall have the following characteristics when tested in accordance with ASTM D2794-93(1999)e1 Standard Test Method for Resistance of Organic Coating to the Effects of Rapid Deformation (Impact), using .625" hemispherical indenter with 2-lb impact weight:
 - 1. Impact Resistance: Maximum Impact Force value shall exceed 30 inch-lbs.
- D. Fire Resistance: Partition material shall comply with the following requirements, when tested in accordance with ASTM E 84: Standard Test Method for Surface Burning Characteristics of Building Materials:
 - 1. Smoke Developed Index: Not to exceed 450.
 - 2. Flame Spread Index: Not to exceed 75.
 - 3. Material Fire Ratings:
 - a. National Fire Protection Association (NFPA): Class B.
 - b. International Code Council (ICC): Class B.

1.05 Submittals

- A. Comply with requirements of Section regarding submittals.
- B. Manufacturer's Data
 - 1. Provide required number copies of:
 - a. Product data sheets.
 - b. Installation instructions.
 - c. Cleaning and maintenance instructions.
 - d. Replacement parts information.
- C. Shop Drawings
 - 1. Provide required number of copies of all shop drawings.
 - 2. Show fabrication and erection of compartment assemblies, to extent not fully described by manufacturer's data sheets.
 - 3. Show anchorage, accessory items and finishes.
 - 4. Provide location drawings for bolt hole locations in supporting members for attachment of compartments.
- D. Samples

1. Furnish scale model of compartments, including stile, shoe, door, door hardware, divider panel, and mounting brackets.
2. Furnish sections showing stile anchoring and leveling devices, concealed threaded inserts, panel, stile, and edge construction.

1.06 Product Delivery, Storage, and Handling

- A. Deliver items in manufacturer's original unopened protective packaging.
- B. Store materials in original protective packaging to prevent physical damage or wetting.
- C. Handle so as to prevent damage to finished surfaces.

1.07 Warranty

- A. Furnish ten-year limited warranty for panels, doors, and stiles against breakage, corrosion, delamination, and defects in factory workmanship.
- B. Furnish one-year guarantee against defects in material and workmanship for stainless steel door hardware and mounting brackets.

1.08 Regulatory Requirements

- A. Wheelchair accessible compartment shall comply with CBC Section 11B-604.8.1.
- B. Toe clearance for at least one side partition of a wheelchair accessible compartment shall comply with CBC Section and Figure 11B-604.8.1.4. It shall be 9" high minimum above the finish floor and 6" deep minimum beyond the compartment side face of the partition, exclusive of partition support members. It shall be 12" high minimum above the finish floor for children's use. Partition components at toe clearances shall be smooth without sharp edges or abrasive surfaces. Toe clearance at the side partition is not required in a compartment greater than 66" wide.
- C. An ambulatory accessible compartment shall be provided where there are six or more toilet compartments, or where the combination of urinals and water closets totals six or more per CBC Section 11B-213.3.1. Such compartment shall comply with CBC Section 11B-604.8.2.
- D. Door and door hardware for accessible compartments shall be self-closing and shall comply with CBC Section 11B-404 except that pull-side clearance for ambulatory accessible compartments shall be minimum 44" clear, rather than 60". CBC Figure 11B-604.8.2.
- E. A door pull complying with CBC Section 11B-404.2.7 shall be placed on both sides of the door near the latch.
- F. Doors shall not swing into clear floor space or clearance required for any fixtures.

PART 2 – PRODUCTS

2.01 Manufacturers

- A. Model numbers for toilet partitions manufactured by Comtec Toilet Partitions, Inc., are listed to establish a standard of quality for design, function, materials, workmanship, and appearance, or equal.
- B. Toilet partitions shall be the product(s) of a single manufacturer.

2.02 Mounting Configurations

- A. Toilet Partitions Compartments shall be Floor-Anchored, and top braced 6' high.
- B. Urinal Screens shall be wall mounted.

2.03 Components/Materials

A. Stiles, Panels, Doors, and Screens

- 1. Stiles, Panels, Doors, and Screens shall be all be manufactured from same manufacturer.

B. Toilet Partition Material

- 1. Subject to compliance with the material performance requirements, solid surface manufactured toilet partition systems or manufactured using the solid surface materials stated below will be acceptable:
 - a. Privacy Plus™ Toilet Compartments by Gerali Custom Design, Inc.
 - b. WilsonArt® Gibraltar® Material
 - c. WilsonArt® EarthStone™ Material

C. Finish Thickness

- 1. Stiles and doors shall be 3/4"
- 2. Panels and benches shall be 1/2"

D. Hardware

- 1. All hardware to be 18-8, type-304 stainless steel with satin finish.
- 2. Doors: full length hinge and full length (aluminum) wall brackets.
- 3. Torx tamperproof head fasteners, stainless steel connectors

E. Latch

1. Sliding door latch shall be 14 gauge and shall slide on nylon track.
2. Sliding door latch shall require less than 5-lb force to operate. Twisting latch operation will not be acceptable.
3. Latch track shall be attached to door by machine screws into factory-installed threaded brass inserts.
4. Threaded brass inserts shall be factory installed for door hinge and latch connections and shall withstand a direct pull exceeding 1,500 lbs. per insert.
5. Through bolted, stainless steel, pin-in-head Torx sex bolt fasteners shall be used at latch keeper-to-stile connections and shall withstand direct pull force exceeding 1,500 lbs. per fastener.

F. Hinges

1. Hinge shall be 16-gauge continuous piano hinge.
2. All doors shall be equipped with self-closing hinge.
3. Continuous piano hinge shall be attached to door and stile by theft-resistant, pin-in-head Torx stainless steel machine screws into factory-installed, threaded brass inserts
4. Fasteners secured directly into the core are not acceptable.
5. Door shall be furnished with two 11-gauge stainless steel door stop plates with attached rubber bumpers to resist door from being kicked in/out beyond stile.
6. Door stops and hinges shall be secured with stainless steel, pin-in-head Torx machine screws into threaded brass inserts.
7. Threaded brass inserts shall withstand a direct pull force exceeding 1,500 lbs per insert.

G. Mounting Bracket

1. Mounting brackets shall be 18-gauge stainless steel and extend full height of panel.
2. U-channels shall be furnished to secure panels to stiles.
3. Angle brackets shall be furnished to secure stiles to walls and panels to walls.
4. Fasteners at locations connecting panels-to-stiles shall utilize through bolted, stainless steel, pin-in-head Torx sex bolt fasteners. Through-bolted fasteners shall withstand direct pull force exceeding 1,500 lbs. per fastener.
5. Wall mounted urinal screen brackets shall be 11 gauge double thickness.

H. Leveling Device shall be 7-gauge, 3/16" hot rolled steel bar; chromate-treated and zinc-plated; through-bolted to base of solid color reinforced composite stile.

I. Stile Shoe shall be one-piece, 4" high, type-304, 22-gauge stainless steel with satin finish. Top shall have 90° return to stile. Shoe will be composed of one-piece of stainless steel and capable of being fastened (by clip) to stiles starting at wall line.

J. Headrail (Overhead Braced) shall be satin finish, extruded anodized aluminum (.125" thick) with anti-grip profile.

PART 3 – EXECUTION

3.01 Inspection

- A. Check areas scheduled to receive compartments for correct dimensions, plumbness of walls, and soundness of surfaces that would affect installation of mounting brackets.
- B. Verify spacing of plumbing fixtures to assure compatibility with installation of compartments.
- C. Do not begin installation of compartments until conditions are satisfactory.

3.02 Erection

- A. Install compartments rigidly, straight, plumb, and level and in accordance with manufacturer's installation instructions.
- B. Installation methods shall conform to manufacturer's recommendation for backing and proper support.
- C. Conceal evidence of drilling, cutting, and fitting to room finish.
- D. Maintain uniform clearance at vertical edge of doors.

3.03 Adjustment and Cleaning

- A. Adjust hardware for proper operation after installation.
- B. Set hinge cam on in-swinging doors to hold doors open when unlatched.
- C. Set hinge cam on out-swinging doors to hold unlatched doors in closed position.
- D. Clean exposed surfaces of compartments, hardware, and fittings.

3.7 TOLERANCES:

- A. Framing Members: 1/4 inch maximum from true position.
- B. Surface Flatness of Floor: 1/4 inch in 10 feet maximum.

END OF SECTION

SECTION 104400

FIRE EXTINGUISHERS, CABINETS AND ACCESSORIES

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes: Requirements for provision of fire extinguishers and fire extinguisher cabinets.
- B. Section Includes: Requirements for provision of :
 - 1. Fire extinguishers.
 - 2. Fire extinguisher cabinets.
- C. Related Sections
 - 1. Section 092500 - Gypsum Board Systems: Metal framing and backing and wall sheathing at walls scheduled to receive fire extinguisher cabinets.

1.2 REFERENCES

- A. UL - Underwriters' Laboratories, Inc.
 - 1. 299 - Dry Chemical Fire Extinguishers.
 - 2. 711 - Rating and Fire Testing of Extinguishers.

1.3 SYSTEM DESCRIPTION

- A. Performance Requirements
 - 1. Provide units conforming to UL 299 and 711.

1.4 SUBMITTALS

- A. Product Data: Submit manufacture's literature completely describing products, including physical dimensions, operational features, color and finish.
- B. Shop Drawings: Submit drawings showing rough-in measurements, wall mounting brackets with mounted measurements, locations and details of attachment to adjacent structure.
- C. Certificates of Compliance: Submit certificates stating that fire extinguisher units comply with standards specified.
- D. Manufacturer's Instructions: Submit manufacturer's installation instructions.
- E. Maintenance Data: Submit data that includes test, refill or recharge schedules, procedures, and re-certification requirements including requirements applicable to the work.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements

1. Provide fire extinguishers that have service tag affixed to them which provides proof that they have been inspected and serviced by licensed fire extinguisher concern. Extinguishers shall be serviced annually as required by Nevada State Fire Marshal standards.
2. Fire Extinguisher Cabinets must comply with CBC Sections 11B-307, 11B-308, 11B-309 and 11B-403.

1.6 PROJECT CONDITIONS

- ### A. Environmental Requirements: Do not install extinguishers when ambient temperatures may cause freezing of extinguisher ingredients.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Storage and Protection

1. Deliver and store packaged products in original containers with seals unbroken and labels intact until time of installation.
2. Provide proper facilities for handling and storage of products to prevent damage. Where necessary, stack products off ground on level platform, fully protected from weather.

PART 2 PRODUCTS

2.1 MANUFACTURED UNITS

A. Extinguishers

1. Type A, Fire extinguishers.
 - a. Type: ABC
 - b. Manufacturer: Amerex. Larsen; or equal.
2. Accessories
 - a. Mounting Bracket: Size as required by required fire extinguisher.
 - b. Manufacturers: Amerex, Larson, or equal.

B. Fire Extinguisher Cabinets

1. Fire Extinguisher Cabinet – Surface mounted and Recessed types.
 - a. Door: Keyed door with Larsen Manufacturing Co 's "Vertical Duo" Door and "Larsen-Loc"; or equal.
 - b. Cabinet
 - 1) Steel box and door: Model No. 2409R7
 - 2) Cabinet size as required to house UL rated ABC dry chemical fire extinguisher.
 - c. Manufacturer And Product: Larsens Manufacturing Co.'s Amerex; or equal.

2.2 FINISHES

- A. Extinguishers: Red epoxy polyester.
- B. Cabinet Door and Trim: Manufacturer's standard brushed aluminum finish.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify rough openings for cabinet are correctly sized and located.
- B. Verify that solid blocking is provided for surface mounted brackets.
- C. Do not install fire extinguisher cabinets until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install cabinets and extinguishers in accordance with manufacturer's instructions.
- B. Ensure cabinets are placed so that tops of fire extinguishers are not more than 5'-0" above finished floor.
- C. Install cabinets plumb and level in wall openings. Secure rigidly in place.

3.3 ADJUSTING

- A. Repair or replace any damaged fire extinguishers and cabinets to the satisfaction of the District's Representative.

3.4 CLEANING

- A. Leave areas designated to receive fire extinguishers and cabinets free of stains, blemishes and other foreign material.

3.5 PROTECTION

- A. Protect fire extinguishers and cabinets from damage or defacement until final acceptance.

END OF SECTION

SECTION 108100
TOILET ROOM ACCESSORIES

PART 1 - GENERAL

1.01 DESCRIPTION: Division 1 applies to this section; provide accessories for toilet rooms, as indicated, specified and required.

1.02 SUBMITTALS:

- A. Shop Drawings: Submit showing installation details and required backing plate locations.
- B. Manufacturer's Data: Complete catalog cuts showing parts lists, fabrication and installation data of each item.
- C. Samples: Submit such samples as the Architect may request, which will be returned to Contractor. Approved samples may be installed in the work.
- D. Certificates:
 - 1. Report of test by independent laboratory of grab bar strength, and installation methods.
 - 2. Certificate of mirror guarantee.

1.03 REFERENCE STANDARDS:

- A. Stainless and heat-resisting chromium-nickel steel plate, sheet and strip: ASTM A167.
- B. Seamless and welded austenitic stainless steel tubing for general service: ASTM A269.
- C. Plumbing Fixtures and Accessories: FS WW-P-541/8A

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver items in manufacturer's original unopened packaging, and store under protective cover until installed; where accessories are furnished with strippable coatings, leave coatings intact until final acceptance.

1.05 COMPLIANCE WITH DISABLED ACCESS LAWS:

- A. Accessories and other items specified herein and hardware provisions therefor shall comply with current requirements for access for the disabled, in the California Building Code.
- B. Toilet accessories required to be accessible shall be mounted at heights according to CBC, Section 11B – Division 6, Section 11B-603.5; Toilet paper and feminine napkin dispensers located on the grab bar side of an accessible toilet room or stall shall not project more than 3 inches from the finished wall surface nor be located closer than 1-1/2 inch clear of the tangent point of the grab bar.

1.06 WARRANTY: Furnish 10 year warranty for all mirrors against silver spoilage.

1.07 REGULATORY REQUIREMENTS:

- A. Elements of Sanitary facilities shall be mounted at locations in compliance with CBC Sections 11B-602 through 11B-612.
- B. Grab bars in toilet facilities and bathing facilities shall comply with CBC Section 11B-609.
 - 1. Grab bars and any wall or other surfaces adjacent to grab bars shall be free of sharp or abrasive elements and shall have rounded edges. The space around the grab bars shall be as follows:
 - 2. 1 ½" between the grab bar and the wall.
 - 3. 1 ½" minimum between the grab bar and projecting objects below and at the ends.
 - 4. 12" minimum between the grab bar and projecting objects above.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS:

American Specialties, Inc. 441
Saw Mill River Road Yonkers NY
10701 (914)476-9000

Bobrick Washroom Equipment Inc.
11611 Hart Street
North Hollywood, CA 91605
(818)764-1000

Bradley Corp.
W142 N9101 Fountain Boulevard
Menomonee Falls WI 53051
(262)251-6000

2.02 MATERIALS:

- A. Stainless Steel: ASTM A167, Type 302 or 304, with No. 4 finish.
- B. Steel: ASTM A366, commercial quality, cold rolled.
- C. Zinc Coating: ASTM A123, Class G-90.
- D. Chromium Plating: ASTM B456, Type SC2.
- E. Aluminum:
 - 1. Extrusions: 6063 T5, satin anodized finish.
 - 2. Sheet: 5005 HI 4.
- F. Brass: FS WW-P-541, cast or forging quality alloy.

- G. Fasteners: Stainless steel where exposed, stainless or galvanized steel where concealed. Provide theft resistant types where exposed.
- H. Mounting Devices: ASTM A386, galvanized steel.
- I. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of pre-consumer recycled content not less than 25 percent.

2.03 LIST OF ACCESSORIES: Catalog numbers listed below are those of American Specialties, Inc.

- A. Grab bars: 3000 Series, concealed mounting, configurations, as indicated.
- B. Seat Cover and Toilet Paper Dispenser: 0485-R
- C. Paper Towel Dispenser and Disposal: 0467-2
- D. Soap Dispensers: 0347
- E. Mirror: 24" W x 36" H: Series 600-A

2.04 FABRICATION

- A. All receptacles and storage containers shall be fabricated of Type 302 or 304 stainless steel.
- B. All edges, both exposed and concealed, shall be ground smooth. Rough edges on any part of the accessories will be cause for rejection.
- C. Use continuous piano hinges on doors.
- D. Accessories specified or furnished with key locks, shall be keyed alike, except that key coin boxes of coin operated dispensing units shall be keyed differently from the locks on the units.

2.05 STRUCTURAL REQUIREMENTS FOR GRAB BARS: The structural strength of grab bars, fasteners and mounting devices shall comply with the following:

- A. Bending stress in the grab bar induced by the maximum bending moment from the application of a 250 pound point load shall be less than the allowable stress for the material of the grab bar.
- B. Shear stress induced in the grab bar by the application of 250 pound point load shall be less than the allowable shear stress for the material of the grab bar; and its mounting bracket or other support is considered to be fully restrained, then direct anti-torsional shear stresses shall not exceed the allowable shear stress.
- C. Shear force induced in fastener or mounting devices from the application of a 250 pound point load shall be less than the allowable lateral load of either the fastener or mounting device or the supporting structure, whichever has the smaller allowable load.
- D. Tensile force induced in a fastener by a direct tension force of 250 pound point load, plus the maximum moment from the application of a 250 pound point load shall be less than the allowable withdrawal load between the fastener and supporting structure..

- E. Grab bars shall not rotate within their fittings.

PART 3 - EXECUTION

3.01 INSPECTION: Verify that openings to receive accessories are constructed to correct size, and are plumb, level, and in alignment with other items so indicated. Verify that surfaces to receive accessories are in alignment, so that installed accessories will be flat, level, plumb, fitted snugly against adjoining surfaces without gaps.

3.02 INSTALLATION:

A. Regulatory Requirements: Accessories shall be located to comply with ADA requirements, and CBC Section 11B-603.5. Toilet paper and feminine napkin dispensers located on the grab bar side of an accessible toilet room or stall shall not project more than 3 inches from the finished wall surface nor be located closer than 1-1/2 inch clear of the tangent point of the grab bar.

B. Install all accessories square, plumb, and level. Securely anchor by mechanical means only using stainless steel fasteners. Conform to rough-in and installation templates. Exact locations shall be as indicated or directed.

C. Installation shall be in accordance with manufacturer's specifications and recommendations.

D. Drill holes to correct size and application so that it is concealed by item with 1/4" tolerance.

E. Mount surface mounted accessories to backing plates with machine screws, plumb and align.

F. Install manufacturer's recommended anchorage system for all grab bars.

G. Fit flanges of accessories snug to wall surfaces. Caulk gaps between flanges and finish wall surfaces after accessories are installed.

3.03 ADJUSTMENT AND CLEANING:

A. At completion, adjust all accessories for smooth operation, and clean and polish all surfaces. Deliver keys and maintenance instructions.

END OF SECTION

SECTION 22 0500
COMMON WORK RESULTS FOR PLUMBING

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. This Section provides the basic plumbing requirements that apply to the Work of Division 22.

B. Related Requirements:

1. Division 01: General Requirements.
2. Division 22: Plumbing
3. Division 26: Electrical.

1.02 REGULATORY REQUIREMENTS

- A. Current federal Safe Drinking Water Act (SDWA) regulations require the furnishing of lead-free pipe, solder, and flux in the installation or repair of plumbing in non-residential facilities connected to public drinking water systems. Under this regulation, solders and flux are considered lead-free when they contain 0.2 percent lead or less. Under California regulations pipes and pipe fittings are considered lead-free when they contain 0.25 percent lead or less as defined in California Assembly Bill 1953 (AB 1953). No pipe, pipe fittings, or any other fitting or fixture intended to convey or dispense water for human consumption by drinking or cooking is allowed in the domestic plumbing system, if they do not meet the low lead definition of AB 1953. Weighted average lead content of the wetted surface area of pipes, fittings and fixtures may not exceed 0.25 percent.

1. Provide lead-free water pipe, solder, and flux materials that meet the standards as outlined by the federal SDWA regulations and California AB 1953 if installed in drinking water system.
2. Collect pipe, solder, and flux material samples as required by the Project Inspector. Test samples shall be delivered to an Owner designated testing laboratory for testing of lead content.
 - a. Test samples for lead content by the atomic absorption spectrophotometry method.
3. Materials found not conforming to SDWA and California AB 1953 regulations shall be deemed defective Work and shall be replaced with lead-free materials.
4. Comprehensive testing of the remaining materials for their lead content shall be performed as required by the Project INSPECTOR.

- A1. Materials, fabrication, equipment, and installation shall comply with industry standards and code requirements. Where manufacturer's recommendations exceed industry standards, the manufacturer's recommendation shall establish the minimum standard. As a minimum, standards from the following organizations shall apply:

1. ANSI - American National Standards Institute.

2. ASME - American Society of Mechanical Engineers.
 - a. ASME Boiler and Pressure Vessel Code.
 - b. ASME B31 - Standards for Pressure Piping.
 3. ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers.
 4. ASTM - American Society for Testing and Materials.
 - a. ASTM A53 Specification for Welded and Seamless Pipe.
 5. AWWA - American Water Works Association.
 6. CSA - Canadian Standards Association.
 7. FM Global - Factory Mutual Global
 8. IAPMO - International Association of Plumbing and Mechanical Officials.
 9. NFPA - National Fire Protection Association.
 10. OSHA - Occupational Safety and Health Administration.
 11. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association.
 12. UL - Underwriters Laboratories Inc.
 13. Intertek (ETL Certification).
- B. Materials, fabrication, equipment, and installation shall comply with federal, state, and local codes including, but not limited to, the following:
1. CBC, California Building Code, and CMC, California Plumbing Code.
 - a. Latest edition as adopted by the City of Los Angeles, the County of Los Angeles, and the State of California including amendments effective on the Effective Date of the Contract.
 2. California Code of Regulations, Title 8, Industrial Relations, Division 1, Chapter 4, Division of Industrial Safety.
3. OSHA - Occupational Safety and Health Administration.
4. CDPH - California Department of Public Health.
 5. SCAQMD - South Coast Air Quality Management District.
- C. Specifications or Drawings shall not be construed to permit deviation from the requirements of governing codes unless approval has been obtained from legally constituted authorities having jurisdiction, and the Architect. The Contract Documents may contain more stringent requirements than those legally required.
- D. Permits and Fees: **Refer to the General and Supplementary Conditions.**
- 1.03 SUBMITTALS
- A. Provide submittals in accordance with Section 01 3000: Submittal Procedures and with specific requirements of Division 22 sections, as applicable.
 - B. The above information shall become the basis for inspecting and testing materials and actual installation procedures performed in the Work.

- C. Shop Drawings: Submit one additional copy when control diagrams having line voltage connections are indicated. Shop Drawings shall be specifically prepared for the Work of this Project. Drawings prepared in accordance with requirements of Section 01 3000: Submittals may be provided by the Architect to serve as a background for the Shop Drawings. Shop Drawings shall comply with the requirements of Section 01 3000 and shall indicate at a minimum:

1. Complete system layout of equipment, components, plumbing fixtures, piping, indicating service clearances, and pipe sizes, fitting types and sizes and pipe elevations, distances of pipes and equipment from building reference points and hanger support locations. The above items shall be coordinated on the shop drawings according to the requirements of Section 01 3000.
2. Schedule and description of equipment, piping and fittings.

1.04 PROJECT RECORD DOCUMENTS

- A. Comply with provisions of Section 01 7000: Contract Closeout.
- B. Project Record Drawings:
1. Provide a complete set of plumbing and fire protection drawings in AutoCAD and, if available, BIM, complete with external reference drawings, fonts, blocks and plotter pen color/line thickness settings on CD-ROM. Also submit one set of full size reproducible plots on vellum and 3 sets of prints.
 2. Before Contract Completion, deliver corrected and completed prints to the OAR. Delivery of project record documents to the OAR does not relinquish responsibility of furnishing required information omitted from project record documents.
- C. Operation and Maintenance Manuals:
1. Submit two copies of operation and maintenance manuals in required form and content. If no revisions are required, furnish one additional copy. If revisions are required, one copy shall be returned with instructions for changes; perform such changes and return three copies of manuals. Manuals shall be bound in accordance to Section 01 7000. Deliver manuals to the OAR. Submit an electronic copy of the entire manual in PDF file format.
 2. Contents of Manual:
 - a. Title sheet with Project name, including names, addresses and telephone number of Contractor, installer, and related equipment suppliers.
 - b. Manufacturer's operating instructions including, but not limited to, the following:
 - 1) Identification of components and controls.
 - 2) Trouble shooting checklist and guidelines.
 - 3) Recommendations for optimum performance.
 - 4) Warnings and safety precautions on improper or hazardous operational procedures or conditions

- c. Manufacturer's product data and parts and maintenance booklet for each item of equipment furnished under Division 22 that includes the following as a minimum:
 - 1) Manufacturer's model, identification and serial numbers.
 - 2) Exploded view of assembly drawings identifying each component or part with the relevant part number.
 - 3) Directory of manufacturer's representatives, service contractors and part distributors.
 - 4) Maintenance and trouble-shooting instructions, including schedule for preventive maintenance, periodic inspection and cleaning criteria.
- d. Project Record Drawings: Complete set of plumbing, fire protection and control system drawings in 50 percent reduced print format shall be furnished with the manual. Submit the above record drawings on CD-ROM in AutoCAD and, if available, BIM, complete with external reference drawings, fonts, blocks, and plotter pen color/line thickness settings.
- e. Testing, Adjusting, and Balancing reports: Submit as specified in Section 014525.
- f. South Coast Air Quality Management District (SCAQMD) permits to install and operate boilers, water heaters and other fuel burning equipment and third-party source test reports as required by SCAQMD to allow start-up and operation of equipment.
- g. San Bernardino County industrial waste permits.
- h. Valve directory complete with location, function, size, and model of each valve with reference to the project record drawings.
- i. Equipment and component identification chart complete with location, function, size, and model of each equipment or component with reference to the project record drawings.

1.05 COORDINATION

- A. Contract Documents indicate extent and general arrangement of Work under Division 22. Contractor shall coordinate work in accordance with Section 01 3113 requirements and make adjustments as required to provide maximum headroom, a neat arrangement to keep passageways and openings clear to provide accessibility and provisions for maintenance, and to meet code requirements.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Delivery and Storage: Deliver materials to Project site in their original unopened containers with labels intact and legible at time of delivery. Store in strict accordance with manufacturer's recommendations.
- B. Do not store plastic pipe or materials in direct sunlight.

1.07 PRELIMINARY OPERATION

- A. OAR may require any portion of plumbing Work to be operated before Substantial Completion. Such operation shall be in addition to regular tests, demonstrations

and instructions required under the Contract Documents, and shall be performed as required.

- B. Notify the INSPECTOR at least 24 hours in advance of lighting or re-lighting pilots.

1.08 TRAINING OF OWNER PERSONNEL

- A. Training of Owner's personnel shall include:

1. A minimum of 4 hours of on-site overview of the overall Plumbing System.
2. Refer to Division 22 sections for specific training on each of the components of the Plumbing System.

- B. Contract shall include the cost of training Owner operation and maintenance personnel in operating, adjusting, maintenance, trouble-shooting, and Project site repair of each component, equipment, or system provided under this Contract.

- C. Operational and maintenance training shall be conducted on the Project site, unless indicated otherwise.

- D. Upon completion of Owner training, a completion certificate indicating the nature of the training and a description of the systems, complete with equipment and component lists shall be issued to each trainee. The certificate should be issued in duplicate with one copy retained by OAR.

- E. An attendance sheet with the names and signatures of all participants attending the training shall be submitted to the OAR and kept as part of the project documents.

1.09 GUARANTEES AND DAMAGE RESPONSIBILITY

- A. Sound of water flowing in piping shall not be transmitted to building structure. Operation of mechanical system shall not produce operational sounds that can be heard outside of rooms enclosing apparatus or equipment.

PART 2 – PRODUCTS

2.01 MATERIALS AND EQUIPMENT

- A. Unless otherwise specified, materials and equipment shall be new, in good and clean condition. Equipment, materials, and components shall be of the make; type and model number noted on Drawings or specified. Pieces of equipment of the same type shall be by the same manufacturer.

- B. Whenever an item is listed by a single proprietary name, with or without model number and type, it shall be for purpose of design only, to indicate characteristics and quality desired. Proprietary designation listed on Drawings, or listed first in Specifications, is used as a basis for design to establish a standard for quality and performance and space requirements.

- C. Equipment and materials indicated or required to be installed outdoors shall be of the type that is designed, manufactured, listed or approved by authorities having jurisdiction for outdoor installation by being resistant to the adverse effects of weather. The additional protective measures against outdoor weather required by the manufacturers' installation instructions and prevalent practice shall be provided.

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

Substitutions after bid may only be granted if the approved product has become unavailable and approval of any such substitution shall be at the responsibility of this Contractor.

PART 3 – EXECUTION

3.01 SERVICE INTERRUPTIONS, OFF-SITE, GAS AND WATER

- A. Schedule Work so there shall be no service interruptions of existing systems or systems during normal hours of operation of affected systems and facilities.
- B. When service interruptions are mandatory, arrange in advance with the OAR as to time and date of such interruptions.
- C. Systems, which are interrupted, shall be returned back into operation in such manner that they will function as originally intended.

3.02 CUTTING, NOTCHING, AND BACKING

- A. Conform to California Building Code, Title 24, Part 2, for notches and bored holes in wood and for pipes and sleeves embedded in concrete and for cuts in steel, as detailed on structural Drawings.
- B. Where pipes pass through, or are located within one inch of any construction element, install a resilient pad, ½ inch thick minimum, to prevent contact.
- C. Furnish provisions for recesses, chases, and accesses and provide blocking and backing for proper reception and installation of plumbing Work.

3.03 LOCATION OF PIPING AND EQUIPMENT

- A. Location of piping, apparatus and equipment indicated on the Drawings is approximate and shall be altered to avoid obstructions, preserve headroom, and provide free and clear openings and passageways.
- B. Trenches parallel to footings shall not be closer than 18 inches to the face of footings and shall not be below a plane having a downward slope of 2 horizontal to one vertical, from a line 9 inches above bottom of footing.
- C. Pipe in tunnels shall be installed close to one side of tunnel to provide maximum space for passage. Pipe shall not be installed through crawl hole unless otherwise specified or detailed on Drawings.
- D. Place equipment in locations and spaces indicated, disassemble and/or reassemble equipment as required by Project conditions.

3.04 TESTS AND TESTING

- A. Tests shall be as required under the applicable sections of Division 22, including this Section.
- B. Additional tests may be required in the case of products, materials, and equipment if:
 - 1. Submitted items are altered, changed, or cannot be determined as exactly conforming to the Contract Documents.
 - 2. Performance testing and results may also be required on certain items which are as specified, including fan, and pump performance.
- C. Piping Tests:

1. Perform tests required to demonstrate that operation of plumbing systems and their parts are in accordance with Specifications covering each item or system, and furnish materials, instruments and equipment necessary to conduct such tests. Tests shall be performed in presence of the Inspector, and representatives of any governmental agency having jurisdiction. Work shall not be concealed or covered until required results are provided.
2. If required tests are not performed, Owner may provide in accordance with the Contract Documents.
3. Pressure gauges furnished in testing shall comply with CPC. Air shall be bled from lines requiring hydrostatic or water tests.
4. Systems shall be pressure-tested in accordance with pipe testing schedule below. Pipe test shall indicate no loss in pressure after a minimum duration of 4 hours at test pressures indicated. Where local codes require higher test pressures than specified herein for fire sprinkler systems, local codes shall govern.
5. Fuel gas lines shall be first tested with piping exposed, before backfilling trenches or lathing; second with piping in finished arrangement, backfilled and paved where required, and walls finished.
6. Piping systems may be tested as a unit or in sections, but entire system shall successfully meet requirements specified herein, before final testing by the Inspector.
7. Repair of damage to pipes and their appurtenances or to any other structures resulting from or caused by these tests, shall be provided.

D. Pipe Testing Schedule:

System Tested	Test Pressure (psig)	Test With:
Durham system, glass or plastic acid waste, vent and roof drain (except pipes running under a slab or underground)	Fill with water to top of highest vent; allow to stand two hours, or longer, as required by Inspector. Minimum head required for any joint shall be 10 feet in building.	Water
Cast-iron soil, waste and interior downspout, condensate drain from air conditioning equipment	10 feet of water, vertically	
Storm water disposal lines	Running water test	Water
Vacuum pump or condensate pump discharge and condensate return piping	150	Water
Domestic water piping	200	Water
Standpipes, wet or dry	300	Water
Fire sprinkler piping	200	Water
Gas piping(steel threaded or plastic)	60 (both tests)	Air
Gas piping (steel welded)	100 (both tests)	Air
Gas welding station	1-1/2 Working pressure 100 min.	Dry nitrogen
Compressed air piping	175	Air

E. Equipment Performance Assurance Tests:

1. Before operating any equipment or systems, a thorough check shall be performed to determine that systems have been flushed and cleaned as required and that equipment has been properly installed, aligned, lubricated, and serviced. Factory instructions shall be checked to verify installations have been completed and recommended lubricants have been installed in bearings, gearboxes, crankcases, and similar equipment. Particular care shall be furnished in lubricating bearings to avoid damage by over-lubrication and blowing out seals. Equipment shall also be checked for damage that may have occurred during shipment, after delivery, or during installation. Damaged equipment, products, and materials shall be replaced or repaired as required.
2. Upon completion of the above, adjust the system settings to within normal operating conditions to prevent the system from being damaged upon start-up.
3. Run-test the equipment after start-up for five consecutive days. Tests shall include operation of all equipment and systems for a period of not less than two 8 hour periods at 90 percent of the full specified capacities.
4. Equipment Start-up Reports: For each equipment or system on which start-up is performed, submit 8 copies of start-up report for review by the Architect.
 - a. The start-up report shall include the manufacturer's standard start-up form completed and signed by the start-up technician.
5. Provide, maintain, and pay costs for equipment, instruments, and operating personnel as required for specified tests.
6. Provide electric energy and fuel required for tests.
7. Final adjustment to equipment or systems shall meet specified performance requirements.
8. Equipment, systems, or Work deemed defective during testing shall be replaced or corrected as required. Test until satisfactory results are provided.

F. Specific Coordinated Plan for Test and Balance:

1. Provide a narrative of the operational intent that clearly describes the function and sequence of operation of each component, equipment, or system installed. Instruct designated Owner personnel in the operation of the installed systems.
2. Prior to final test and balance, plumbing equipment and systems shall be operated and tested as indicated in Article 3.04.F above to demonstrate satisfactory overall operation of the installed systems.
3. Welding performed as part of this Division may be subject to radiographic inspections at random in accordance with requirements specified in Section 22 0513: Basic Plumbing Materials and Methods.

3.05

NOISE AND VIBRATION REDUCTION

- A. Correct noise or vibration caused by plumbing systems. Provide all necessary adjustments to specified and installed equipment and accessories to reduce noise to the lowest possible level
- B. Correct noise or vibration problems caused by failure to install work in accordance with Contract Documents. Include all labor and materials required as a result of such failure. Pay for re-testing of corrected noise or vibration problems by the project acoustical consultant including travel, lodging, test equipment expenses, etc.

3.06 PROTECTION, CARE AND CLEANING

- A. In addition to storage criteria of the General Conditions, and provisions under Section 01 5000: Construction Facilities and Temporary Controls, the following shall be provided:
 - 1. Provide for the safety and good condition of materials and equipment until Substantial Completion. Protect materials and equipment from damage.
 - 2. Protect installed Work.
 - 3. Replacements: In case of damage, immediately provide repairs and/or replacements as required.
 - 4. Protect covering for bearings, open connections to tanks, pumps, compressors and similar equipment.
 - 5. Interior of piping shall be maintained free of dirt, grit, dust, and other foreign materials.
 - 6. Fixtures, piping, finished brass or bronze, and equipment shall have grease, adhesive, labels, and foreign materials removed. Chromium, nickel plate, polished bronze or brass Work shall be polished. Glass shall be cleaned inside and out.
 - 7. Before initial start-up and again before Substantial Completion, piping shall be drained and flushed to completely remove grease and foreign matter. Pressure regulating assemblies, traps, strainers, boilers, flush valves, and similar items shall be thoroughly cleaned. Tag system with an information tag listing responsible party and date of element, before initial start-up and again before Substantial Completion. Compressed air, oil, and gas piping shall be blown out with oil-free compressed air or inert gas.

END OF SECTION

SECTION 22 0513

BASIC PLUMBING MATERIALS AND METHODS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. This Section prescribes basic materials and methods generally common to the Work of Division 22.

B. Related Requirements:

1. Division 01: General Requirements.
2. Division 22: Plumbing.
3. Division 26: Electrical.

1.02 SUBMITTALS

- ###### A. Provide in accordance with Division 01, Section 22 0500 and specific requirements of each section of Division 22.

- ###### B. Types of welding rods to be used.

1.03 QUALITY ASSURANCE

- ###### A. Standards: Comply with applicable national, state, and local codes and standards: ASTM, ASME, and ANSI. Federal Specifications, AWWA, SISPI, NFPA, FM, UL, CPC (California Plumbing Code), CMC (California Plumbing Code), CSA.

- ###### B. Qualifications of Manufacturer: Products used in the Work of this Section shall be produced by manufacturers regularly engaged in manufacture of similar items and with a history of successful production as reviewed by the Architect.

1.04 COORDINATION

- ###### A. Coordinate related Work in accordance with provisions of **Section 01 3000: Submittals**.

PART 2 – PRODUCTS

2.01 GENERAL

- A. Provide the following products if they are indicated in the Contract Documents or if they are required for the proper installation, function or operation of equipment, systems or components indicated in the Contract Document.
- B. Provide the following products as a complete assembly with required accessories for a complete and functioning entity in compliance with governing codes and applicable standards as specified in Section 22 0500, manufacturer's instructions or as required.
 - 1. Omission of minor details in the Contract Documents does not waive and/or otherwise relinquish compliance with the above requirements.

2.02 MANUFACTURERS AND MATERIALS

- A. Ball Valves: Bronze, 2-inch and smaller:

BV-1: Class 150, 600 psi, CWP, 2 piece construction reinforced Teflon seats, full port, adjustable packing gland, stainless ball and stem, threaded ends.

Hammond UP-8303A/UP-8305/UP-8513, NIBCO T-685-80-LF/TS-685-66-LF, Milwaukee UPBA400S/450S, or equal.

Provide valve Handle shall be stainless steel when valve is installed below grade or in the ground valve box.

BV-2: Class 150, 600 psi, CWP two piece construction with reinforced TFE seats, full port, adjustable packing gland, (no threaded stem designs allowed), threaded ends.

NIBCO T-685-80-LF, Hammond UP-8303A, Milwaukee UPBA-400 or equal.

NIBCO T585 S6R66 (Stainless Steel), Milwaukee BA-260 (Stainless Steel).

Provide BV-1A shall be used on hot domestic and cold water systems.

BV-3 Class 150, 600 psi CWP, 2-piece construction, bronze body, reinforced Teflon seats, adjustable packing gland, (no threaded stem designs allowed), threaded ends.

Hammond UP8301A, NIBCO T-585-70, Milwaukee BA-400, or equal.

Provide BV-2 to be used only where water is NOT used for water consumption.

Ball Valves in Insulated Piping: Use extended operating handle of non-thermal conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation and memory stops that are fully adjustable after insulation is applied. NIBCO Nib-Seal Handle.

B. Butterfly Valves:

Provide Butterfly Valves in a domestic plumbing system intended to convey water for human consumption shall comply with Quality Assurance, article 1.03 of this Section.

BFV-1 Centerline Series A, 200 psi CWP tight shut-off.

1. Body: Lug type ductile iron. Suitable for bi-directional dead-end service at rated pressure without use of downstream flange.
2. Disc: Bronze, or aluminum bronze.
3. Stem: One or two-piece, 400 series stainless steel.
4. Seat and O-Rings: EPDM.
5. Upper and Lower Stem Bearings: Copper alloy or non-metallic material.
6. Operators: Valves 6 inches and smaller, with lever handle. Valves 8 inches and larger, with manual gear operator and disc position indicator.
7. Manufacturers:
 - a) Valves 2.5 to 6-inch: NIBCO, Milwaukee ML-233E, Hammond 6411-03, or equal.
 - b) Valves 8-inch and larger: Milwaukee ML 333E, Hammond 6411-03, NIBCO LD 2000, or equal.

C. Check Valves:

Provide check valves in a domestic plumbing system intended to convey water for human consumption shall comply with Quality Assurance, article 1.03 of this Section.

1. Bronze, 2-inch and smaller:

CHV-1: 200 psi, CWP horizontal swing, Y pattern, renewable seat and disc, threaded ends.

NIBCO T-413-Y-LF, Milwaukee UP-509, Hammond UP-904 or equal.

Provide on domestic hot and cold water systems.

CHV-2: Class 125 200 psi, swing check, bronze body, Teflon disc, soldered ends.

Stockham B-310TY, Crane 1340, NIBCO S-413-Y, Milwaukee 1509-T, Hammond IB-912 or equal.

Provide on junior fire sprinkler systems less than 3 fire sprinkler heads.

CHV-3: 200 psi, CWP, bronze body, horizontal swing, Y pattern, renewable seat and disc, solder ends.

Nibco S-413-Y-LF, Milwaukee UP 1509-T, Hammond Up-946 or equal.

Provide on domestic hot and cold water systems.

2. Cast Iron 2 1/2-inch and larger:

CHV-4: Class 125, 200 psi, CWP, IBBM, renewable seat and disc, bolted cap, threaded ends:

Crane 372, Stockham G-927, NIBCO T-918-B, or equal.

Provide on multiple domestic hot and chilled water pump systems, multiple steam boiler return lines from steam trap.

CHV-5: Special low-pressure check valve for installation in gas lines.

Circle Seal Products Co.

119B-PP-0-15 psi; #1:1/8 inch IPS; #2:1/4 inch IPS #3:3/8 inch IPS.

Provide on low pressure gas in chemistry laboratory systems.

D. Earthquake Valve:

EQV-1 Mechanically triggered by seismic movement, complying with state of California seismic response specifications, UL listed and certified by D.S.A. Size and pressure as required or indicated on Drawings. (Minimum 1/4 psi, maximum 10 psi. Earthquake valve shall shut off gas automatically during an earthquake to prevent an explosion or fire. Valve shall be Koso California seismic valve, or equal.

1. Not sensitive to vibrations caused by passing trucks or accidental bumping.
2. Sensitive to wide amplitude G's only. Preset at factory for the correct G-rating.
3. Positive sealing from minus 10 degrees F. to 150 degrees F.
4. Visual open-close indicator.
5. Manual reset.
6. Plumb line for mounting.
7. Tripping mechanism has non-creeping rolling latch.
8. Install valve per manufacturer's recommendations only.

Provide automatic shut-off for gas systems during earthquake at gas.

D. Expansion Tank:

ET-1 Pressurized, vertical, steel expansion tank for potable water systems with FDA approved, replaceable, heavy duty, butyl rubber blend diaphragm, polypropylene lined dome, 1/2 inch, 3/4 inch, 1 inch or 1 1/2-inch NPT system connection, 1/2 inch or 3/4 inch drain, 0.302 inch-32 standard automobile tire valve type charging connection, lifting rings and a floor mounting skirt for vertical installation. The tank must be constructed in accordance with Section VII of the ASME Boiler and Pressure Vessel Code and stamped for 125 psi working pressure. The tank must be also rated for a continuous working temperature of 240 degrees F. Provide weather and rust resistant coating.

Bell and Gossett, Wheatley, Taco, Amtrol or equal.

ET-2 except for potable water system such as domestic hot water system. Provide at each domestic hot water heater or system.

E. Flow Control Valve – Manual:

FC-1 Flow control valves: Bell and Gossett Series CB circuit setter balancing valve, line size, with integral pointer (to register degree of valve opening), differential pressure meter connections with built-in check valves and lockable memory stops. Armstrong Series CBV circuit-balancing valves, Victaulic/TA Hydronics, or equal.

Provide balancing and controlling of domestic hot water system flow for different branch circuits.

F. Gate Valves:

Provide gate valves in a domestic plumbing system intended to convey water for human consumption shall comply with Quality Assurance, article 1.03.

1. Bronze, 2-inch and smaller:

GV-1 Class 125, 200 psi CWP, bronze body and bonnet non-rising stem, inside screw, screw-in bonnet, solid disc, threaded ends:

Hammond IB645, Crane 1701, Milwaukee 105, American 3F, NIBCO T-113, or equal.

Provide shut-off and isolation of equipment and device for gas system.

GV-2 Class 125, 200 psi, CWP, bronze body and bonnet, non-rising stem, inside screw, screw-in bonnet, solid disc, threaded ends:

NIBCO T-113-LF, Milwaukee UP 105, Hammond UP 645 or equal.

Provide on domestic hot and cold water systems.

GV-3 Same as GV-1, except solder ends:

NIBCO S 113, Milwaukee 115, Hammond IB 647, or equal.

Provide in yard box, to each group of fixtures behind access panels, where valves are located near ceiling and beams.

GV-4 Class 125, 200 psi, CWP, bronze body and bonnet, non-rising stem, inside screw, screw-in bonnet, solid disc, threaded ends:

NIBCO T-113-LF, Milwaukee UP 105, Hammond UP 645 or equal.

Provide on domestic hot and cold water systems.

GV-5 Class 125, 200 psi WOG, rising stem, inside screw, screw-in bonnet, solid disc, threaded ends:

Stockham B-100, Crane 428, NIBCO T-111, Milwaukee 148, Hammond IB-640, or equal.

Same as GV-3 except where clearance is not an issue. Adequate clearance for operation must be provided because hand wheel and stem rise. Provide inlet and outlet connections to water heaters and pumps, make up water lines to HVAC equipment and expansion tanks.

GV-8A Class 250, 250 psi, CWP, O S and Y, IBBM, resilient seat gate valve, flanged ends.

Watts 408-OSY-RW, Kennedy 7168 or equal.

The epoxy coated valves are recommended in the domestic cold water system where corrosives in the water line might cause damage to the inside of valve and where pressure rating in excess of 200 psi is required.

GV-9 Class 125 250 psi CWP iron body, flanged ends, bolted bonnet with wheel handle, resilient wedge, non-rising stem.

Provide in walls for cold water system pipe sizes 2 ½-inch and larger.

NIBCO F-619-RW or equal.

GV-10 Class 125, 250 psi CWP iron body, flanged ends, bolted bonnet with 2-inch operating nut, resilient wedge, non-rising stem, fusion bonded epoxy coated.

Provide for using below grade for cold water system pipe sizes 2 ½-inch and larger.

NIBCO F-619-RW-SON or equal.

G. Globe Valves:

1. Bronze, 2-inch and smaller:

Provide in a domestic plumbing system intended to convey water for human consumption shall comply with Quality Assurance of Article 1.03.

GLV-1A Class 125, 200 psi, CWP, screw-in bonnet, Teflon disc, threaded ends:

Milwaukee UP 502, Hammond UP 440 or equal.

GGLV-2 Class 125, 200 psi, CWP, screw in bonnet, Teflon disc, solder ends.

Hammond IB-418, Milwaukee 1502, NIBCO S-211-Y, or equal.

GLV-2A: Class 125, 200 psi, CWP, screw in bonnet, Teflon disc, soldered ends.

Milwaukee UP 1502, Hammond UP 418 or equal.

Provide on domestic hot and cold water systems.

H. Heater Vent Pipe:

1. Schedule Number:

HVP-1 Shall be UL approved for service specified. Concealed heater vent pipe, including pipe in or through attic spaces, shall be Los Angeles City approved double wall metal vent pipe. For recessed wall heaters, furnish B.W. type. All others may be Type B, or B.W. Clearances must comply with Los Angeles City code and conditions of UL listing.

American Metal Products Co., Inc., Simpson Dura-Vent, AmeriVent, Hart & Cooley Mfg. Co., Metalbestos, or equal.

Provide component parts of a vent assembly, including vent cap, shall be companion items of same manufacturer. Each item shall be UL-approved and listed.

I. Liquid Level Gage:

LLG-1 Refrigerant type, carbon steel with stainless steel trim or all forged steel construction, back-seating standard design. Upper and lower valve furnished with ball check valves; 1/2 inch diameter glass on center. Four 3/16 inch diameter gage glass guard rods or slotted steel guard.

Peneberthy, Henry, Conbraco, or equal.

Magnetic Lever Valves:

MLV-1 Bronze, stainless steel and bronze trim, 2-way, packless normally closed, metal seat.

General Controls, K-10AA2030 or equal.

Provide for Can washing system. Provide for can washing installation.

K. Piping:

PROVIDE FOR PIPES IN A DOMESTIC PLUMBING SYSTEM INTENDED TO CONVEY WATER FOR HUMAN CONSUMPTION SHALL COMPLY WITH QUALITY ASSURANCE ARTICLE 1.03.

1. Piping shall be continuously and permanently marked with manufacturer's name, type of material, size, pressure rating, and the applicable ASTM, ANSI, UL, or NSF listing. On plastic pipe, date of extrusion must also be marked.
2. Underground non-ferrous pressure pipes shall be installed with proper color tracer wires. Refer to color code provisions in Section 22 0553: Plumbing Identification.
- P-1 Cast iron: Hubless, service weight, ASTM A888, CISPI 301, conforming to CISPI 310 and installed in accordance to IAPMO 1S 06. American Foundry, Tyler, or AB & I or equal.
- P-2 Galvanized steel, Schedule 40, ASTM A53., US Steel or equal.
- P-3 Copper drainage tube, underground, type L hard, ASTM B 88, Mueller, Cerro Brass or equal.
- P-4 Copper drainage tube, inside structure and above grade. Type DWV hard temper, ASTM B 306, Mueller, Anaconda, Cerro Brass, Cambridge-Lee, Halstead or equal.
- P-5 Purple pipe, PVC, schedule 40 for reclaimed or recycled water (below ground only for non-potable irrigation systems), type 1, grade 1, PVC-1120, Cell Class 12454 B.
- P-6 Copper water tube, Type L hard, ASTM B88. Mueller, Cambridge-Lee, Halstead or equal. (when used above ground only)
- P-7 Copper water tube, Type K hard, ASTM B88, by Mueller, Cerro Brass, Cambridge-Lee, Halstead or equal.
- P-8 Polyethylene plastic pipe, ASTM D 2513, standard dimension ratio. 11, rated at 80 psi working pressure at 73 degrees Fahrenheit (F). for 3-inch and smaller, SDR 11.5 rated at 76 psi at 73 degrees F. for 4-inch and above, butt or socket type fittings, joined by heat fusion, orange or yellow color.
CPCHEM (Chevron Phillips Chemical Company LP) PE 2406, or equal.

Provide for natural gas below grade only. Transition to anodeless steel riser at meter, regulator, or building wall.

- P-9 Red seamless brass 85-5-5-5, iron pipe size (IPS), threaded pipe, ASTM B43. Mueller, Cerro Brass, Cambridge-Lee, Halstead or equal.
- P-10 Black steel pipe, Schedule 40, ASTM A53, Type E, ERW by US Steel, or equal.
- P-11 Seamless copper tubing, tempered drawn, Type M, ASTM B88 by Mueller, Cerro Brass or equal.
- P-12 High Silicon Iron Casting, 1 ½-inch and 2-inch, threaded for science room vents when ferrous waste piping is provided, ANSI-A21.10, WWP-356-36, ASTM D1784-699, by Duriron or equal.
- P-13 PVDF (Polyvinylidene Fluoride) schedule 40 pipes, conforming to ASTM F1673, ASTM D3222 and complying with UL723 (ASTM E84). The joints may be no-hub or electro-fusion type. Installer shall be certified by manufacturer for joint installation. Orion, Fuseal or equal.

Provide for installations where the corrosive waste piping passes through air plenums as defined by California Mechanical Code (CMC) and underground.

- P-14 Polypropylene chemical waste, flame retardant pipe, conforming to ASTM F1412 and ASTM D4101. The joints may be no-hub or electro-fusion type. Installer shall be certified by the manufacturer for joint installation. Orion, Fuseal or equal.

Provide fireproof wrapping where the corrosive waste piping passes through air plenums as defined by CMC. This type may be used for underground.

- P-15 PVC, thick wall, cast-iron OD sized, UL listed, AWWA listed, NSF listed, Class 200 with tracer wire, Blue Brute, or equal.

Provide Domestic water, irrigation and main fire line below ground only (4-inch and over).

- P-16 Type 316L Stainless steel chemical waste pipe, marked with manufacturer's identification and fittings. Mechanical press fit joints with EPDM seals Manufacturer's representative shall instruct installers and certify them for joint installation. Piping system shall be provided with a five-year manufacturer's material warranty.

Blucher-Josam or equal.

THIS TYPE SHALL NOT BE USED FOR UNDERGROUND INSTALLATIONS. ONLY WHERE THE CORROSIVE WASTE PIPING PASSES THROUGH AIR PLENUMS AS DEFINED BY CMC.

P-17 304 / 304L Stainless Steel, .049 wall, ASTM A312. Pipe must be certified for use with the Vic-Press 304TM piping system, by Trent Tube, Victaulic or equal.

THIS TYPE SHALL NOT BE USED FOR UNDERGROUND INSTALLATIONS. ONLY WHERE THE CORROSIVE WASTE PIPING PASSES THROUGH AIR PLENUMS AS DEFINED BY CMC.

P-18 CPVC (Chlorinated polyvinyl Chloride) schedule 40 pipe, conforming to ASTM D1784 and complying with UL723 (ASTM E84). The joints shall be of solvent cement type conforming to ASTM F493. Installer shall be certified by the manufacturer for this type of joint installation. Spears, Corzan, Charlotte or equal.

P-19 PVC, schedule 40, extruded from 100 percent virgin Polyvinyl Chloride (PVC) compound, meeting requirements of class 1254-13 of ASTM D1784.

L. Pipe Fittings:

Pipe fittings in a domestic plumbing system intended to convey water for human consumption shall comply with Quality Assurance, article 1.03.C.

PF-1 Cast iron, soil or waste no-hub coupling with neoprene gaskets, stainless steel corrugated shields and stainless steel clamps. 2 bands for size 1 ½-inch thru 4-inch, IAPMO, ASTM C 564 and CISPI 310.

American Foundry, Mission, Tyler, or equal.

PF-2 Cast iron, soil or waste, Heavy-duty no-hub coupling with neoprene gaskets, stainless steel corrugated shields and stainless steel clamps. 4 bands for size 5-inch thru 10-inch. IAPMO, ASTM C564 and CISPI 310.

American Foundry, Mission, Tyler, or equal.

PROVIDE WITH P-1.

PF-3 Malleable iron, Class 150, threaded, galvanized, beaded, ANSI B 16.3. P-2

Stockham, Stanley Flagg, Grinnell Oreual.

PROVIDE WITH P-2.

PF-4 Cast brass drainage fittings ASA B 16.23, ASTM B 42. Provide with copper drainage tube.

Mueller Brass, Nibco, Stanley Flagg, Lee Brass Or equal.

PROVIDE WITH P-3 AND P-4.

PF-5 Wrought copper - solder type ANSI B 16.22

Mueller Brass, Nibco, Lee Brass or equal.

PROVIDE WITH P-6 PIPE, SOLDER, AND FLUX SHALL BE LEAD-FREE FOR DRINKING WATER. FLUX SHALL BE AN APPROVED WATER-SOLUBLE MATERIAL.

PF-6 Polyethylene plastic fittings, ASTM D 3261 and D 2683, standard dimension ratio 11, rated at 80 psi working pressure at 73 degrees F. for 3 inches and smaller, SDR 11.5 rated at 76 psi at 73 degrees F. for 4 inches and above, butt or socket type fittings, joined by heat fusion, color orange or yellow.

CPCHEM, (Chevron Phillips Chemical Company LP) or equal.

Provide with P-8.

PF-7 Polyethylene transition risers, for Pff-6 above, Transition fitting must have a minimum vertical height of 36 inches from the horizontal connection which will allow for a 6-inch steel riser above ground. Polyethylene transition risers shall be anodeless.

Central Plastics Company or equal.

Installed in a gas piping system for the purpose of providing a transition from horizontal below ground (polyethylene) to a vertical above ground (steel). Transition must be made on the horizontal side of the gas piping system and meet ASTM standards for Polyethylene plastic pipe and fittings.

PF-8 Bronze and brass, 250 psi, threaded, ASA B16.17 and F S WW-P-460.

PROVIDE WITH P-9.

Mueller Brass, Lee Brass Or equal.

PF-9 Malleable iron, Class 125, ANSI B 16.3, threaded or welded Schedule 40 black steel for 2-inches and below and welded for 2 ½-inch and above, by Stockham or equal.

PROVIDE WITH P-10.

PF-10 Cast iron, threaded, Class 125, ANSI B 16.1.

PROVIDE WITH P-12.

Stockham or equal.

PF-11 Cast-iron OD sized,, bell and spigot gasket joints.

PF-12 Steel butt weld type, ASTM A 234WPB.

PROVIDE WITH P-12.

PF-13a No-hub couplings for factory grooved PVDF or polypropylene, schedule 40 piping. The coupling shall be of the same material and gauge as the pipe. Each coupling shall have 300 series stainless steel

outer band and 5/16 inch bolts, nuts and washers plated to meet a 100-hour salt spray test per ASTM B117. Installer shall be certified by the manufacturer for this type of joint installation. Orion, Fuseal or equal.

PROVIDE WITH P-13.

PF-13b The pipe and fitting shall be joined using the socket fusion system conforming to ASTM 2657. Installer shall be certified by the manufacturer for this kind of joint installation. Orion, Fuseal or equal.

PROVIDE WITH P-14.

PF-13c CPVC (Chlorinated Polyvinyl Chloride) schedule 40 pipe and fittings, conforming to ASTM D1784 and complying with UL723 (ASTM E84), shall be joined using solvent cement conforming to ASTM F493. Installer shall be certified by the manufacturer for this kind of joint installation. Spears, Corzan or equal.

PROVIDE WITH P-18.

PF-14a Drains, bottle traps and similar devices for CPVC, PVDF or polypropylene, schedule 40 piping, shall be of same material and gauge as the pipe with mechanical joints. Installer shall be certified by the manufacturer for this kind of joint installation. Orion, Fuseal or equal.

FURNISH WITH MATCHING PIPE ONLY. PROVIDE FIREPROOF WRAPPING WHERE THE POLYPROPYLENE PIPING PASSES THROUGH AIR PLENUMS AS DEFINED BY CMC.

PF-14b Type 316L Stainless steel joint for chemical waste piping systems including drain or bottle traps. Blucher-Josam or equal.

FURNISH WHEN USED WITH MATCHING PIPE ONLY. THIS TYPE SHALL NOT BE USED FOR UNDERGROUND INSTALLATIONS AND ONLY WHERE THE CORROSIVE WASTE PIPING PASSES THROUGH AIR PLENUMS AND THE AVAILABLE SPACE IS NOT SUFFICIENT FOR FIRE PROOF WRAPPING OF POLYETHYLENE PIPING. GRADE TO SUIT INTENDED SERVICE. PROVIDE WITH PIPING SCHEDULE P-16.

Victaulic Vic Press 304TM or equal.

PF-15 Precision cold drawn austenitic 304/304L stainless steel, with elastomer O-rings

PF-16 Grooved end type– ASTM A395 and A536 ductile iron; ASTM A234 WPB forged steel; fabricated from ASTM A53 carbon steel. Couplings shall be supplied with angle-pattern bolt pads for rigidity, except in locations where flexibility is desired. Gaskets shall be pre-lubricated. Galvanized or painted, by Victaulic or equal.

GRADE TO SUIT THE INTENDED SERVICE. PROVIDE WITH PIPING SCHEDULE NUMBER P-2 OR P-10.

PF-17 Grooved end type– ASTM B75 or B152 and ANSI B16.22 wrought copper, bronze sand casting per ASTM B584-87 copper alloy CDA 836 per ANSIB16.18. Couplings shall be CTS style 606 supplied with angle pattern bolt pads for rigidity, coated with copper coated alkyd enamel. Gaskets shall be pre-lubricated Flush seal type by Victaulic or equal.

FOR DOMESTIC HOT AND COLD WATER 2 ½-INCH AND LARGER COPPER APPLICATIONS. PROVIDE WITH PIPING SCHEDULE NUMBER P-6.

PF-18 CPVC fittings must conform to ASTM D2846 specification for chlorinated polyvinylchloride (CPVC) plastic for hot and cold water distribution system.

PF-19 Plastic fittings, schedule 40 molded from PVC type I compound, conforming to the requirements of specification ASTM D2466.

M. Pipe Isolators:

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

Provide for copper piping.

Holdrite, LSP, Stoneman, Potter-Roemer, Trisolator, PR-Isolator, or equal.

PLA-2 PLASTIC CUSHION TO FORM AN INSULATING LINER AND ELIMINATE METAL TO METAL CONTACT WHEN SECURING COPPER TUBES AND PIPES IN AIR CONDITIONING AND REFRIGERATION INSULATION PREVENTING GALVANIC EROSION. (ACOUSTICAL TYPE FOR SOUND ABSORPTION).

Hydra-Zorb Cushion Clamps, Acousto-Clamp, or equal.

N. Pressure Gage: Aluminum or steel case, minimum 4 ¼-inch dial; pressure type or combination vacuum-pressure type, with provisions for field calibration. Dial indicator to indicate pressure in psi with accuracy to within plus or minus 0.5 percent of maximum dial reading. Furnish gages with restriction screw, size 60, to eliminate vibration impulses. Black case and ring, bourdon tube of seamless copper alloy with brass tip and socket. Three way gage cock, constructed of brass with stuffing box, 1/2 inch couplings, with fixed or movable cap nut to shut off pressure gage.

PG-1 Pressure type, black drawn steel case, 4-1/2-inch glass dial, range approximately twice line pressure.

Marsh Keckley, Trerice, Weksler, Weiss, or equal.

O. Plug Valves:

PV-1 2 inches and smaller: Rockwell No.114, lubricated plug type, 200-pound., water operating gauge pressure iron body and plug, regular pattern, threaded, with indicating arc; by Walworth, Homestead, WKM, or equal.

Provide Isolation and on-off application for gas system.

PV-2. 2 ½-inch and larger: Rockwell No.115 and No.165 lubricated plug type, 200 pound water operating gauge. Iron body and plug, regular pattern, flanged, with indicating arc. Walworth, Homestead, WKM, or equal.

P. Safety Relief Valves:

SRV-1 Combination temperature and pressure relief type. CSA approved. Set to open at 125 psi pressure.

Watts 40L Cash-Acme NCLX-1

Provide for Steam system, hot water system.

SRV-2 Same as SRV-1, except provide on storage type water heater with anode in dip tube.

Watts 10 x L, Cash-Acme NCLX-1

SRV-3 Spring type, ASME and NB stamped and certified with manual lifting device for air or gas.

Bailey, Cash-Acme, Watts, Keckley or equal.

Provide for Gas system and compressed air system.

Q. Strainers:

STR-1 Description: Wye type with monel or stainless steel strainer cylinder (manufacturer's standard mesh), and gasketed machine strainer cap. Where indicated on Drawings, provide with valved (globe valve) blowout piping, same size as blowout plug.

1. 2-inch and smaller:
C.M. Bailey No.100-A, 250 lb., cast iron body, threaded, Keckley 'B', Spirax Sarco Y-type, or equal.
2. 2 ½-inch and larger:
C.M. Bailey No.100-A, 125 lb., cast iron body, flanged, or Victaulic style 732, 300 psi, ductile iron body, grooved, fusion bonded epoxy coated.
C.M.Bailey, Armstrong, Muessco, Keckley 'A', or equal.

Provide for Oil and gas systems.

STR-2 Y pattern cast iron bodies, 125 psi, monel screen. Open area at least twice the cross-sectional area of IPS pipe in which strainer is installed and may be woven wire or perforated type. Screwed ends for sizes up to 2 inches, flanged ends fusion bonded epoxy coated for 2 ½-inch and larger perforations, in accordance with the following:

1. Steam service - 40 square mesh.

2. Other services - 16 square mesh.

Bailey No.100, Armstrong, RP&C, Keckley or equal.

Provide as same as STR-1.

STR-3 Flanged, bucket type, semi-steel body, 125 psi, stainless steel screen with 1/8 inch diameter perforations, all sizes.

Bailey No.1, Zurn 150 Series, RP&C, Keckley GFV or equal.

Provide for Domestic cold and hot water system. Mount above grade for water service.

STR-4 Grooved, T-pattern, ductile iron body, 300 psi, stainless steel frame and mesh basket, grooved ends.

Provide for Domestic hot and cold water system except for high pressure system.

R. Vent Caps:

VC-1 Vandal-proof hood type, for plumbing vent lines.

Stoneman Engineering and Mfg., Semco 1550

Provide for Sanitary drainage system.

S. Vacuum Valves:

VV-1 Vacuum valves; for vacuum serve, 125 psig working pressure, cast iron body, spring loaded lubricated plug type.

General Controls, Honeywell, Valmatic, or equal.

Provide for Domestic hot and cold water system.

T. Protective Coating for Underground Steel Piping

Provide for WORKING HOIST PIPING ONLY.

1. Black steel or galvanized steel piping indicated for below grade installation, shall be protected as specified prior to delivery to the Project site:

a. Sandblast black steel pipe to a gray finish. Sandblast galvanized steel pipe lightly only.

b. Install one coat of cut back asphalt to galvanized pipe immediately after sandblasting. Pre-heat black pipe to 180 degrees F. immediately before coating.

c. Install one coat of high-temperature (melting point of 240 degrees F. minimum) Grade B asphalt enamel.

- d. Install one wrapping of 20 mils thick glass, fiber mat, Owens-Corning Coromat or L.O.F. Blueflag with 1/4 inch overwrap. Glass fiber shall be dry at time of installation.
 - e. Install a second coat of asphalt enamel as specified above. Glass fiber mat shall be centered in the asphalt enamel.
 - f. Install an overwrap of Kraft ripple paper.
2. Total thickness of pipe wrapping shall be not less than 1/8 inch. Entire coating operation shall be accomplished by mechanical means in a continuous operation. Hand installation of protective coating is not permitted.
3. Each piece of wrapped pipe shall be legibly identified at no greater than 5 feet intervals by fabrication company. Each material submittal shall include the name of the fabrication company. Maintain one reviewed Sample on the Project Site.
4. Acceptable manufacturers of wrapping are: Hunt, Mobile, Conway or equal.
5. Fittings (including couplings), unprotected pipe adjacent to fittings, and damaged pipe protection shall be wrapped at Project site as follows:
 - a. Fittings and pipe to be wrapped shall be thoroughly cleaned of material foreign to pipe manufacturer.
 - b. Install one coat of Plicoflex No. 105 or Protecto Wrap No. 1170 adhesive primer to metal.
 - c. Wrap pipe and fittings with a minimum thickness of 3/32 inch of Plicoflex No. 310 pipe line butyl molding tape, or Protecto Wrap No. 200 molding tape. Install 3 layers, each layer overlapping next approximately 2/3 width of tape, without stretching. Tape and primer shall be of the same manufacturer.
 - d. Wrap vinyl tape, 10 mil thickness, over molding tape with 1 inch minimum overlap.
J.M. Trantex, 3M Scotchwrap or equal.
5. Pipe and fittings specified to be wrapped shall be tested with a holiday detector, after pipe has been installed in trench and before backfilling, in presence of the Project Inspector. Furnish a Tinkler and Raser model E-P holiday detector, or similar equipment for this test. Work, which is deemed defective, shall be repaired or replaced. The Project Inspector may test for damaged pipe wrapping after backfilling.
6. Instead of wrapping underground steel pipe as specified above, pipe may be machine-wrapped before delivery to the Project site as follows:

- a. Pipe shall be cleaned of moisture, oil, grease, scale, and other foreign material by cleaning with non-oily solvent and wire brushing. Remove metal burrs and projections.
 - b. Install one coat of Plicoflex No.105 adhesive primer to cleaned pipe. If thinning is required, furnish only non-oily thinners as recommended by tape manufacturer.
 - c. Wrap coated pipe with Plicoflex No.340-25 tape (15 mil butyl and 10 mil vinyl laminate) Tape shall be installed by machine wrapping at approved plant only. Maintain tension (minimum of 5 pounds per inch of width) on tape over entire diameter of pipe. Tape shall be permanently identified and visible on vinyl side.
 - d. Fittings, unprotected pipe, and damaged pipe protection shall be wrapped as indicated above.
- U. Pipe and Fitting Requirements Schedule: Unless otherwise specified or indicated on Drawings, pipe and fittings shall be installed in accordance with the following table:

TABLE I
 PIPE AND FITTING SCHEDULE

Use	Limits	Pipe	Fittings
Domestic hot and Cold water, underground	Up To8 inches	P-7	PF-5
Copper, underground only	All	P-7	PF-5
Cold water, underground (Site piping)	4-inch and over	P-15	PF-11
Domestic hot and cold water, in building and above ground	All	P-6	PF-5
In building above ground	2 to 8-inch	P-6	PF-5
Compressed air	Underground or in concrete	P-9	PF-8
	Above ground	P-10	PF-3
Condensate drains and drains From HVAC Equip.	All	P-6	PF-5
Downspouts, interior above and below grade, up to 5 feet from building.		P-1	PF-1 Or PF-2
Acid Vent	All	P-12	PF-10
Fire Mains (Fire Hydrant)	Underground	P-15	PF-11
Gas Natural	Underground	P-8	PF-6
Gas Natural	Above ground	P-10	PF-9
Copper Drainage Tube (Underground)	Waste and Vent	P-3	PF-4
Copper Drainage Tube (Above Ground)	Waste and Vent	P-4	PF-4

Vents	New Building	P-1	PF-1 or PF-2 (IRE) if required by engineer
Vents	Existing Buildings and Exposed Downspouts	P-2	PF-3
Vents	For acid waste lines underground	P-13, 14, 16, 17, 18	PF- 13a, 13b, 13c, 14a, 14b or 15
Waste lines, Sanitary		P-1	PF-1 or PF-2 (IRE) if required by engineer
Waste lines, Acid	To nearest water dilution jet	P-13, 14, 16, 17, 18	PF- 13a, 13b, 13c,14a, 14b or 15

- V. Flanges: Flanges shall be furnished and installed at each flanged connection of each type of equipment, tanks, and valves. Faces of flanges being connected shall be furnished alike. Connection of a raised face flange to a flat-faced flange is not permitted. Flanges shall conform to following schedules:

TYPE OF PIPE	FLANGE
Screwed black or galvanized grooved steel pipelines.	125 pound black cast iron screwed flange, flat faced or grooved flange adapters, Victaulic Style 741, Tyco-Grinnell Fig. 71, Gruvlok Fig. 7401, or equal.
Welded or grooved steel pipe, except high pressure steam lines.	150 pound black forged steel welding flanges, 1/16 inch raised face ASTM A 105, Grade II or grooved flange adapters, Victaulic Style 741, Tyco-Grinnell Fig. 71, Gruvlok Fig. 7401, or equal.
Copper and brass pipe or tubing.	150 pound cast bronze, flat-faced flange with solder end or grooved flange adapters, Victaulic Style 641, Tyco-Grinnell Fig. 61, Gruvlok Fig. 6084, or equal.

- Gasket material for flanged connections shall be full faced or ring type to suit facing on flanges and shall be furnished in accordance with following schedule

<u>SERVICE</u>	<u>TYPE</u>
Cold water	1/16 inch thick neoprene

Grooved end flange adapters supplied with pressure responsive elastomeric Gaskets supplied with grooved flange adapters shall be pre-lubricated by the manufacturer. Grade of gasket to suit intended service.

W. Unions:

- Unions shall be furnished and installed in accordance with the following requirements (unless flanges are furnished):
 - At each threaded or soldered connection to equipment and tanks, except in Freon or fuel gas, piping systems, whether indicated or not.

- b. Immediately downstream of any threaded connection to each manually operated threaded valve or cock, and each threaded check valve, yard box or access box except those in Freon piping systems, whether indicated or not.
 - c. At each threaded connection to threaded automatic valves (except those in Freon piping systems) such as reducing valves and temperature control valves, whether indicated or not.
 - d. If grooved piping is used, couplings shall serve as unions. Additional unions are not required
2. Unions shall be located so that piping can be easily disconnected for removal of equipment, tank, or valve.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Examine areas and conditions under which Work of this Section shall be performed. Correct conditions detrimental to proper and timely completion of Work. Do not proceed until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Provide all materials and equipment for the Work. Furnish and install necessary apparatus, parts, materials, and accessories.
- B. Pipe Installation:
 1. Install piping parallel to wall and provide an orderly grouping of proper materials and execution.
 2. Piping shall clear obstructions, preserve headroom, provide openings and passageways clear, whether indicated or not. Verify the Work of other Divisions to avoid interference.
 3. If obstructions or the Work of other Divisions prevent installation of piping or equipment as indicated by the Drawings, perform minor deviations as required by the Architect.
 4. Install piping after excavation or cutting has been performed. Piping shall not be permanently enclosed, furred in, or covered before required inspection and testing is performed.
 5. Exposed polished or enameled connections from fixtures or equipment shall be installed with no resulting tool marks or threads at fittings. Residue or exposed pipe compound shall be removed from exterior of pipe.
 6. Piping shall be concealed in chases, partitions, walls, and between floors, unless otherwise directed or specifically noted on Drawings. When penetrating wood studs, joists, and other wood members, provide such

members with reinforcement steel straps of Continental Steel & Tube Co., ULINE, Independent Metal Strap, or equal.

7. Reduce fitting where any change in pipe size occurs. Bushings shall not be furnished unless specifically reviewed by the Architect, or indicated on Drawings.
8. Piping subject to expansion or contraction shall be anchored in a manner, which permits strains to be evenly distributed. Swing joints or expansion loops shall be installed. Seismic restraints shall be installed so as not to interfere with expansion and contraction of piping. Seismic loops required at all building separations.
9. Immediately after lines have been installed, openings shall be capped or plugged to prevent entrance of foreign materials. Caps shall be left in place until removal is necessary for completion of installation.
10. Couplings shall not be installed except where required pipe runs between other fittings are longer than standard length of type of pipe being installed and except where their installation is specifically reviewed by the Architect.
11. Water piping shall be installed generally level, free of traps, unnecessary offset, arranged to conform to building requirements, clear of ducts, flues, conduits, and other Work. Piping shall be arranged with valves installed to provide for complete drainage and control of system. Piping shall not be installed which causes an objectionable noise from flow of water therein under normal conditions. Refer to Section 22 0500: Common Work Results for Plumbing.
12. Water lines may be installed in same trench with sewer lines, provided bottom of water line is 12 inches minimum above top and to the side of sewer line.
13. Changes in pipe sizes shall be furnished with eccentric reducers, flat on top. Offsets to clear obstruction shall not be installed so as to produce air pockets.

C. Pipe Sleeves and Plates:

1. Provide pipe sleeves of Schedule 40 black steel pipe or Schedule 40 PVC plastic pipe in concrete or masonry walls, footings, and concrete floors below grade. Provide adjustable submerged deck type sleeves at locations where pipes pass through concrete floors, except concrete slab floors on grade, and at locations where soil pipe for floor type water closets passes through concrete floors.

FOR FIRE RATED WALL PENETRATIONS FOLLOW THE UNIFORM BUILDING CODE.

2. Sleeves shall provide ½ inch clearance around pipes, except plastic pipe shall have 1 inch clearance. Caps of deck type sleeves shall be removed

just prior to installation of pipe. Area around sleeves shall be smooth and without high or low spots. Sleeves in walls shall not extend beyond exposed surface of wall. Sleeves in concrete floors and walls shall be securely fastened to forms to prevent movement while concrete is being placed.

3. Piping installed on a roof shall clear the roof surface by 10 inches minimum, with or without insulation. Bottom of individual fittings may infringe on 10 inches clear space but not groups of fittings or fittings located within 27 inches of each other.
4. Stiles shall be provided to facilitate crossing of piping when parallel piping runs are laterally greater than 12 inches out-to-out, or any pipe is higher than 18 inches, and more than 40 feet long or runs between two or more major pieces of equipment or housings greater than 20 feet apart. Stiles shall be not less than 20 inches wide with a minimum tread depth of 10 inches. Where stiles are required, they shall be located so greatest obstructed distance is 30 feet.
5. Where pipes pass through waterproofed walls, floors, or floors on grade, sealant with Link-Seal Modular Seals, or equal, between pipe and sleeve to provide a waterproof joint. Where earth is in contact with pipe on both sides of a wall or foundation, the waterproof joint is not required. Commercial rubber compression units may be furnished instead of sealed sleeves if reviewed by the Architect.
6. A swing joint, or other required device, shall be furnished and installed in hot water lines with 10 feet of sealant or compression joint to allow for expansion.
7. Provide polished, chrome-plated flanges when plumbing pipes pass through walls at plumbing fixtures, etcetera as specified in Section 22 1000 Plumbing. Provide polished steel, chromium-plated split floor and ceiling plates at locations where pipes pass through walls, floors, ceilings, and partitions in finished portion that neatly conceals pipe insert.
8. Pipe sleeves shall be provided where pipes intersect footings or foundation walls and sleeve clearances shall provide for footing settlement, but not less than one inch all around pipe.

D. Welding of Pipe and Qualifications of Welder:

1. Joints above grade or accessible conduit or tunnels in steel piping may be either welded or screwed unless specifically indicated otherwise on Drawings or specified. Joints in below grade steel piping, whether in insulation or not, shall not be welded, unless otherwise indicated.
2. Welded joints in pipe shall be continuous around pipe and shall comply with ASME B31: Code for Pressure Piping, unless otherwise specified.
3. Each pipe weld shall be stamped with welder's identification mark. Welding shall be performed by welders possessing a valid certificate of

qualification for welding carbon steel welding pipe in horizontal position (2G) and horizontal fixed position (5G) in accordance with the requirements of Section IX of the ASME Boiler and Pressure Vessel Code, by an Owner-recognized, DSA approved testing laboratory.

4. Before any welder performs welding on the Work, furnish the INSPECTOR with a copy of welder's valid qualification papers and obtain verification. Welder qualification is not valid unless it has been issued while welder was performing work for current employer, and has performed type of work described by qualification in the preceding 3 months.

REFERENCE: ASME BOILER AND PRESSURE VESSEL CODE, SECTION VIII, UW-29 TESTS OF WELDERS AND WELDING OPERATORS.

5. Welding performed under these Specifications is subject to special tests and inspections including rigid Ultra Sonic Testing (UT) and radiographic inspection at random, in accordance with Technique for Radiographic Examination of Welded Joints by an Owner recognized, DSA approved testing laboratory.

ASME BOILER AND PRESSURE VESSEL CODE, SECTION VIII, UW-51 RADIOGRAPHIC EXAMINATION OF WELDED JOINTS.

E. Unacceptable Welds and Repairs to Welding:

1. Welds containing any of the following types of imperfections shall be deemed defective Work:
 - a. Cracks of any type.
 - b. Zones of incomplete (in excess of 1/32 inch) fusion or penetration.
 - c. Elongated slab inclusions longer than 1/4 inch.
 - d. Groups of slag inclusions in welds having an aggregate length greater than thickness of parent metal in a length 12 times the thickness of the parent metal.
 - e. Undercuts greater than 1/32 inch.
 - f. Overlaps, abrupt ridges or valleys.
2. When a defective weld is detected by examination as outlined above, two additional welds shall be radiographed at locations selected by the Project Inspector. If the two selected welds demonstrate compliant welding, then the two tested welds shall be deemed to be in compliance. Welding revealed by radiographs to be defective Work shall be removed, repaired, and tested by radiograph.
3. If either of the two selected welds demonstrates welding deemed to be defective Work, all welding in that portion of the Work shall be deemed

defective Work and either: all welds shall be cutout, prepare new ends for welding and weld to comply with this Specification, or radiograph all welds, removing and repairing only such welding deemed to be defective Work.

4. Repair welding shall be performed in a manner in full compliance with ASME B31. The welded joints or repairs shall be spot examined with UT or radiographic tests in accordance with foregoing requirements.

REFERENCE, ASME BOILER AND PRESSURE VESSEL CODE, SECTION VIII, UW-52.

5. Owner shall cause to be performed additional random UT and radiographic examinations of welds. Owner shall be responsible for the costs of any UT and radiographic examinations found to be in compliance with specified requirements.
6. Installer shall be responsible for the costs of UT and radiographic re-examinations of welds deemed defective Work and not in compliance with this Specification, and shall repair or replace said welds in accordance with specified requirements.

F. Welding Rods: Submit a written list of materials and proposed type of welding rods.

G. Backing Rings: Backing rings may be submitted for installation provided the Product Data is submitted with the material list.

H. Qualification Tests for Low-pressure Welding:

1. Tests shall be performed on 3-inch standard weight pipe ASTM A53, Grade A, and shall be welded by acetylene and electric arc. Each sample shall consist of 2 pieces, each 10 inches long, with 30-degree bevel at point weld.
2. Two 20-inch samples shall be performed in the 2G and two 20-inch samples in the 5G positions, with positions defined in Section IX, ASME Boiler and Pressure Vessel Code. Welds shall have the reinforcement ground or machined flush to the surface of the pipe before testing. Samples shall be tested as full section tensile.
3. Weld shall develop a load of 90 percent of 50,000 psi, i.e., 45,000 psi or shall develop a fracture in parent metal.
4. Each qualified welder shall carry an identification card listing welder's name, date of test, and type of welding tests passed; signed by the welder and the laboratory.
5. A valid certificate of qualification issued in compliance with requirements of the ASME Boiler Pressure Vessel Code Section IX shall qualify a welder for issuance of a certificate for low-pressure pipe welding.

- I. Certificates of Qualification for Welding of Unfired Pressure Vessels:
1. Certificates of qualification shall be issued by a laboratory recognized by the Owner in compliance with the requirements of the ASME Boiler Pressure Vessel Code Section IX. Qualifications shall be for both acetylene and arc welding of Schedule 40 ASTM A53, Type B ,steel welded or seamless pipe in the Horizontal Position (2G) and the Horizontal Fixed Position (5G) as defined by said code.
 2. Certificate described above is not valid unless it has been issued while welder was working for his current employer, and unless welder has performed type of work described by certificate in the preceding three months. Requirements for possession of a valid certificate shall not be waived for welders fabricating unfired pressure vessels when the Specifications require compliance with ASME code or when welding pipe carries working pressures greater than 75 psi and temperatures greater than 250 degrees F.
- J. Pipe Joints and Connections:
1. Pipe and tubing shall be cut per IAPMO Installation Standards. Pipe shall have rough edges or burrs removed so that a smooth and unobstructed flow shall be provided.
 2. Hot tapping of gas lines is strictly prohibited.
 2. Threaded Pipe: Joints in piping shall be installed according to the following service schedule:
 - a. Soap Piping: Litharge and glycerine, or Expando, Gasoila, or equal.
 - b. Plastic Piping: Teflon pipe joint compound tape.
 - c. Oxygen Piping: Wash treads with S.P., rinse, blow-dry and apply litharge and glycerine.
 - d. Cleanout Plugs: No compound shall be used. After inspection and test, plugs shall be removed, cleaned, greased, and replaced.
 - b. Other services furnish sealant, suitable and as reviewed by the Architect.
 3. Threads on pipe shall be cut with sharp, clean, unblemished dies and shall conform to ANSI/ASME B2.1 for tapered pipe threads.
 4. Joint compounds shall be smoothly placed on male thread and not in fittings. Threaded joints shall be installed tight with tongs or wrenches and sealant of any kind is not permitted. Failed joints shall be replaced with new materials. Installation of thread cement or sealant to repair a leaking joint is not permitted.

5. Sharp-toothed Stillson, or similar wrenches, is not permitted for the installation of brass pipe or other piping with similar finished surfaces.
- K. Copper Tubing and Brass Pipe with Threadless Fittings:
1. Silver brazed joints shall be used for attaching fittings to non-ferrous metallic refrigerant piping.
 2. Non-pressure gravity fed condensate lines may be soldered with 95/5 solder.
 3. Silver brazing alloy, Class BCUP-5. Surfaces to be joined shall be free of oil, grease, and oxides. Socket of fitting and end of pipe shall be thoroughly cleaned with emery cloth and wiped to remove oxides. After cleaning and before assembly or heating, flux shall be installed to each joint surface and spread evenly. Heat shall be applied in accordance with instructions in the Copper Tube Handbook issued by Copper Development Associates. Joints constructed of rough bronze fittings shall be provided as recommended by manufacturer.
 4. Do not overheat piping and fittings when installing silver brazing.
 5. Joints in non-ferrous piping for services not covered above shall be installed with solder composed of 95/5 tin/antimony, ASTM B32, Grade 5A. Surfaces to be jointed shall be free of oil, grease, and oxides. Sockets of fitting and end of pipe shall be cleaned with emery cloth to remove oxides. Solder flux shall be sparingly installed and solder added until joint is completely filled. Do not overheat. Excess solder, while plastic, shall be removed with a small brush in order to provide an uninterrupted fillet completely around joint. Random inspection of joints shall be conducted by Project Inspector to ensure joints are lead-free.
 6. Grooved end joints for copper piping shall be assembled in accordance with the latest manufacturer recommendations. Pipe ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove for proper gasket sealing. Grooving tools shall be as manufactured by Victaulic, RIDGID, MAG Tool, or equal.
- L. Ring-Type Pipe: Joints shall be installed in accordance with manufacturer's instructions with grooved couplings, fittings and rubber rings. Couplings and pipe shall be compatible and of the same manufacturer. Rings shall be accurately located and installed by grooves in coupling. Pipe shall be installed with zero deflection unless otherwise specified. Pressure pipe shall be furnished with thrust blocks at each offset point.
- M. Welded Pipe Joints:
1. Joints in welded steel pipelines shall be installed by oxyacetylene or electric arc process. Welding shall be continuous around pipe and provided as specified.

2. Butt welds shall be of the single V-type, with ends of pipe and fittings beveled approximately 37 ½ degrees. Piping shall be aligned before welding is started with the alignment maintained during welding.
 3. Welds for flanges and socket fittings shall be of the fillet type with a throat dimension not less than pipe wall thickness.
- N. Grooved End Pipe Joints: Grooved end joints for carbon steel piping shall be assembled in accordance with the latest manufacturer recommendations. Pipe ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to grove for proper gasket sealing. Grooving tools shall be as manufactured by Victaulic, RIDGID, MAG Tool, or equal.
- O. Joints shall be Vic-Press 304TM, or equal, made with Victaulic Series 'PFT' tools and the appropriate sized jaw. Pipe shall be certified for use with Vic-Press 304TM system, and shall be square cut, properly deburred and cleaned, and marked at the required location to insure full insertion into the fittings and/or couplings.
- P. Polyethylene (Plastic) Pipe:
1. Joints shall be installed by the heat fusion method, in accordance with manufacturer's recommendations and IAPMO installation standard IS 12, for natural gas.
 2. Pipe Riser at Meter, Regulator and Building Wall: Prefabricated, anodeless type, utilizing a grade level transition between underground polyethylene pipe and gas supply steel pipe of riser outlet, R. W. Lyall Co., or equal. Below grade to above grade transition shall be installed in a welded, epoxy coated, steel casing.
 3. Connections to Existing Pipe Line or Branch:
 - a. Steel-to-plastic (PE): Provide manufacturer's prefabricated standard transition fitting, transition from epoxy-coated steel pipe to plastic, R. W. Lyall Co., or equal.
 - b. Plastic-to-plastic, PVC to PE: Provide manufacturer's prefabricated standard transition fitting, transition from PVC to epoxy-coated steel pipe to PE; R.W. Lyall Co., or equal..
 - c. Plastic-to-plastic, PE to PE: Provide manufacturer's standard fused tapping tee assembly with shut-off feature.
 4. Provide PE reinforcing sleeves where PE pipe is fused to multi-saddles, service punch tee, reducing tees, transition fittings and anodeless risers.
- Q. Valves: Valves shall conform to the following:
1. Piping systems shall be furnished with valves at points indicated on Drawings and specified, arranged to provide complete regulating control of piping system throughout building and the Project site.

2. Valves shall be installed in a neat grouping, so that parts are easily accessible and maintained.
3. Valves shall be full size of line in which they are installed, unless otherwise indicated on Drawings or otherwise specified, and shall be one of types specified.
4. Provide chain operators on valves 2-inch and larger located 7 feet or more above the servicing floor level.
5. Valves for similar service shall be of one manufacturer.
6. Except where otherwise specified, valves shall be Belimo, Victaulic, Stockham, Crane, Jenkins, Milwaukee, Hammond, American, NIBCO, Hoffman, or equal.
7. Ball valves below grade in yard boxes shall have stainless steel handles.
8. Hose bibs in dense garden areas shall be $\frac{3}{4}$ inch in size with one hose bib in the lunch pavilion 1 inch in size. Other hose bibs shall be $\frac{3}{4}$ inch lock shield type. Bibs shall be furnished with vacuum breaker protection.
9. Safety valves and pressure relief valves shall have stamp of approval as required by ASME and shall be provided with annual test lever. Where a hot water storage tank is heated by means of a coil, pressure relief valve shall have a steam BTU discharge rating of the coil. Discharge pipe from safety or pressure relief valves shall be not less than one pipe size larger than inlet pipe size of valve. Discharge pipe shall terminate as indicated and shall be free of traps. In addition to locations specified, pressure relief valves shall be installed in the following locations:
 - a. On discharge side of each pressure-reducing valve.
 - b. On each water heater connected to a hot water storage tank and other pressure vessels.
 - c. On cold water line to each water heater or hot water storage tank when there is a check valve, backflow prevention valve or similar device between water heater or hot water storage tank and meter or relief valve at the pressure reducing valve assembly.
 - d. On discharge side of each air compressor.
 - e. On each air receiver connected to an air compressor.
10. Temperature relief valves and combination temperature and pressure relief valves shall be as specified and furnished as set forth in this Section. Discharge pipe from relief valves shall be not less than discharge area of valve or valves it connects, based on discharge area of valves, and shall terminate as indicated and free of any traps. Valves shall be installed at following locations:

11. A combination temperature and pressure relief valve or combination of valves on each heating hot water storage tank. Temperature sending element shall extend into water inside tank.
 12. Manual air vent valve assemblies shall be installed at each high point of hot water space heating and chilled water piping systems. Valves shall discharge through 1/4 inch diameter copper tubing and drain to nearest floor sink. Automatic type air vent valve shall only be installed where specifically indicated. Radiator, convectors, and finned pipe convectors shall be fitted with packless radiator valves, angle or straight pattern. Each convector or radiator installed as part of a space hot water heating system shall be furnished with a manual-type air vent valve.
- R. Strainers: Strainers shall be installed on each water main (except for fire line) downstream of the meter, above grade, when a pressure regulator assembly is not installed. Main strainer shall be of Y-flange or groove type. On closed loop chilled and heating hot water systems pump systems, a strainer shall be installed at each pump inlet and upstream of each flow control valve assembly. The control valve assembly may include a modulating temperature control valve and a flow-limiting valve, manufactured by Griswold, AutoFlow, Flow Control Industries, Inc., or equal.
- S. Hangers and Supports:
1. Piping shall be securely fastened to building structure by approved iron hangers, supports, guides, anchors, and sway braces to maintain pipe alignment to prevent sagging and to prevent noise or excessive strain on piping due to uncontrolled or seismic movement under operating conditions. Hangers and supports shall conform to Manufacturer's Standardization Society Specification SP-69. Hangers shall be relocated as required to correct unsatisfactory conditions that may become evident when system is placed into operation. Appliances, heat exchangers, storage tanks, and similar equipment shall be securely fastened to structure in accordance with seismic requirements. Outdoor metal hangers and supports shall be hot-dipped galvanized steel, unless otherwise specified.
 2. Hose faucets, compressed air outlets, and similar items at ends of pipe branches shall be rigidly fastened to building construction near point of connection.
 3. Piping shall not be supported by wire, rope, wood, plumbers' tape, or other non-recognized devices.
 4. Hangers and supports shall be designed to support weight of pipe, fittings, weight of fluid and weight of pipe insulation, and shall have a minimum factor of safety of five, based on ultimate tensile strength of material installed.
 5. Burning or welding of any structural member under load is not permitted. Field welding not specified on Drawings or reviewed Shop Drawings is not permitted without review by Architect and DSA.

6. Burning holes in beam flanges or other structural members is not permitted without review by the Architect and DSA.
7. Pipe hangers on piping covered with low temperature insulation shall be installed on outside of insulation and not in contact with pipe unless otherwise detailed on Drawings. Insulation shall be protected by 18 gage galvanized steel shield, with a minimum length of 10 inches, installed completely around pipe covering between covering and hanger. Installing hangers directly on pipe and butting adjoining sections of insulation against hanger is permitted provided void and hanger rod are properly insulated and sealed so that no sweating occurs at hangers.
8. Hanger rods shall be fastened to structural steel members with suitable beam clamps. Clamps shall be Tolco, Carpenter & Patterson, Fee and Mason, or equal, as follows:
 - a. Tolco I beam, Fig.62 for maximum 1000 pounds.
 - b. Tolco I or WF beam, Fig. 329, for maximum of 1290 pounds.
9. Hanger rods shall be fastened to concrete inserts in concrete slabs or beams. Inserts shall be Tolco, Carpenter & Patterson, Fee and Mason, or equal, as follows:
 - a. Tolco Fig.310 for maximum of 600 pounds.
 - b. Tolco Fig. 309 for maximum of 1140 pounds.
10. For fastening to wood ceilings, beams, or joists, furnish Grinnell Fig. 128R, Grinnell Fig. 153, Tolco 78, or equal pipe hanger flange fastened with drive screws. Under wood floors, 3/8 inch hanger rods shall be hung from 2-inch by 2-inch by 1/4 inch angle clips 3 inches long, with 2, staggered 10d nails, clinched over joist.
11. Hanger rod sizes for copper, iron, or steel pipe: 3/8 inch for pipe sizes 1/2 inch through 2-inch, 1/2 inch for pipe sizes 3-inch, 4-inch and 5-inch, 5/8 inch for pipe size 6-inch, and 3/4 inch for 8-inch and 10-inch pipe.
12. Turnbuckles, if furnished, shall provide a load carrying capacity equal to that of the pipe hanger with which they are being installed.
13. Pipe hangers shall be of same size, or nearest larger manufactured size available, as pipe or tubing on which they are being installed.
14. Hangers, clamps, and guides furnished for support of non-metallic pipe shall be padded with 1/8 inch thick rubber, neoprene, or soft resilient cloth.
15. Where special pipe-supporting requirements in the Specifications conflict with any standard requirements specified herein, the Specification requirements shall govern.

16. Vertical Piping:

- a. Vertical pipe risers shall be securely supported with riser clamps of recognized type. Risers in reinforced concrete buildings shall be furnished with extension clamps fastened to pipe above each concrete floor slab with extended arms of clamp to rest on slab. Clamps shall be provided with lead or Teflon liners when installed on copper tubing. Clamps shall be plastic-coated when installed on non-ferrous pipe or tubing.
- b. Copper tubing in sizes 1 ½-inches and larger and steel pipelines passing up through building shall be supported at each floor of building or every 15 feet whichever is less.
- c. Copper tubing sizes 1 ¼-inches and smaller shall be supported at not intervals not more than 6 feet on center. Special provisions shall be installed for vertical lines subject to expansion and contraction caused by operating temperature differences.
- d. Vertical cast iron pipelines shall be supported from each floor and at its base. Malleable iron or steel pipe clamps with minimum thickness of 1/4 inch shall be furnished and fastened around pipe for support.

17. Horizontal Piping:

- a. Pressure piping on roofs shall be supported from stands, trapezes, or structures so that the bottoms of pipes clear the roof surface by 10 inches.
- b. Insulated steam and space heating hot water insulated condensate lines, insulated domestic hot water supply and return piping shall be supported with Tolco Figure 4, B-Line Figure B3140, Grinnell Figure 212, or equal, steel hangers with welded eye rods to permit hinge movement at point of attachment of hangers. Hinge movement at point of support shall be provided by welded eye linked rods Tolco Figure 101L, B-Line Figure B3211X, Grinnell Figure 278, or equal.
- c. Domestic cold water piping, water supply and return piping, condenser water piping, insulated refrigerant piping gas piping, compressed air piping, cast iron soil piping, galvanized steel vents, waste and downspout piping and glass to be supported with Tolco Figure 1, B-Line Figure B3100, Grinnell Figure 260, or equal, hangers with rods, turnbuckles and inserts suitable for above hangers.
- d. Maximum hanger and support spacing shall conform to CPC schedule for horizontal piping installed above grade.

18. A hanger or support shall be installed close to the point of change in direction of a pipe run, in either a horizontal or vertical plane.

19. When practicable, supports and hangers for cast iron soil pipe shall be installed as close as possible to joints and when hangers or supports are not located within one foot of a branch line fitting, an additional hanger or support shall be installed at fitting.
20. In systems where grooved piping is used, couplings shall be provided with angle pattern bolt pads to comply with support and hanging requirements of ANSI/ASME B31.1, ANSI/ASME B31.9, and NFPA Pamphlet 13.

T. Flashings:

1. Each pipe, duct, or gas-fired equipment vent passing through roof shall be installed with waterproof flashing.
2. Flashing or flanges on pipes, vents, and ducts passing through a tile or slate roof shall be constructed of sheet lead. Flashing for pipes and heater vents passing through a roof shall be 4 pound soft sheet lead. Flashing and flanges for ducts and heater vents passing through exterior walls shall be 22 gage sheet metal. Flanges and flashing shall be installed waterproof at point of connection with pipe or duct. No soldered joints on roof flashings will be allowed.
3. Lead flashing and flanges shall be constructed of 4 pound sheet lead with burned joints. Flange of lead flashing or lead flange on a duct shall extend out onto roof a minimum of 12 inches from pipe or duct. Lead flashing shall extend up the pipe or duct not less than 7 inches.
4. Sheet metal flashing shall be constructed of 24 gage galvanized sheet steel. Flanges on these flashings shall extend out onto roof a minimum of 10 inches from pipe or duct. Flanges on ducts through exterior walls shall extend out from duct a minimum of 2 ½ inches. Flanges on gas-fired equipment single-wall vents shall be of ventilated type. Type B gas vents through a roof shall be furnished with non-ventilated flashing as per NFPA Pamphlet 211.
5. Cast iron, steel, brass, and copper pipe, which terminates less than 18 inches above roof, shall be furnished with a combination counter-flashing and vandal-proof hood for protection against water, birds and foreign matter. Cast iron, steel, brass and copper pipe, which does not terminate within 18 inches of roof, shall be furnished with a counter-flashing sleeve. Pipe, which terminates more than 18 inches above roof, shall be furnished with protection against entrance of water, birds, and foreign matter.
6. Counter-flashing and combination counter-flashing sleeves and vandal-proof hoods shall be cast iron, vandal-proof, threaded, sealed or approved gas-heated sleeve type. Counter-flashing sleeves on each of these items shall extend down over flashing a minimum of ¾ inch.
7. Flashing and flanges on ducts shall be installed waterproof at point of connection to the duct by riveting and soldering. Storm collars shall be

securely screwed and installed waterproof around appliance vent pipe immediately above flashing.

8. Vent piping above roof shall be furnished with a combination counter-flashing sleeve and vandal-proof hood.
- U. Equipment Installation: Install roof or floor mounted equipment on level platforms, housekeeping pads or curbs and provide sound, vibration and seismic control measures even if not indicated on Drawings.

END OF SECTION

SECTION 22 0553
PLUMBING IDENTIFICATION

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes: Marking and identification on mechanical piping systems, ducts, controls, valves, and apparatus.
- B. Related Requirements:
 - 1. Division 01: General Requirements
 - 2. Section 22 0513: Basic Plumbing Materials and Methods.
 - 3. Section 22 1000: Plumbing.

1.02 SUBMITTALS

- A. Submit in accordance with Division 01 and Section 22 0500: Common Work Results for Plumbing.
- B. Submit product data and installation instructions for each item specified.
- C. Submit Samples of materials.

1.03 QUALITY ASSURANCE

- A. Comply with provisions of:
 - 1. Section 22 0500: Common Work Results for Plumbing.
 - 2. ANSI/ASME A13.1: Scheme for the Identification of Piping Systems.
 - 3. APWA: Uniform Color Code.
 - 4. IAPMO: Uniform Plumbing Code (UPC)

PART 2 – PRODUCTS

2.01 MATERIALS

- A. General: Piping systems, controls, valves, apparatus, etc., except those that are installed in inaccessible locations in partitions, walls, and floors, shall be permanently identified.

2.02 VALVES

- A. Furnish prepared chart or diagram for each piping system, indicating by identifying letter or model number of each valve in the system, its location, and function.
- B. Install charts in aluminum frame with clear glass front and secure on wall where designated by the Project Inspector.
- C. Bind copies of each chart in operating instructions manual.
- D. Provide each valve with a brass, aluminum, or plastic disc, not less than 1-1/4 inches diameter bearing engraved numbers corresponding to those indicated on chart. Fasten discs to valve with No. 14 brass wire.
- E. Provide an additional tag for safety valves and other valves that could be hazardous to safety and health of occupants. Distinguish these tags from regular valve tags by color (such as yellow with black letters, and marked "Danger"); submit Sample tag to the Architect for review.

2.03 INSTRUMENTS AND CONTROLS

- A. Identify panel-mounted instruments and controls with engraved bakelite nameplates permanently affixed to panel boards.
- B. Identify alarm indicating devices and alarm reset devices by nameplates.
- C. Identify automatic valves, flow switches, and pressure switches, with embossed aluminum or plastic tape affixed to controller, indicating service and setting.

2.04 EQUIPMENT

- A. Identify each major piece of equipment with engraved bakelite nameplates permanently affixed to the equipment, indicating the room numbers it services, Equipment identification designation shall be the same to its designation indicated on the "As-Built Drawings". Room numbers in the nameplates shall correspond to the final room numbers.

2.05 ABOVE GRADE PIPE IDENTIFICATION

- A. Identify pipes by means of colored labels with directional flow arrows and identification of the pipe content, in conformance to ANSI/ASME A13.1 or the UPC.
- B. Materials: Precoiled acrylic plastic with clear polyester coating, all-temperature, self-adhering, as manufactured by Brady, Brimar Industries, Seton, Stranco, Inc., or equal.
- C. Size:

Outside Diameter of Pipe or Insulation (in inches)	Length of Color Field (in inches)	Size of Letter (in inches)
3/4 to 1 1/4	8	1/2

1 ½ to 2	8	¾
2 ½ to 6	12	1 ¼
8 to 10	24	2 ½
over 10	32	3 ½

D. Locations:

1. On accessible piping, whether insulated or not (including mechanical rooms, attic and ceiling spaces); except that labels shall be omitted from piping where contained material is obvious due to its connection to fixtures (such as faucets, water closets, etcetera.).
2. Near each valve and branch connection in such accessible piping.
3. At each pipe passage through wall or floor.
4. At not more than 20 feet spacing on straight pipe run between bands required in 2 and 3 above.
5. At each change in direction.

E. Application: Install on clean surfaces free of dust, grease, oil, or any material that will prevent proper adhesion. Replace non-adhering or curling labels with new labels.

F. Color Schedule:

Content of Pipe	Legend	Background Color	Lettering Color
Domestic cold water	Domestic. C.W.	Green	White
Non-potable cold water	Caution: Non-potable Water Do Not Drink (1)(2)	Purple	Black
Domestic hot-water 140°F	Domestic H.W. 140°F	Blue	Black
Sanitary waste	San waste	Green	White
Sanitary vent	San vent	Green	White
Storm drain or downspout	Storm drain	Green	White
Indirect drain	Ind drain	Green	White
Sump pump discharge	Pump discharge	Green	White
Fire sprinkler supply	Fire Sprinkler supply	Red	White
Fire sprinkler drain	Sprinkler drain	Red	White

Fuel oil	Diesel oil	Yellow	Black
Gas	Gas	Yellow	White
Reclaimed Water	Caution: Reclaimed Water Do Not Drink (1)(3)	Purple	Black

H. Notes on Schedule:

1. Note (1) indicates 2 ¼ inch by 1 inch yellow label with ½ inch letters reading UNSAFE WATER at one end of primary label.

Note (2) words should read "CAUTION: NONPOTABLE WATER DO NOT DRINK." with international *do not drink* symbol.

2.06 UNDERGROUND PIPE

A. Detectable Marking Tape:

1. Provide and install detectable marking tape along buried piping. Tape shall be specifically manufactured for marking and locating underground utilities with electronic equipment. Tape shall be acid and alkali resistant, and manufactured with integral wires or foil backing, encased with protective cladding. Tape shall be a minimum of two inches in width.
2. Manufacturer: Reef Industries, Inc., Advantage Brands, Inc., Northtown Company, Mutual Industries, Inc., or equal.
3. Detectable marking tape shall be color-coded per APWA Color Code:
 - a. Yellow: Oil and gas.
 - b. Blue: Water, irrigation and slurry lines.
 - c. Green: Sewer and drain lines.

B. Tracer Wire:

1. Solid copper wire type THWN, 12 AWG gauge, with heat and moisture resistant insulation.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Correct detrimental conditions prior to commencing the Work of this Section. Install markers and identification tags as specified with materials and installation procedures recommended by manufacturer.

- B. Place tracer wire on top of non-metal utility lines allowing some slack. Do not wrap tracer wire around pipe. Fasten tracer wire in place at approximately 10 feet on centers with non-metal ties.
- C. Install underground detectable pipe marking tape continuously buried 8 to 10 inches above the buried utility pipe. Wrap tape on pipe risers up to a height of 12 inches above grade.

3.02 CLEANUP

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

END OF SECTION

SECTION 22 0700

PLUMBING INSULATION

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Insulation for plumbing piping.

B. Related Requirements:

1. Division 01: General Requirements.
2. Section 22 0500: Common Work Results for Plumbing.
3. Section 22 0513: Basic Plumbing Materials and Methods.
4. Section 22 0553: Plumbing Identification.
5. Section 22 1000: Plumbing.

1.02 REFERENCES

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

1. ***ASTM C302 - Standard Test Method for Density and Dimensions of Preformed Pipe-Covering-Type Thermal Insulation.***
2. ***ASTM C411 - Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.***
3. ***ASTM C423 - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.***
4. ***ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.***
5. ***ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation.***
6. ***ASTM C1104 - Standard Test Method for Determining the Water Vapor Sorption of Unfaced Mineral Fiber Insulation.***
7. ***ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.***
8. ***ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.***

B. Underwriters Laboratories, Inc.

1. UL 723 - Test for Surface Burning Characteristics of Building Materials.

- C. National Fire Protection Association:
 - 1. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.

- D. California Code of Regulation Title 24.
 - 1. California Green Building Standards Code.

1.03 SUBMITTALS

- A. Submit in accordance with Division 01 and Section 22 0500: Common Work Results for Plumbing.
 - 1. Complete material list of items to be furnished and installed under this Section.
 - 2. Manufacturer's specifications and other data required demonstrating compliance with the specified requirements.
 - 3. Shop Drawings, catalog cuts and manufacturer's data indicating insulation, jacketing, adhesives, and coating. Insulating materials shall be certified by manufacturer to comply with the California quality standards for insulating materials.
 - 4. Display sample cutaway sections.
 - 5. Manufacturer's recommended method of installation procedures, which will become part of this Section.

1.04 QUALITY ASSURANCE

- A. Qualifications of Manufacturer and Installer, Materials, Fabrication, Execution, and Standard of Quality: Comply with provisions stated under Section 22 0500: Common Work Results for Plumbing and Section 22 0513: Basic Plumbing Materials and Methods.
- B. Insulation Work shall be in accordance with the California Building Energy Efficiency Standards, CBC, and California Mechanical Code and the California Green Building Standards Code.
- C. Test Ratings:
 - 1. Comply with provisions stated under Section 22 0500 and 22 0513 with emphasis on ASTM E84, NFPA 255, or UL 723. ASTM C167, ASTM C302, UL label or listing of satisfactory test results from the National Institute of Standards and Technology, or a satisfactory certified test report from an acceptable testing laboratory. Approval by the State Fire Marshal is required.
 - 2. Furnish labels, legibly printed with the name of the manufacturer or listings indicate that fire hazard ratings do not exceed those specified for materials proposed for installation. Flame spread index of not more than 25 and smoke developed rating not exceeding 50.
 - 3. Tests shall be performed on each item individually when insulation, vapor barrier covering, wrapping materials, or adhesives are installed separately at the Project site.

4. Test insulation, vapor barrier covering, wrapping materials and adhesives as an assembly when they are factory composite systems.

D. Regulatory Requirements: Insulation furnished and installed under this Section shall meet minimum legal requirements of the Building Energy Efficiency Standards adopted and incorporated in the California Energy Commission, Title 24, Part 2, Chapters 2 through 53 and the California Green Building Standards Code unless otherwise noted, for the piping,

E. Chemically based products such as sealers, primers, fillers, adhesives, etcetera must meet the California air quality regulations.

1.05 PRODUCT HANDLING

A. Protection, Replacement, Delivery and Storage: Comply with provisions stated under Sections 22 0500: Common Work Results for Plumbing and 22 0513: Basic Plumbing Materials and Methods.

PART 2 – PRODUCTS

2.01 MATERIALS

A. General:

1. Insulating material shall be fire resistant, non-corrosive, shall not break, settle, sag, pack or disintegrate under vibration, nor absorb more than 1 percent moisture by weight.
2. Insulating material shall be furnished with thickness indicated in Table 1, and shall furnish thermal resistance in the range of R-4.0 to 4.6 in accordance with inch at 75 degrees F. For any other value of R, insulation thickness shall be calculated accordingly and submitted for review.
3. Asbestos in any quantity in insulating material is not permitted.
4. Provide insulation materials, adhesives, coatings, sealants, fitting covers, and other accessories with a fire hazard rating not to exceed 25 for flame spread, 25 for fuel contributed and 50 for smoke developed, except for materials listed as follows:
 - a. Nylon anchors for installing insulation to equipment.
 - b. Treated wood blocks.
5. Flame-proofing treatments subject to moisture damage are not permitted.

TABLE 1 - MINIMUM PIPING INSULATION THICKNESS ⁽¹⁾

Insulation Thickness Required (in inches)

Piping System Type	Temp. Range (degrees F)	Runouts up to 2 ⁽²⁾	1 and less	1.25 to 2	2.5 to 4	5 to 6	8 and larger
Service Water Heating Systems (recirculating, piping supply and return)							
Hot Water	Up to 180	0.5	1.0	1.0	1.5	1.5	1.5
Condensate Drain	½ inch minimum insulation	0.5	0.5	0.5	0.5	0.5	0.5

	thickness.						
From A/C Equipment:	Insulate condensate drain lines within building, in room, inside walls and above ceilings.	0.5	0.5	0.5	0.5	0.5	0.5

NOTES: (1) For piping exposed to ambient temperatures, increase thickness by 0.5 inch.

(2) Runouts to individual terminal units, not exceeding 12 feet in length.

B. Lagging Adhesives: Shall be nonflammable and fire-resistant and shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E84. Insulation finished with canvas shall be provided with laps adhered in accordance to manufacturer's recommendation. A finish coat of same material shall be applied to entire outer surface of lagging cloth at coverage specified by manufacturer.

C. Canvas Jackets: Provide 6 ounce, in accordance with square foot minimum, 48 by 48 thread count canvas jacketing.

D. Insulation Jackets:

1. Exterior insulation exposed to weather shall be weatherproofed with Childers aluminum jacketing as basis of design, or Pabco, RPR, or equal. Jacketing shall be manufactured from 1100, 3105 or 5010 aluminum alloy with 3/16 inch corrugations. Smooth or embossed jackets may be permitted in special situations to match an existing installation. Jacketing shall be furnished with an integrally bonded moisture barrier over entire surface in contact with insulation. A minimum thickness of 0.016 aluminum jacketing is to be provided on ducts and piping. A minimum thickness of 0.020 shall be provided on tanks, equipment, and heat exchangers.
2. Insulated elbows, of 90 degrees and 45 degrees, with a nominal iron pipe size of 1/2 inch to 8-inch shall be provided with Childers aluminum Ell-Jacs insulation covers as basis of design, or Pabco, RPR, or equal, manufactured from 1100 aluminum alloy of 0.024 inch thickness. Insulated elbows with a nominal pipe size of 10-inch to 18-inch shall be provided with Childers 4-piece aluminum Ell-Jacs as basis of design, or Pabco, RPR, or equal.
3. Tees, Flanges, and Valve Insulation in Conjunction with Aluminum Jacketing: Furnish Childers Aluminum Special Fabrications Insulation Covers as manufactured by Childers Products Company, Pabco, RPR, or equal.

E. Adhesives: Adhesives shall be water based, UL Classified, meet the requirements of NFPA 90A and NFPA 90B, have been tested according to relevant ASTM requirements, and be acceptable to the State Fire Marshal. Name, type and method of installation shall be submitted for review.

F. Valve and Fitting Cover: When installed in conjunction with PVC jacketing, furnish Zeston 25/50 rated polyvinyl chloride fitting covers as manufactured by Johns Manville, Knauf Insulation, Speedline, or equal.

2.02 DOMESTIC HOT WATER PIPING SYSTEM INSULATION

- A. General: Insulate domestic hot water supply and return piping, including valves, strainers and fittings with insulation thickness as indicated on Table 1.
- B. Materials:
 - 1. Classes of Insulation:
 - a. Class A: Glass fiber molded pipe insulation suitable for service temperatures up to 850 degrees F. Pipe insulation shall be one piece, preformed, and provide a minimum R factor of 4.0 at 75 degrees F mean temperature. Insulation shall be faced with all-purpose fire retardant vapor barrier jacket. Pipe insulation shall be Johns Manville Micro-Lok, Knauf Redi-Klad 1000, Owens Corning FIBERGLAS Pipe Insulation SSL II-ASJ, or equal.
 - b. Class B: Flexible open-cell melamine (foam insulation) suitable for service temperature -150 degrees F to 400 degrees F. Thermal conductivity at 75 degrees F, K= 0.26. Pipe insulation, one-piece pre-formed, laminated to heavy non-reinforced PVC jacket, with locking track, factory installed to jacket, to snap insulation and jacket onto pipe. Similar to TechLite 079 Series as manufactured by Accessible Products Co., or equal. Installation shall comply with manufacturers recommendations.
 - c. Class C: Mineral fiber pipe insulation suitable for service temperatures up to 1200 degrees F. Pipe insulation shall be one-piece, preformed up to 3 inches thick, and provide a minimum R factor of 4.0 at 75 degrees F mean temperature. Insulation shall be faced with all-purpose fire-retardant vapor barrier jacket. Pipe insulation shall be 8 pounds in accordance with cubic foot density by Roxul Tecton 1200, Fibrex COREPLUS 1200, Industrial Insulation Group, LLC (IIG) MinWool-1200, or equal.

2. Locations and Class of Insulation Required:

TABLE 2 – LOCATIONS AND CLASS OF INSULATION REQUIRED

<u>LOCATION</u>	<u>CLASS OF INSULATION</u>
Equipment Room	A, B or C
Other Locations	A, B or C

- 3. Fittings on indoor piping shall be covered with flush, hand-wrapped Class A, B, or C insulation, to match the adjoining pipe insulation and covered with polyvinyl chloride fitting covers: Zeston 2000 25/50 by Johns Manville, Knauf Insulation Proto PVC Fitting Cover, Speedline Polyco Smoke Safe, or equal.
- 4. Adhesive: Fibrous Adhesive to bond calcium silicate to itself and non-porous surfaces.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Except as specified herein, install material in accordance with recommendations of manufacturer. Do not install insulation materials until tests specified in other sections are

completed. Remove foreign material such as rust, scale, or dirt. Surfaces shall be clean and dry. Maintain insulation clean and dry at all times.

- B. On cold surfaces where a vapor barrier must be provided and maintained, insulation shall be installed with a continuous, unbroken moisture and vapor seal. Hangers, supports, anchors, or other projections that are fastened to cold surfaces shall be insulated and vapor sealed to prevent condensation.
- C. Surface finishes shall be extended in such a manner as to protect raw edges, ends, and surfaces of insulation.
- D. Pipe or duct insulation shall be continuous through walls, ceiling or floor openings, or sleeves; except where firestop or firesafing materials are required.
- E. Metal shields shall be installed between hangers or supports and the piping insulation. Rigid insulation inserts shall be installed between the pipe and the insulation shields. Inserts shall be of equal thickness to adjacent insulation and shall be vapor sealed accordingly.
- F. Insulation shall not be installed in the following locations unless otherwise noted:
 - 1. On unions, flanged connections or valve handles.
 - 2. Over edges of any manhole, clean-out hole, clean-out plug, and to restrict opening or identification of access.
 - 3. Over any label or stamp indicating make, approval, rating, inspection, or similar data, unless provision is made for identification and access to label or stamp.

3.02 INSTALLATION OF DOMESTIC HOT WATER PIPING SYSTEM INSULATION

- A. General: Domestic hot water, tempered water supply and return piping and condensate return piping, after having been tested, shall be cleaned and insulated.
- B. Application: Insulate condensate return piping, domestic hot water supply and return, including tempered supply and return piping in accordance with manufacturer's instructions and as specified herein.
 - 1. Install insulation on valve bodies up to valve bonnet. Fill void in saddles, in accordance with Section 22 0513: Basic Plumbing Materials and Methods, with insulation and seal joints.
 - 2. Install insulating material to fittings, valves, and strainers and smooth to thickness of adjacent covering. Leave strainer clean-out plugs accessible. Covers fabricated from polyvinyl chloride shall be furnished.
- C. Insulation Jackets in Exposed Indoor Locations:
 - 1. Cover completed insulation with canvas jacket tightly pasted to covering with lagging adhesive. Lap jacket seams 1 1/2-inch minimum. Finish entire jacket with coating of undiluted adhesive.
 - 2. Equivalent factory applied pre-sized, glass fiber reinforced, or glass fiber jackets may be furnished. Seal jacket seams with adhesive in accordance with manufacturer's instructions.
 - 3. Johns Manville Zeston 2000, Knauf Insulation Proto PVC Fitting Cover, Speedline Polyco Smoke Safe, or equal, fitting covers may be furnished, with molded or

segmented insulation equal to specified insulation applied to fittings. Secure covers in accordance with manufacturer's instructions.

4. In addition to above requirements, cover exposed insulated piping within a distance of 8 feet above floors with 26 gage galvanized steel jacket. Omit jacket in areas accessible only to maintenance personnel, such as mechanical equipment rooms, utility corridors, accessible pipe tunnels and manholes.

D. Concealed Indoor Locations: Cover insulation over fittings, valves, and strainers with canvas. Provide pipe insulation with factory or field applied standard jacket of 4 ounce minimum canvas, fiberglass cloth, or glass fiber reinforced jacket. Seal jacket laps with adhesive in accordance with manufacturer's instructions.

E. Exposed Outdoors: In addition to canvas or fiberglass cloth cover, pipe insulation exposed to weather shall be provided with an additional 0.016 inches thick aluminum jacket with 2-inch lap connected with one inch hem overlap joint located on side of pipe and turned down to shed water. Jacket shall be strapped 12 inches on center with ½-inch wide stainless steel strapping and wing seals. Aluminum jacket shall be mitered to fit fittings.

3.03 CLEANUP

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

3.04 PROTECTION

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

END OF SECTION

SECTION 22 1000
PLUMBING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Labor, materials, tools, and equipment to install plumbing systems as indicated.
- B. Related Sections:
 - 1. Division 01 - General Requirements.
 - 2. Section 07 9000: Joint Sealants.
 - 3. Section 22 0500: Common Work Results for Plumbing.
 - 4. Section 22 0513: Basic Plumbing Materials and Methods.
 - 5. Section 22 0553: Identification for Plumbing piping and Equipment.
 - 6. Section 22 0700: Plumbing Insulation.

1.02 SUBMITTALS

- A. Provide in accordance with Division 01 and Section 22 0500: Common Work Results for Plumbing.
- B. Provide necessary documentation to Owner for processing rebates for water efficient fixtures.

1.03 QUALITY ASSURANCE

- A. Unless otherwise noted, the California Plumbing Code is hereby made part of this section.
- B. Conform to provisions of Section 22 0500: Common Work Results for Plumbing.
- C. Manufacturer of plumbing products must have ANSI/NSF Standard 61, Section 9 certification to demonstrate compliance with the federal requirements for lead contribution to drinking water, Safe Drinking Water Act SDWA and AB 1953.

1.04 PRODUCT HANDLING

- A. Conform to provisions of Section 22 0513: Basic Plumbing Materials and Methods.

PART 2 - PRODUCTS

2.01 PIPING SYSTEMS

- A. Materials: Refer to Section 22 0513: Basic Plumbing Materials and Methods.
- B. Insulation for Piping: Refer to Section 22 0700: Plumbing Insulation.

2.02 FIXTURES AND DRAINS

- A. General: Fixtures specified shall be furnished complete with trim and fittings. Cast iron plumbing fixtures shall be acid resistant enamel, and identified by casting letters "AR" or words "acid-resistant" into metal. Fixtures shall be white unless otherwise specified. Cast iron fixtures shall be white enamel inside and on back, rim and apron, with exposed unfinished surfaces painted white. Fixtures of same general classifications shall be of same make.
- B. Finished Brass:
1. Unless otherwise specified, finished brass of a similar type shall be of same manufacturer and model throughout buildings.
 2. Finished and exposed brass equipment, except floor, shower and urinal drains shall be chromium-plated and polished. Floor, shower and urinal drains, unless otherwise specified, shall be nickel-bronze metal.
- C. Traps, Trap Arms and Tailpieces:
1. Fixture traps shall be all cast brass, chromium-plated and polished. **(No tubular traps)**. Exceptions as follows:
 - a. Traps that are an integral part of a fixture.
 - b. Traps concealed in floors, walls and furring.
 - c. Traps standard for service sinks and Industrial Shop equipment.
 - d. Laboratory traps and tailpieces shall be as specified in section 22-0513.
"Basic Plumbing Materials and Methods"
 2. Concealed traps and 17 gage tailpieces may be rough brass finish, except as otherwise specified. Laboratory traps and tailpieces shall be as specified in Section 22 0700: Basic Plumbing Materials and Methods. Furnish chromium-plated and polished cast brass wall flanges with setscrews and chromium-plated and polished brass casing on discharge side of each trap.
 3. Tailpieces shall be not lighter than 17 gage, brass, chromium-plated, and polished. Furnish and install chromium brass plated wall flanges with set screws and chromium-plated 20 gage brass casing on discharge side of each chrome-plated all cast trap.
- D. Faucet and Shower Valve Handles: Faucet and shower valve handles shall be solid brass, chromium-plated and polished, and fastened to their stems by Allen type hollow head stainless steel set screws through the side of the handle extending into the stem. Handles with sharp edges or projections shall not be furnished.
- E. Fixture Supplies:
1. Supplies for water heaters shall be unplated rigid copper water tube with threaded adaptors for connections to valves and other threaded connections. All other supplies shall be chromium-plated brass with hospital threads or shall be furnished with fittings and valves, which completely cover threads.
 2. Exposed supplies for showers shall be chromium-plated brass pipe up to header with hospital threads or shall be furnished with fittings and valves, which completely cover threads.

3. Supplies to water closet tanks, lavatories, and drinking fountains shall be furnished with chromium-plated and polished screwed type angle compression stops with square shank stems and lock shields extending beyond stem. Instead of solid supply piping, polished chrome-plated risers of 3/8 inch outside diameter with ferrule stop end and metal nosepiece may be furnished. The installation of braided stainless or easy hooker's supplies is not permitted. Exception: Supplies that rise vertically from floor shall be furnished with straight type instead of angle type stops.
4. Each supply or pipe that penetrates a finished surface and plumbing pipes passing through a countertop or part of a cabinet shall be furnished with a chromium-plated brass flange except flanges furnished by manufacturer of flush valves as an assembly.
5. Water supplies of plumbing fixtures shall be protected against back-siphonage in event of a vacuum in piping system.
6. Discharge outlets of supply faucets for lavatories and sinks shall clear top of overflow rim by at least one inch.
7. Toilet and urinal flush valves shall be furnished with recognized atmospheric vacuum breakers, installed a minimum of 6 inches above fixture.

2.03 ACCESS PLATES (To cleanouts, valves, water hammer arrestors and hose faucets)

A. Schedule Numbers:

AP-1: Square, unless otherwise noted, steel, prime coated; frame, 18 gage minimum. Door shall be 16 gage minimum with concealed hinge or be removable, with vandal-proof lock operated by Allen wrench. Provide for painted and stucco walls.

SMITH	ZURN	ELMDOR	MILKOR	WATTS	MIFAB	JOSAM
Fig 4760 AK	Z-1462- VP	DW-AKL	MOR DW AK1	CO-300- S-6	UA-A	58650-VP OR EQUAL

AP-2: Round type, stainless steel, vandal-proof, 5/16 inch No. 18 or 1/4 inch No. 20 flat-head machine screw into cleanout plug. Plate shall be prime coated minimum 18 gage steel or polished chrome-plated brass, 18-8 No. 302 stainless steel, or polished nickel bronze. Provide for painted walls, screwed into cleanout plug.

SMITH	ZURN	JOSAM	WADE	WATTS	MIFAB	OR EQUAL
4710U	Z-1469- VP	58600	8480R	CO-480- RD-6	C1400-RD-6	

AP-3: Square, polished face chrome-plated bronze, aluminum alloy or brass chrome-plated brass frame with 14 gage polished 18-8 No. 302 stainless steel or brass chrome-plated secured cover with vandal-proof screws. Provide for tile walls.

SMITH	ZURN	WADE	WATTS	MIFAB	JOSAM	OR EQUAL
4735U	Z-1460- VP	58630	CO-300- S-6	C1400-S- 3-6	58640- VP	

AP-4: Square, floor type, cast nickel-bronze aluminum alloy or brass, with carborundum or scoriated, secured top. Provide for floor access to solid interceptor in Science Room, Ceramic Room, and Agriculture Room.

SMITH	ZURN	JOSAM	WATTS	MIFAB	OR EQUAL
4910U	Z-1461-VP	58630	CO-300-S-6	C1300-S-6	

2.04 BACKFLOW PREVENTION ASSEMBLIES

A. Schedule Numbers:

BPV-1: Pressure vacuum breakers ½ inch to 2 inches. Provide for irrigation lines to protect the potable water systems.

WILKINS	WATTS	FEBCO	OR EQUAL
720A	800 MUQT	765	

BPV-2: Non-pressure type, atmospheric vacuum breaker. Provide for “Point-of-Use” conditions.

CHAMPION	WATTS	WILKINS	OR EQUAL
262	288A	35	

BPV-3: Reduced pressure or pressure differential type and in compliance with DWP Rule 16-D for meter protection. Sizes ½ inch to 6 inch. Provide where potential health hazard exists and at main meter. Group component devices into a dual (parallel) configuration to avoid service interruptions during testing and servicing of devices. Devices shall be designed and installed in an above ground compact, low profile and serviceable valve station.

WILKINS	WATTS	FEBCO	OR EQUAL
375 and 975 XL (for uninterrupted service)	909 NES, 009 NRS	860, 880	

BPV-4: Double check valve assembly for water protection. Sizes 2 ½-inch to 6-inch.

Provide with non-toxic systems or where no potential health hazards exists. Devices shall be designed and installed in an above ground compact, low profile and serviceable valve station.

FEBCO	WILKINS	WATTS	OR EQUAL
870 Series	350	709	

BPV-5: Double check valve assembly. Sizes ¾ inch to 2-inch.

Provide with non-toxic systems or where no potential health hazard exists.

WILKINS	WATTS	FEBCO	OR EQUAL
950 XL	007	850	

BPV-6: Pressure vacuum breakers with 3/4 inch hose bib. Install 6 feet above finished floor.

WILKINS	WATTS	FEBCO	OR EQUAL
420 or 720A	800M3QT	765	

2.05 BACKWATER SEWER VALVE ASSEMBLY

A. Schedule Numbers:

BSV-1: Cast iron with access cover with line size gate valve upstream and downstream.

SMITH	ZURN	WATTS	MIFAB	JOSAM	OR EQUAL
7022-S	Z-1090	BV-200	BV-1000	67500	

2.06 CLEANOUT ASSEMBLIES

A. Cleanout plug shall be line size.

B. Schedule Numbers:

CO-1: Iron body cleanout tee full line size up to 4 inches and round access plate, plugs shall be brass, countersunk with tapped boss for 5/16 inch No. 18 or 1/4 inch No. 20 screws. Provide for finished walls at base of waste stack, above urinal and service sink. AB&I and TYLER may be used as iron body cleanouts. Trim and accessories shall be Smith or Zurn or equal.

SMITH	ZURN	WATTS	MIFAB	JOSAM	OR EQUAL
4532-U	Z-1446-BP	CO-460-RD-34B	C1460-RD-6	58600-CO	

CO-2: Iron body with approved UPC plug, top and adjustable sleeve, cut-off ferrule, polished scoriated brass nickel bronze secured cover. AB&I and TYLER may be used as iron body cleanouts. Trim and accessories shall be Smith or Zurn or equal Provide for finished floors inside buildings, in covered areas, and in concrete paving.

Square:

SMITH	ZURN	WATTS	MIFAB	JOSAM	OR EQUAL
4053L-U-NB	ZN-1400-T	CO-200-S	C1220-S-1-6I	55000-1-SQ	

Round:

SMITH	ZURN	WATTS	MIFAB	JOSAM	OR EQUAL
4033-L-U-NB	ZN-1400	CO-200-R	C1220-1-6	55000-1	

CO-3: Secured cover, extra heavy-duty, adjustable sleeve, cut-off ferrule, UPC. Brass approved type plug, scoriated tractor type cover. Provide for areas outside building on concrete paving.)

SMITH	ZURN	WATTS	MIFAB	JOSAM	OR EQUAL
4233-U	ZN-1400-HD	CO-200-RX-4	C1220-4-6	55000-22	

CO-4: Tapped soil tee with brass plug, full line size. Provide for above grade, outside building at base of exposed downspout.

SMITH	ZURN	WATTS	MIFAB	JOSAM	OR EQUAL
4512	Z-1445-BP	CO-460-34A	C1460	58910	

CO-5: Raised threaded head brass plug. Provide for yard box YB-3.

ZURN	WAATS	SMITH	JOSAM	OR EQUAL
Z-1470-A	CO-590	4285	58540-20	

2.07 CIRCULATING PUMPS, HOT WATER HEATING SYSTEM

A. Schedule Numbers:

CPH-1: Centrifugal, single stage, close coupled with adjustable cast iron base, bronze enclosed impeller, lead-free mechanical shaft seal suitable for water temperature range from 20 degrees to 300 degrees F. Screwed or flanged connections. GPM and TDH capacities as indicated.

BELL & GOSSETT	WEIMAN	PACIFIC	TACO	OR EQUAL
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2.08 DRINKING FOUNTAINS

A. Also see Electric Water Coolers, below.

B. Drinking Fountains shall be provided with brass free waterways and lead mitigating water filtering systems (DFWF).

C. Schedule Numbers:

DFWF-1: In-line head and Cartridge assembly, for single bubbler drinking fountains assembly with ANSI/NSF 61 section 9 and annex G approved 1/4 Turn Cartridge with 0.5 Micron sediment/Carbon prefilter. Filter is to be preceded by a 3800gal capacity in-line Water meter that can be set to 1500gal capacity after which the meter must interrupt and shut off water supply. Provide for Single Bubbler applications.

FILTER	MODEL	
CUNO	FM DWS 1500	OR EQUAL
METER	MODEL	
WATER MINDER	WM3000B	OR EQUAL

DFWF-2: In-line head and Cartridge assembly for multi-bubbler drinking fountains, with ANSI/NSF 61 section 9 and annex G approved 1/4 Turn Cartridge with 0.5 Micron sediment/Carbon prefilter. Filter is to be preceded by a 3800gal capacity in-line Water meter that can be set to 3000gal after which the meter must interrupt and shut off water supply and then be reset for additional 3000gal capacity for a total of 6000gal thereby the meter must again interrupt and shut off water supply. Provide for Multi- Bubbler applications.

FILTER	MODEL	
AQUA PURE	3MFF100	OR EQUAL
METER	MODEL	
WATER MINDER	WM3000B	OR EQUAL

DF-7: Dual Height - Two unit, access compliant, wall-mounted, 14 gage Type 304 stainless steel dual height (high, low) drinking fountains of one-piece construction, with 1/4 inch thick stainless steel backs, furnished with two (one each unit) integral basin shank, vandal-resistant bubbler heads, with brass free flow/pressure regulating valves, flow adjustable push button activation, chrome-plated cast brass waste strainers, and bottom plates with stainless steel screen water supply strainers at inlet. Install with a 3/16 inch thick steel mounting plate inside the wall. The complete drinking fountain with trim and brass free fittings must be tested and certified lead free to ANSI/NSF 61, Annex G. Provide for indoor, fully access compliant, severe vandalism locations. Specify lowest fountain, mounted at 35 inches to 36 inches bubbler height for ages 12 and over, and at 32 inches bubbler height for Elementary school (ages 6 to 12), lowest fountain mounted at 30 maximum inches bubbler height for Kindergarten age children. Comply with DSA requirements.

HAWS	ACORN AQUA	OR EQUAL
1119.14 with mounting plate 6700.4 1117L or 1117LBP with mounting plate 6717	A152400S-FG-W32	

DF-1: See plans.

2.09 DRUM TRAPS

A. Schedule Numbers:

DT-1: Extra heavy cast iron, bolted top.

SMITH	ZURN	WATTS	MIFAB	JOSAM	OR EQUAL
8714	ZA1180	SI-742-X	MI-SOLID-S	61030	

DT-2: Aluminum solid interceptor, furnish for on-floor installation.

SMITH	ZURN	WATTS	MIFAB	JOSAM	OR EQUAL
8710-AA	Z-1180	SI-742	MI-SOLID-S-AL	61030-26	

2.10 DIELECTRIC UNIONS

A. Schedule Numbers:

1. Dielectric style Unions using ferrous and no-ferrous metals are prohibited. Dielectric flanges are admitted for use – see DU-2.

DU-1: Brass union with 6-inch brass nipple.

DU-2: Brass union or Brass flanged fittings are to be used in between pipes made of dissimilar metals to prevent accelerated corrosion and deterioration in the piping systems due to galvanic and stray current.

WATTS	WILKINS	ZURN	OR EQUAL
3100-CXC,	DUX SERRIES	DUXL	

2.11 FAUCETS

- A. Access compliant faucets: Force to activate controls shall be no greater than 5 pounds. Self closing metering, where specified, to remain open 10 seconds minimum when activated.
- B. Schedule Numbers: See plans

2.12 FLOOR DRAINS

- A. Schedule Numbers: See plans.

2.13 FLEXIBLE HOSES

- A. Schedule Numbers:

FLH-1: Braided stainless steel metal hose (for gas use). US Flex, Metraflex, Nelson Dunn or equal.

FLH-2: Braided bronze metal hose (for non pressure condensate connection use). US Flex, Metraflex, Nelson Dunn or equal.

2.14 FLUSH VALVE ASSEMBLY

- A. Schedule Numbers: See plans.

Valves shall be furnished so that flush will remain constant and not require any adjustment.

1. Each flush valve shall be provided with a loose key, square shank, lock shield angle service stop connected to flush valve with a union connection.
2. Provide 17 gage pressed brass escutcheons for wall and fixture. Escutcheons shall be fastened to not turn or rattle.
3. Each flush valve shall be furnished with a vacuum breaker providing one inch opening to atmosphere, which will not leak under any degree of back pressure and will not restrict rate of flow more than 10% at 10 pounds pressure and will operate noiselessly.
4. Tailpiece shall be not lighter than 17 gage, and shall be part of flush valve assembly.

5. Exposed metal parts of flush valve assembly shall be nickel or chromium-plated on a brass or copper base.

2.15 FLOOR SINKS

- A. Schedule Numbers: See plans.

2.16 HOSE BIBBS

- A. Schedule Numbers: See plans.

2.17 LAVATORIES

- A. Access compliant faucets for Lavatories: Force to activate controls shall be no greater than 5 pounds. Self closing metering, when specified, to remain open 10 seconds minimum when activated.
- B. Cast Iron Lavatories shall be acid resistant enamel, and shall conform to Commercial Standards CS 77.63. Unites furnished in conjunction with strainer installation or faucet installation shall be brass. Exposed brass nuts shall be chrome plated.
- C. Exposed trim shall be free from sharp edges or points. Fixture shall be furnished with other listed manufacturer specified trim. Instead of solid supply pipe, polished chrome-plated risers, 3/8 inch outside diameter with ferrule stop end and metal nosepiece may be furnished.
- D. Insulate cold water, hot water and drain lines under all access compliant lavatories with approved type insulation.

PLUMBEREX	LAV-GUARD	OR EQUAL
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Schedule Numbers: See plans.

2.18 PIPE HANGERS

- A. Refer to Section 22 0513: Basic Plumbing Materials and Methods.
- B. Schedule Numbers:

1. PH-1: Complete with clamps, inserts, etcetera.

SUPERSTRUT	UNISTRUT	TOLCO	B-LINE	OR EQUAL
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2.19 P-TRAPS

- A. Schedule Numbers:

PT-1: Cast brass complete, chrome-plated.

ZURN	AB&A	KOHLER	OR EQUAL
Z-8712-LC	107	K-9018	

2.20 PRESSURE REGULATING VALVE ASSEMBLIES

A. Schedule Numbers: See plans.

2.21 ROOF DRAINS

A. Schedule Numbers: See plans.

2.22 SERVICE SINKS and TRIM

A. Schedule Numbers: See plans.

2.23 SINKS and TRIM

For classrooms, offices and dining room sinks.

- A. Access compliant faucets for sinks: Force to activate controls shall be no greater than 5 pounds. where specified self closing metering to remain open 10 seconds minimum when activated.
- B. Cast iron sinks shall be acid resistant enamel, and shall conform to Commercial Standards CS 77.63. Units furnished in conjunction with strainer installation or faucet installation shall be brass. Exposed brass nuts shall be chrome-plated. Refer to the Fixture Supplies paragraph of this section.
- C. Exposed trim shall be free from sharp edges or points. Fixture shall be furnished with other listed manufacturer specified trim. Instead of solid supply pipe, polished chrome-plated risers, 3/8-inches outside diameter with ferrule stop end and metal nosepiece may be furnished.
- D. For access compliant sinks: Insulate cold water, hot water and drain pipes under sinks with district approved type insulation.

PLUMEREX	LAV GUARD	OR EQUAL
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E. Schedule Numbers: See plans.

2.24 SERVICE STOP GAS VALVES

A. Schedule Numbers:

SGV-1: Bronze/Brass, 3/4-inches to 2-inch IPS (WOG) water, oil, or gas – full port ball valve. CSA approved.

Provide for larger water heaters, small boilers, pool heaters, and A/C units on roofs.

WATTS	NIBCO	WILKINS	OR EQUAL
G4000-FDA	F-510-CS-R-66-FS	Model 850	

SGV-2: Lubricated plug gas valve, 3/4-inch to 2-inch IPS valve.

Provide for use after gas meter headers, gas regulators, and isolation valves for building isolation, individual floor level isolation, and boiler rooms.

NORDSTROM	WALWORTH	RESUN	OR EQUAL
142	1786	1430	

SGV-3: Lubricated plug gas valve flanged type 2 ½-inch and larger valve.

Provide for use after gas meter headers, gas regulators, isolation valves for buildings isolation, individual floor level isolation and boiler rooms.

NORDSTROM	WALWORTH	RESUN	OR EQUAL
142	1786-F	1431	

SGV-4: Bronze/Brass ½ inch to 2-inch IPS X Flare Appliance ball valves with Tee handle. Flares to be used in conjunction with corrugated flex lines.

Provide for clothes dryer, water heaters, unit heaters, and wall heaters up to 100,000 BTU.

RED and WHITE	BRASSCRAFT	NIBCO	OR EQUAL
RW 5210	TBV 10-12	GBV 12	
RW 5211	TBV 8-8	GBV 1516	
RW 5221	TBV 6-8		

2.25 STOP VALVES

- A. Stops shall be loose key type, ½-inches IPS inlet and outlet chrome-plated brass casting, except as noted.
- B. Schedule Numbers:

STV-1: Angle:

CHICAGO,	CRANE	NIBCO	OR EQUAL
442-LKABCP	8.5113.	77	

STV-2: Partition:

CHICAGO	T & S BRASS	OR EQUAL
1771-ABCP	B-1028	

STV-3: Straight Type, with Loose Key:

CHICAGO	CRANE	T&S BRASS	OR EQUAL
45-LKABCP (1/2 inch)	8-5111	B-O418	

2.26 THERMOSTATIC MIXING VALVE ASSEMBLIES (TMVA)

- A. General: Valve bodies shall be cast brass or bronze valve assembly provided with holding bracket and shall be installed on wall bracket. Valve shall be rough brass or bronze satin sprayed finish unless otherwise noted. Assembly shall include a 3 5/8-inch diameter dial thermometer, color-coded with white face and black letters. The temperature range between 100 degrees F. and 150 degrees F. shall be background in red or red line enclosed. Valve complete with fail safe feature,

square shank loose key stops, checks and strainers on both hot and cold water inlets and shutoff valve on outlet. Valves shall be sized on a 45 psig (maximum) pressure drop at the following flow rates:

TMVA-1: 5 to 15 GPM.

TMVA-2: 25 GPM.

TMVA-3: 40 GPM.

B. Manufacturers:

POWERS	T & S	LEONARD	LAWLER	OR EQUAL
Type 430 Series Single Valve Hi- Lo (1430 series)	Ultra-Safe	Type TM	4000 Series 802, 805, 66	

2.27 TRAP PRIMERS

A. Schedule Numbers: See plans.

2.28 URINALS

A. Schedule Numbers: See plans.

2.29 WATER CLOSETS

A. General: Water closets shall be vitreous china with Polyvinyl chloride bolt caps. Fixtures with auto-flush valves shall be provided with manual override button.

B. Schedule Numbers: See plans.

2.30 WATER TEMPERATURE CONTROLLERS

A. Schedule Numbers:

WTC-1: Remote bulb type, plain steel case, baked enamel finish, glass fronted cover, mercury to mercury switch. 80 degrees F. to 240 degrees F. range of not more than 10 degrees F. differential.

MERCOID	HONEYWELL	JOHNSON CONTROLS	OR EQUAL
DA-4-35	T675A1540	A19 SERIES	

WTC-2: Immersion type, black hard steel case, separate well type, outside adjustment, temperature range 40 degrees to 180 degrees F. range of not more than 10 degrees F. differential.

HONEYWELL	PENN	JOHNSON CONTROLS	OR EQUAL
T-6031D 1007	A19ABC-11	A19 SERIES	

2.31 WATER HEATERS / Domestic / Boilers

A. Gas fired water heaters shall meet the Flammable Vapors Ignition Resistance requirements (FVIR).

- B. Gas and electric water heaters must meet NAECA energy efficiency requirements. Exceptions: Table top and point of use models (electric) less than 20 gallons. In capacity and gas models over 75,000 BTUH.
- C. Water heaters from 75,000 BTU/hr to Boilers 2,000,000 BTU/hr shall comply with rule 1146.2 "Emission of Nitrogen from large water heaters and small boilers". Natural gas fired water heaters with heat input rates less than 75,000 Btu/hr shall comply with rule 1121.
- D. Instantaneous/Tank-less water heaters of any kind are prohibited. A minimum 6 gallon water heater is to be used.
- E. Schedule Numbers: See plans.

2.32 WATER HAMMER ARRESTORS

WHA-1: Headers for Lavatories, Wash Sinks, Wash Fountains, Kitchen Sinks, Service Sinks, Urinals and Water Closets. For sizing purposes size according to manufacturer's recommendations.

SIOUX CHIEF	PPP	JR SMITH	WATTS	JOSAM	OR EQUAL
655 and 656 SERIES	SC SERIES	5005 TO 5050 SERIES	Series 05 and 150	75000	

2.33 YARD BOXES

A. Schedule Numbers:

YB-1 Yard Boxes: 14 3/4-inch by 20-inch by 12-inch, cast concrete, with cast iron traffic cover marked "GAS"

Provide for use over gas stops.

BROOKS 36-H MB with No. 36-T Cast iron Cover	EISEL 363.5	OR EQUAL
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YB-2: Same as YB-1, marked "WATER" Provide for use over water valves.

BROOKS 36- H MB with No. 36-T Cast iron Cover	EISEL 363.5	OR EQUAL
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YB-3: Same as YB-1, marked "SEWER"

BROOKS 36- H MB with No. 36-T Cast iron Cover	EISEL 363.5	OR EQUAL
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2.34 FIXTURE CONNECTIONS

A. Branches to individual fixtures shall be of the following sizes unless larger sizes are indicated on Drawings:

	Copper, Cold	Copper, Hot	Trap and Connections	Soil/Waste	Vent
WC Flush Valve	1 inch	-----	4-inch	4-inch	2-inch
Lavatories	1/2 inch	1/2 inch	1 1/2-inch by 1 1/4-inch	2-inch	1 1/2-inch

Sinks:					
Service	½ inch	½ inch	2-inch	2-inch	1 ½-inch
Kitchen	½ inch	½ inch	1 ½-inch by 1 ½ inch	2-inch	1 ½-inch
Classroom	3/8 inch	3/8 inch	1 ½-inch by 1 ½-inch	2-inch	1 ½-inch
Wash	¾ inch	½ inch	1 ½-inch by 1 ½-inch	2-inch	1 ½-inch
Drinking Fountains:					
Multiple	3/8 inch	-----	1 ½-inch by 1 ½-inch	2-inch	1 ½-inch
Single	3/8 inch	-----	1 ½-inch	2-inch	1 ½-inch
Individual Showers	½ inch	½ inch	2-inch	2-inch	2-inch
Fixture		Water Supply	Soil/Horizontal	Vent	
Urinals, Wall-Hung Flush Valve					
Standard		¾ inch	2-inch	1 ½-inch	
Access Compliant Use		1 inch	2-inch	1 ½-inch	
Sill cocks		¾ inch minimum	-----	-----	

- B. Water headers serving water closets shall be copper water tube, with following size throughout length:
 - 1. 1-1/2 inches for 2 flush valves.
 - 2. 2 inches for 3 to 9 flush valves.
- C. Water headers serving urinals shall be of following size throughout length:
 - 1. 1" for 1 or 2 flush valves.
 - 2. 1-1/4" for 3 flush valves.
 - 3. 1-1/2" for 4 to 8 flush valves.
- D. Water headers serving showers shall be same as listed above for urinals.
- E. Water headers serving lavatories shall be of following size throughout length:
 - 1. 1/2 inch for 2 lavatories.
 - 2. 3/4 inch for 3 and 4 lavatories.
 - 3. One inch for 5 and 6 lavatories.

2.35 HEIGHT OF FIXTURES

- A. Heights for standard fixtures.

Fixture	Adult and High School	Middle	Elem.	Kindergarten and Younger
Water Closets	15-inch	15-inch	15-inch	10-inch
Lavatories	32-inch	32-inch	30-inch	25-inch
Drinking Fountains	42-inch	40-inch	32-inch	30-inch
Wash Sinks	30-inch	30-inch	28-inch	24-inch

Urinals, lip height	24-inch	21-inch	18-inch	N/A
Shower Heads Male (Student and Instructor) From tip of shower head to finish floor.	72-inch	60-inch		
Shower Heads Female (Student and Instructor) From tip of shower head to finish floor.	72-inch	60-inch		
Shower valves	48-inch	48-inch		

B. Heights for access compliant fixtures.

Fixture	Adult	Elementary	Kindergarten and Younger
Toilets, center line from wall	18-inch	15-inch	12-inch
Toilets, height to top of seat	17 to 19 inches	15-inch	10-inch-12-inch
Lavatories, sink top height	34-inch maximum	29-inch maximum	24-inch maximum
Lavatories, sink knee clearance	27-inch minimum	24-inch minimum	19-inch minimum
Urinals, lip height	17-inch maximum	15-inch maximum	N/A
Urinals, flush handle height	N/A	N/A	N/A
Drinking fountains, bubbler height.	36-inch maximum	32-inch maximum	30-inch maximum
Drinking fountains, knee clearance	27-inch minimum	24-inch minimum	22-inch minimum
Wash Sink	Per Drawings		
Shower Valves	Per CBC		
Shower Seat	Per CBC	Per CBC	Per CBC
Shower Head (adjustable) Bar	Per CBC		

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine areas and conditions under which Work of this section will be performed. Correct conditions detrimental to proper and timely completion of Work. Do not proceed until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. General:

1. Unless otherwise specified, plumbing fixtures, equipment and appliances that require connections to plumbing line shall be connected. This shall include fixtures specified or indicated as furnished by others, furnished by Owner, or specified in other related sections. Install supplies, stops, valves, traps, wall flanges, or pipe casing for connection of this equipment.

2. Install equipment as indicated on reviewed and accepted Shop Drawings.
 3. Avoid interference with Work of other trades. Do not deviate from Drawings without review of the Architect.
- B. Examination: Check each piece of equipment in system for defects verifying that parts are properly furnished and installed.
- C. For piping Work, refer to Section 22 0513: Basic Plumbing Materials and Methods.
- D. Plumbing Fixture and Equipment Installation:
1. Unless otherwise indicated, fixtures shall be installed with 5/16 inch brass bolts or screws of sufficient length to securely fasten fixture to backing, wall, or closet ring.
 2. Fixtures installed against concrete or masonry walls shall have their hangers fastened with 5/16 inch brass bolts, Philip Shield type anchors, or 2 unit cinch anchors. Wood or plastic plugs are not permitted.
 3. Fixtures installed against wood or metal stud walls shall have their hangers fastened to metal backing plates with 5/16 inch brass bolts screwed into plate. Fixture hangers for urinals shall be fastened centered vertically on metal backing plate with three 5/16 brass bolts each for small individual hangers and six, for larger one piece hangers. Lavatories shall be hung with not less than four 5/16 inch brass bolts or not less than five 1/4 inch brass bolts. Each sink hanger shall be hung with not less than four 5/16 inch brass bolt or not less than five 1/4 inch brass bolts.
 4. Pan type drinking fountains shall be hung with 5/16 inch cadmium plated bolts with a bolt in each bolt opening in hanger. Hangers for pan type drinking fountains shall provide 2 inches (plus or minus 1/4 inch) between pan and wall. Spaces due to irregularities between fixtures and tile walls shall be neatly filled with white cement or silicone filler.
 5. Backing for hanging of plumbing fixtures and equipment shall be installed in supporting wall at time rough piping is installed. Backing for stud walls shall be steel plate 1/4 inch thick, not less than 4 inches wide. Backing for urinals shall be 1/4-inches thick by 6-inch wide steel plate. Steel plate shall be attached to stud at each end of plate and to each stud it crosses. Plate shall be attached to metal studs by bolting with two 1/4 inch U-bolts per stud with bolts through plate and around stud flange or by welding with a 1/8 inch fillet weld full width of stud flange, top and bottom of plate. At wood studs, plate shall be carefully recessed flush with face of stud and attached to each stud with 2 No. 14 flat-head wood screws, 2 inches in length into pre-drilled 1/8 inch holes. Backing for stud walls supporting wall-hung closets shall be as detailed.
 6. Rough-in for fixtures, equipment and appliances shall be as indicated on Drawings and as specified, including those items indicated as furnished by others, furnished by Owner, or future capacity. When connections to equipment from capped or plugged lines are required, caps or plugs shall be removed at time equipment is set and stops or valves installed and connections provided as specified.
 7. Piping materials for trap arms shall be Brass, Cast Iron or DWV copper

8. Piping shall be stubbed out to exact location of fixtures and stubs shall be installed symmetrical with fixtures. Hot and cold water supplies for center set faucets on lavatories shall be installed on 8-inch centers, unless otherwise specified or required.
 9. Kitchen equipment requiring backflow protection with hot and cold water connections shall be installed with approved backflow prevention assemblies; BPV-3 and drain into floor sink with air gap.
- E. Cleanouts in Drain, Waste, Vent and Sewer Lines:
1. Cleanouts shall be installed at locations stated in the California Plumbing Code and accessible at following locations:
 - a. At locations above first floor as stated on construction documents and 5 feet outside of the building.
 - b. Install an accessible main line upper terminal cleanout in all restrooms above water closet over flow. (Install above upper terminal water closet where there are more than one water closet in a restroom).
 - c. Above faucets of each sink with brass plug.
 - d. Above service sink with brass plug.
 - e. At each Drinking Fountain with brass plug.
 - f. At each urinal and locate above urinal with brass plug.
 - g. Above overflow level of pot sinks with brass plug.
 - h. In vertical line at base of each downspout connected to an underground storm drain system extend cleanout to exterior of building.
 - i. At upper end of a horizontal vent line when any part of horizontal line is below overflow level of fixture it serves.
 - j. Not to exceed 100-foot intervals in sewer and waste lines exterior of building.
 - k. At property line connection.
 - l. Where indicated on Drawings.
 2. Cleanouts shall be extended to grade as follows:
 - a. Not to exceed 100-foot intervals in straight runs of pipe outside buildings.
 - b. At horizontal changes of direction in aggregate greater than 135 degrees (underground).
 - c. At property lines.
 - d. Where cleanouts occur under concrete.
 - e. Where marked for future connections.

3. Cleanouts in building shall be extended to floor level or above floor level or above floor level in walls or furring when cleanouts are not accessible or where clearance is less than 18 inches.
4. Cleanouts in finished areas in building shall be concealed except that cleanouts above service sinks in janitor's rooms or closet, and cleanouts above service sinks or in exposed piping in boiler or heater equipment rooms, may be exposed. Cleanouts for urinals shall be installed above urinal and shall terminate behind an access plate.
5. Cleanouts in floors of covered areas and those extended to grade in concrete areas shall be floor level type with extensions body brass plugs and detachable nickel-bronze or aluminum alloy scoriated.
6. Concealed cleanouts in vertical lines shall be service weight soil cleanout tees with brass plugs and round cover plates unless otherwise specified or indicated. A snug fitting sleeve of galvanized sheet metal shall be placed around hub of tee and shall extend to flush with finished soil, or cleanout shall be extended to finished wall.
7. Cleanouts extended from below floor to a wall or furring or on horizontal lines above floor that terminate at a wall or furring shall be iron body type with brass plugs and round cover plates.
8. Cover plates over cleanouts in painted walls shall be steel, bonderized and prime coated. Cover plates cover cleanouts in tile walls shall be chromium-plated brass or nickel bronze. Plates shall be attached to cleanout plugs with 5/16 inch No. 18 or 1/4 inch No. 20 stainless steel vandal-proof type screws. Plates shall be one inch larger in diameter than fitting opening.
9. Cleanouts at bases of downspouts shall be tapped soil tees with brass plugs as hereinafter specified, full size of line.
10. Cleanouts extended to grade in exterior sewer lines other than floors or concrete areas shall be a cleanout assembly with secured top, extra heavy-duty, adjustable sleeve, cut-off ferrule, countersunk threaded brass plug and scoriated tractor type cover.
11. Other cleanouts shall be iron body type.
12. Cleanout extensions shall be no-hub cast iron soil pipe. Exterior cleanouts, those in concrete excepted, shall terminate in a 14-inch by 6-inch thick concrete block with cleanout assembly and top of block flush with finish grade.
13. Fittings in lines utilized as cleanouts shall be approved soil fittings including no-hub pipe. Tees and crosses in vent headers excepted.
14. Pipe joint compound shall not be installed on cleanout plug. After lines are tested and approved, each cleanout plug shall be removed, greased, and replaced.

3.03 EXCAVATION, TRENCHING AND BACKFILLING

A. N/A

3.04 SERVICE CONNECTIONS

- A. Determine exact location of required water, drain, and sewer connections and provide proper connections.
- B. Potable water lines shall be purged completely before connecting to sources of water for the Project. Determine quality of water supply before connection.

3.05 WATER HAMMER ARRESTORS

- A. Install water hammer arrestors indicated on Drawings and in following locations (only non-ferrous arrestors may be installed in copper water system):
 - 1. Water lines to lavatory headers, water closet and urinal headers, service sinks, kitchen sinks, wash fountains, drinking fountains, laboratories with medical type faucets and on wash sinks having three or more stations and all other quick closing fixture such as clothes washers, as close to fixture as possible.
 - 2. Between last two fixtures when three or more fixtures, other than those listed in Number 1 above, are served by a common header.
- B. When possible, arrestor shall be installed in wall or furring. When arrestor is installed in wall or furring, furnish an access plate large enough to permit removal of arrestor. Access plate shall be a minimum of 2 inches larger in each direction than the arrestor.
- C. Fixture water lines shall be provided with mechanical water arrestor hammer dampening devices. Air chambers are not approved.

3.06 CONDENSATE DRAINS - FROM AIR CONDITIONING UNITS

- A. Connect drain piping from drain pan of air conditioning unit to condensate disposal location indicated. When coil or unit housing is shock or vibration isolated, connection shall be furnished through a flexible connector not less than 10 inches long. Drain line shall pitch to flow out at not less than one inch in 8 feet. Drain line size shall be per UPC (3/4 inch up to 3 ton only). Drain line shall not be reduced smaller than unit outlet connection.
- B. Condensate drain piping installed within building whether in air conditioned space or not shall be insulated. Refer to Section 22 0700: Plumbing Insulation, for type of material required.
- C. Condensate Trap:
 - 1. A condensate trap shall be installed for each air conditioning coil. Trap shall be assembled from 2 brass unions: one between A/C unit and inlet of trap, and one at outlet of trap that connects to main drain.
 - 2. Trap configuration shall be per manufacturer's recommendations based on total unit casting static pressure (simulated plugged filter condition), but not less than 3 inch water seal.
 - 3. Running trap design is not permitted.
 - 4. Secondary drain shall not be trapped.
- D. Condensate trap shall be checked at equipment operational tests for proper water drainage flow from air conditioning unit. Cooling condensate pan shall be filled with water, filters covered with plastic (plugged filter simulated), unit panels replaced,

and unit motor running at design condition. Pan shall drain without hesitation to bottom of inlet connection. Tests are made prior to installation of ceiling.

E. Secondary Overflow Drain:

1. Drain pan installed underneath air conditioning units in concealed ceiling space or units that incorporate dam fitting shall be furnished with secondary drain piped to outside planter area with outflow location clearly visible.
2. If outside building location is not available or feasible, secondary drains shall be piped to a classroom sink, if sink is not available pipe to a room corner away from cabinets, computers, desks, door ways/entrances or stairs.
3. Secondary vertical pipe that penetrates through suspended ceiling shall be furnished with a coupling or threaded adapter so ceiling tile can be removed without damage.

3.07 CONDENSATE DRAINS - FROM WINDOW TYPE HEAT PUMP AND EXTERIOR WALL MOUNT HEAT PUMP UNITS

- A. Whether indicated on Drawings or not, window units and wall mount units without built in bottom drain pan for evaporator and condenser coils shall be provided with galvanized steel condensate pan at bottom of unit with drain line that drains into drywell. Install copper 1/2 inch diameter pipe for window type air conditioners and 3/4 inch diameter pipe for exterior wall-mounted heat pump units.

3.08 MAKE-UP WATER SYSTEMS

- A. Provide and connect make-up water systems for equipment in other sections.

3.09 GREASE TRAPS (INTERCEPTORS)

- A. Grease traps shall be installed only when required by municipal authority. Grease traps shall be separately vented; fixtures connected to grease traps shall be trapped and vented. When grease traps are installed in concrete boxes, fill spaces between grease traps and concrete boxes with sand and place 2 inches of concrete seal over sand. Concrete seals shall pitch toward grease traps with inner edges flush with top of grease traps. Position openings for ease of cleanout.

3.10 GAS SERVICE

- A. Above Grade Service: Pipe shall be steel, hammered, free of dirt and scale, and blown out with oil-free air or nitrogen to a clean, dry condition. Piping shall not be installed in or through a ventilation duct or plenum.
- B. Underground Service, Gas approved (yellow) Polyethylene Plastic Pipe: Refer to Section 22 0513: "Basic Plumbing Materials and Methods".
1. Pipes shall be joined with polyethylene fitting and joined together by thermal fusion in accordance with procedures recommended by Polyethylene plastic pipe and fitting manufacturer.
 2. Plastic pipe shall be installed not less than 30 inches below grade..
 3. Underground Warning Tape shall be installed 12 inches above buried gas piping. Warning tape shall be yellow with caution statement as follows: "CAUTION – BURIED GAS LINE BELOW".

4. Plastic pipe shall not be installed in or under a building or structure. Pipe shall be installed under bituminous surfacing or compacted soil area, free from large stones. Pipe may be installed under sidewalks or driveways, as long as no joint occurs. Pipe installed under paved covered areas wider than 40 feet shall be installed in ventilated conduits extending 2 feet past paving.
5. Pipe shall be installed on a 6 inches deep sand bed. After required pressure-leak test, pipe shall be covered with sand not less than 6 inches thick.
6. Piping shall not support weight of valves, metal fittings or other items. Pipe shall be installed strain free.
7. Plastic pipe fittings shall not be stored or left exposed to sunlight. Pipe in open trenches shall be shielded. A sand envelope of 6 inches minimum shall be placed around pipe, with exception of joints, until inspection by IOR is completed. Protection for pipe shall be provided when necessary to leave pipe exposed overnight.
8. Installer of piping is required to have training and to have attained a certification. Non-trained/Non-certified installer must contact the manufacturer or manufacturer's representative to provide on-site fusion training and certification, prior to work commencement
9. Polyethylene plastic pipe shall connect to a steel epoxy coated anodeless type riser to minimum of 6 inches above grade, when exiting the underground installation and transitioning to steel pipe connection.
10. Where a steel pipe riser passes into a structure or building, a double swing or double-offset joint shall be furnished. Pipe shall pass into structure 6-inches above grade and through a sleeve with a minimum one inch clearance. An isolation valve is required before pipe entering the building.

3.11 CLEANING - PLUMBING PIPING SYSTEMS AND FIXTURES

- A. Plumbing lines and fixtures shall be flushed to remove dirt and foreign material until water runs clear and no foreign substance or odor is present. Strainers and screens on faucets shall be removed during this cleaning operation.
- B. After satisfactory cleaning of strainer and screen replacements has been witnessed by the Project Inspector, post and maintain signs stating: "CAUTION - Water at this construction project has not yet been certified for human consumption." Signs shall be furnished with letters at least 1/2 inch in height, and shall be conspicuously posted at entrances to the Project site. Signs shall be paneled, black and yellow, in conformance with OSHA Section 1910.1455.

3.12 DISINFECTING DOMESTIC WATER PIPING SYSTEMS

- A. Newly installed or replaced piping and/or fixtures dispensing potable water shall be disinfected and undergo an approved bacteriological analyses before water system is allowed for public use.
- B. Work shall be performed by Technicians Certified by the American Water Works Association (AWWA) and/or the State of California Department Health Services, Grade II Water Treatment Operator Certification or higher issued by the Department of Health Services (DHS) for the State of California. Comply with Title

22, Code of Regulations Division 4, Chapter 13, and Article 2 Operator Certification Grades.

C. Method:

1. A Reduced Pressure Backflow assembly shall be installed to protect from cross contamination of the local water purveyor's meter service supply when at any time there is any type of water connection with the piping to be disinfected (Chlorinated) and the water meter service supply.
2. System is to be flushed to remove any materials that may have entered the system.
3. Using a chemical feed metering pump and a chlorine tank, the chlorine solution is injected into the water system.

D. Disinfection and De-chlorination procedure (24 or 3 Hour Contact Time):

1. 24-hour Test Method:

- a. Prior to disinfection, post signs on all water outlets of the system to be disinfected. Sign or tags shall read, "Water System Being Chlorinated- "Danger Do Not Drink Water" or similar warning.
- b. Piping system shall then be adequately flushed with water to remove any particles and eliminate air pockets.
- c. Using the continuous feed method, sodium hypochlorite conforming to ANSI/ AWWA B300 will be injected into the water system at a minimum of 50 PPM. A water flow meter provided by the water treatment technician will be used to determine the rate of injection and a chlorine test kit, Hach or equivalent, will be used to monitor the residual.
- d. Chlorine residual test will be taken at all appropriate points and outlets to verify 50 PPM residual levels.
- e. The chlorinated system shall be shut down for any use and the chlorinated water shall remain in the water system for retention of 24 hours.
- f. After 24 hours, chlorine residual levels will again be tested at various points throughout the system to insure a minimum of 25 PPM residual. If the system has not met the minimum of a 25 PPM residual, the above disinfection process shall be repeated.
- g. After satisfactory completion of the residual testing, flush out system until Hach or equivalent test reveal the water outlets have a free chlorine residual concentration less than 0.5 PPM. The procedure shall be in accordance with the AWWA standard C651-05.
- h. The OAR may allow temporary use of the water system for construction purposes pending results of the bacteriological test analysis. Sign or Tags shall be left on all outlets stating water system is not safe for consumption until laboratory results are complete and meet these specifications.

2. 3 Hour Test Method:

- a. If the water systems must be turned on for use as soon as possible, a 3 hours chlorine contact time to allow for disinfection is permitted with the OAR's approval.
- b. Prior to disinfection, post signs on all water outlets of the system to be disinfected. Sign or tags shall read, "Water System Being Chlorinated- "Danger Do Not Drink Water" or similar warning.
- c. Piping system shall be then adequately flushed with water to remove any particles and eliminate air pockets. Using the continuous feed method, sodium hypochlorite conforming to ANSI/ AWWA B300 will be injected into the water system at a minimum of 200 PPM. A water flow meter provided by the water treatment technician will be used to determine the rate of injection and a chlorine test kit, Hach or equivalent, will be used to monitor the residual.
- d. Chlorine residual test will be taken at all appropriate points and outlets to verify 200 PPM levels. The chlorinated system shall be shut down for any use and the chlorinated water shall remain in the water system for retention of 3 hours.
- e. After satisfactory completion of a 3 hour disinfection period, flush out system until Hach or equivalent test reveal the water outlets have a free chlorine residual concentration less than 0.5 PPM. The procedure shall be in accordance with the AWWA standard C651-05.
- f. The OAR may allow temporary use of the water system for construction purposes pending results of the bacteriological test analysis. Sign or Tags shall be left on all outlets stating water system is not safe for consumption until laboratory results are complete and meet these specifications.

E. Bacteriological Test:

1. After final flushing and satisfactory results from the residual free chlorine concentration test, Bacteriological test samples shall be collected. The intent of the following is to provide insurance for an accurate representation to a complete Bacteriological test of the water system. At least two samples shall be taken from each floor of each building.
2. Bacteriological test samples shall be delivered to a State of California Department of Health Services Certified Laboratory to perform qualitative and quantitative bacterial analyses on the water samples for the presence of any Total Coliform bacteria and Plate Count. This count must be less than 500 cfu/mL.
3. The procedure shall be repeated if it shown by bacteriological examination made by an approved agency that the level of Disinfection does not meet these specifications.
4. After satisfactory results for the bacteriological test are provided to the OAR, warning sign or tags shall be removed.

3.13

VALVES ON PLUMBING SYSTEM

- A. Furnish and install gates, ball, globes, angles, and check valves on plumbing Work at following locations whether indicated on drawings or not.
- B. Hot and cold valves shall be:
 - 1. Lead free complying with AB1953.
 - 2. Above the ground copper water system, 2-inch and larger, may utilize Victaulic butterfly valves and fittings for their connections. A 2-inch or larger Victaulic valve may be in a wall if an adequately sized access panel is provided for maintenance or removal.
- C. Valves shall be accessible and installed within an access panel approximately 3 feet above floor and no more than 7 feet above floor, or in a marked yard box to prevent tampering.
 - 1. Immediately after each water meter, in addition to any valve furnished by utility company, there shall be an accessible valve on the inlet side for a strainer assembly, dual backflow device assembly and/or possibly a dual pressure reducing valve assembly.
 - 2. A gate or ball valve on each water supply before it enters building. Valves shall be accessible from outside building and shall be installed in a marked yard box, unless otherwise indicated on drawings. Ball valves 2 ½-inch size or larger shall omit gate valve handle and furnish 2-inch square operating nut.
 - 3. At multi story buildings, provide an isolation-valve or multiple valves for both hot and cold water in access panel to isolate and control each floor level.
 - 4. For classrooms, shops, offices and boiler or mechanical room, install a gate or ball valve to control hot and cold water lines to each group of fixtures, a group of fixtures shall be considered to be 2 or more fixtures in the same room. When practical, valves shall be installed on the same wall as group of fixtures. Valves shall control only fixtures in rooms in which they are installed.
 - 5. For restrooms, a gate or ball valve shall be installed in each restroom to isolate the hot and cold water supply into a restroom regardless of the number of fixtures. These valves shall control and be accessible only from within the restroom in which fixtures are installed. Valves shall be installed on the same wall as the group of fixtures it serves. Valves shall control only fixtures in restroom in which they are installed. Back to back restrooms shall be isolated separately and individually.
 - 6. Install a gate or ball valve on each building branch line, which serves two or more fixtures, when these fixtures are not provided with a group isolation valve as specified above. These valves shall be located approximately 3 feet but not more than 7 feet above finish floor.
 - 7. Install a gate, ball valve or partition stop for a drinking fountain or a group of drinking fountains.
 - 8. Install a gate, ball valve or partition stop for hot and cold water supply to plumbing fixtures with no accessible supply stops, such as wall mounted faucets.

9. Install a gate, ball valve or partition stop for stops adjacent to, and controlling water flow to each sill cock and hose bib except as follows:
 - a. A sill cock immediately below an exterior drinking fountain may be controlled by the same gate, ball valve or partition stop as drinking fountain.
 - b. Valves or stops will not be required for individual hose bibs when these hose bibs are on a branch line serving only hose bibs and branch line is furnished with a shut-off valve.
10. Install a loose key angle stop, on each exposed fixture supply, and for each flush valve unless otherwise specified,
11. Install gate or ball valve at each location where a water line is connected to a piece of equipment other than items mentioned above.
12. Install a check valve on each hot water return line where it connects to a hot water storage tank or a water heater.
13. Handles, hand wheels (including dishwasher fill valve handles) and operating nuts shall be furnished of steel, brass, or cast iron and shall be removable. Unless specified to be loose key type, handles shall be securely fastened to their stems. On exposed outdoor valves, omit operating handles and provide operating nuts.
14. Provide a handle or a key for each five, or fraction thereof, loose key valves, bibs, or stops and deliver them to the project OAR.

3.14 VALVES - GAS SERVICE

- A. A gas readily accessible shut-off stop shall be installed on each gas line entering a building immediately prior to the point it enters the building. Unless otherwise specified or indicated, shut-off valves for lines entering a permanent structure, buildings or portable buildings, shall be installed in a vertical riser above grade.
 1. Gas shut off valve for portable buildings – A dedicated Gas shut off valve shall be provided in a marked Yard Box, for each portable building to facilitate relocation/removal of building without the need to shut off gas to entire school.
- B. Gas Shut off valve within a building – A gas shut off valve with handles shall be accessible and serviceable within an access panel. Install valve minimum 3 feet above floor but less than 7 feet above floor.
- C. In addition to locations specified, gas shut off valve shall be installed at following locations:
 1. Install a lubricated plug gas shut off valve on any line connected to gas main or header at master assembly.
 2. Install a lubricated plug gas shut off valve before entering any building or structure.
 3. Install a gas valve on each outlet, in addition to any gas stop furnished with equipment.
 4. Service to laboratory gas cocks shall be furnished with a special precision check valve, located downstream from gas stop servicing room outlet at

each laboratory cock. Unless otherwise specified, 1/8-inches bore shall be provided for each outlet cock.

5. Install a gas shut-off valve on each gas line serving 2 or more gas outlets in same room. Service stop shall be installed not more than 7 feet above floor, and shall be in the room it serves.
 6. Install a gas shut-off valve on inlet side of each gas pressure regulating valve.
 7. Gas shut-off valves to be furnished with equipment.
 8. Install gas shut-off valve at not more than 1,000 foot intervals on each gas main.
 9. At multi-story buildings, provide gas-shut off valve(s) to isolate and control each floor or level. Install valves in a concealed manner in walls with access panels.
 10. Gas shut-off valves in classrooms and locations subject to tampering shall be protected while remaining accessible.
- D. When a gas-shut off valve adjacent to gas-fired equipment is indicated in Contract Documents it shall be furnished and installed as part of Work of this section.
- E. When electrical wall switches with emergency push button are specified for controlling gas outlets at Laboratory Classrooms, provide main shut-off gas valve with normally closed electric solenoid valve within an accessible access panel.

3.15 ELECTROLYSIS PREVENTION

- A. Brass nipples, 6 inches, with recognized brass unions; flanges shall be furnished and installed at locations described herein. Flanges shall be installed with complete insulating component consisting of gasket bolt sleeves and bolt washers. Dielectric insulators shall be installed at following locations:
1. Where special applications indicated on Drawings require an insulation flange or brass union, with 6-inch brass nipple to be installed in a condensate line, or steam line, flange insulation shall be of a high temperature type, suitable for continuous operation at temperatures up to 220 degrees F. for condensate and 400 degrees F. for steam.
 2. Where steel or cast iron in ground connects to copper or brass piping above ground, transition from steel or cast iron pipe to copper or brass pipe shall be provided in an accessible location.
 3. Underground dielectric connections shall be furnished in accessible yard boxes.
 4. Above ground dielectric connections shall be exposed; or if in finished rooms shall be located in accessible access boxes.

3.16 UNDERGROUND PIPE MARKERS

- A. Pipe markers shall be furnished according to Section 22 0553: "Plumbing Identification"

- B. Under ground Caution Tape shall be placed 12 to 18 inches above the utility line. The Caution Tape shall be a designated color and marked with the appropriate name for the specific type of utility pipe as follows:
 - 1. Yellow – with the words: CAUTION GAS LINE BELOW
 - 2. Blue – with the words: CAUTION WATER LINE BELOW

3.17 HOT WATER CIRCULATING PUMPS

- A. Floor-mounted pumps shall be provided with a 4-inch high concrete base with ½ inch reinforcing bars at 12-inch centers each way and doweled into concrete floor.
- B. Piping shall be supported from building structure so as to prevent any strain on pump casing.
- C. In-line pumps, unless otherwise specified, shall be centrifugal type with non-overloading characteristics and shall not overload motor above its horsepower rating under operating conditions with ratings based on continuous operation.
- D. Centrifugal water pumps shall be rated according to Hydraulic Institute Test Code for Centrifugal Pumps. Pumps shall be furnished with bronze water chamber, bronze impeller and mechanical seal. Rotating parts shall be statically and dynamically balanced.
- E. Flanged connections shall be provided on pumps with discharge connections larger than 2 inches. Smaller sizes may be threaded connections.
- F. Hot water circulating pump shall be arranged so that pump can be automatically turned off when hot water system is not in operation.

3.18 WATER TEMPERATURE CONTROLLERS

- A. Furnish and install a water temperature controller in hot water line adjacent to, and for control of, circulating pumps on hot water return lines when said pump is indicated on Drawings or herein specified. Bulb of temperature controller shall be installed so as to be directly in path of flowing water and so as not to obstruct flow of water.
- B. Furnish and install a water temperature controller in hot water storage tanks for control of circulating pump on hot water circulating line when said pump is indicated on Drawings or specified herein.

3.19 COMPRESSED AIR SYSTEMS

- A. Compressed air systems including compressors, air line filters, receivers, piping and appurtenances shall be installed as indicated and specified.
- B. Component parts of compressor unit shall be installed on a base firmly attached to receiver; motor and compressor shall be properly aligned auxiliary equipment and controls specified, furnished with necessary controls, automatic moisture eliminator fittings, piping, conduits and wiring properly installed and connected in a professional manner. Lubricant shall be furnished to fill until ready for operation. Safety valves shall be installed to permit normal operation and properly protect equipment. Thermal units shall be installed in motor starter to trip at 125 percent of motor nameplate rating. Pressure switches shall be installed to cut in and cut out of settings indicated.

- C. Compressor shall be installed on vibration dampers and flexible connections installed in piping to isolate vibration. Dampers shall be furnished with transmissibility of less than 10 percent for grade installation and less than 5 percent for above grade floor installation.
- D. Furnished compressed air system shall comply with safety orders of Industrial Accident Commission of State of California, Building and Safety Department of City of Los Angeles, and electrical units shall be listed as UL approved. Piping between first downstream moisture eliminator and receiver shall pitch down to receiver and shall be not less than one pipe size larger than pipe leaving eliminator. Provide drip points at each building with piping pitching down to them. Drip leg at each drip point and moisture eliminator shall be not less than 6 inches long, capped 1 ½-inch pipe with drain petcock. Upon completion of compressed air piping installation and prior to testing of pipe and final connection to compressed air receivers, systems shall be blown out to a clean, dry condition.

3.20 DEPTH OF SEWER LINES

- A. Minimum depth of below grade sewer lines shall be 24 inches to centerline of pipe. Sewer lines shall slope ¼ inch per foot minimum, unless otherwise indicated. Minimum depth at Owner property line shall be 6 feet, unless otherwise required.

3.21 BACKFLOW PREVENTION DEVICES

- A. Backflow Devices: Installation of backflow devices shall be tested and certified by Los Angeles County backflow device tester before Substantial Completion. Tests shall be performed in presence of Project Inspector. Test reports shall be turned over to Project Inspector for mailing to proper agency.

3.22 CLEANUP

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

3.23 PROTECTION

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

END OF SECTION

SECTION 23 05 00
COMMON WORK RESULTS FOR HVAC

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

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

B. Related Requirements:

1. Division 01: General Requirements.
2. Division 26: Electrical.

1.02 REGULATORY REQUIREMENTS

A. Materials, fabrication, equipment, and installation shall comply with industry standards and code requirements. Where manufacturer's recommendations exceed industry standards, the manufacturer's recommendation shall establish the minimum standard. As a minimum, standards from the following organizations shall apply:

1. AMCA - Air Movement and Control Association.
2. ANSI - American National Standards Institute.
3. ASME - American Society of Mechanical Engineers.
 - a. ASME Boiler and Pressure Vessel Code.
 - b. ASME B31 - Code for Pressure Piping.
4. AHRI - Air-Conditioning, Heating, and Refrigeration Institute.
5. ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers.
6. ASTM - American Society for Testing and Materials.
 - a. ASTM A53 - Specification for Welded and Seamless Pipe.
7. CSA - Canadian Standards Association.
8. FM Global - Factory Mutual Global
9. IAPMO - International Association of Plumbing and Mechanical Officials.
10. NFPA - National Fire Protection Association.
11. OSHA - Occupational Safety and Health Administration.
12. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association.
13. UL - Underwriters Laboratories Inc.
14. Intertek (ETL Certification).

- B. Materials, fabrication, equipment, and installation shall comply with federal, state, and local codes including, but not limited to, the following:
 - 1. CBC, California Building Code, and CMC, California Mechanical Code.
 - a. Latest edition as adopted by the City of Los Angeles, the County of Los Angeles, and the State of California including amendments effective on the Effective Date of the Contract.
 - 2. California Code of Regulations, Title 8, Industrial Relations, Division 1, Chapter 4, Division of Industrial Safety.
 - 3. OSHA - Occupational Safety and Health Administration.
 - 4. CDPH – California Department of Public Health.
 - 5. SCAQMD - South Coast Air Quality Management District.
- C. Specifications or Drawings shall not be construed to permit deviation from the requirements of governing codes unless approval has been obtained from legally constituted authorities having jurisdiction, and the Architect. The Contract Documents may contain more stringent requirements than those legally required.
- D. Permits and Fees: Refer to the General and Supplementary Conditions.

1.03 SUBMITTALS

- A. Provide submittals in accordance with Section 01 3000: Submittal Procedures and with specific requirements of Division 23 sections, as applicable.
- B. After Architect's approval, the above information shall become the basis for inspecting and testing materials and actual installation procedures performed in the Work.
- C. Shop Drawings: Submit one additional copy when control diagrams having line voltage connections are indicated. Shop Drawings shall be specifically prepared for the Work of this Project. Drawings prepared in accordance with requirements of Section 013000 may be provided by the Architect to serve as a background for the Shop Drawings. Shop Drawings shall comply with the requirements of Section 013000 and shall indicate at a minimum:
 - 1. Complete system layout of equipment, components, ductwork, and piping, indicating service clearances, duct and pipe sizes, fitting types and sizes, top or bottom of duct and pipe elevations, distances of ducts, pipes and equipment from building reference points and hanger / support locations. All the above items shall be coordinated on the shop drawings according to the requirements of Section 013000.
 - 2. Schedule and description of equipment, ductwork, piping, fittings, valves, dampers, and controllers.

1.04 PROJECT RECORD DOCUMENTS

- A. Comply with provisions of Section 017000: Contract Closeout.
- B. Project Record Drawings:
 - 1. Provide a complete set of mechanical and control system drawings in AutoCAD and, if available, BIM, complete with external reference drawings, fonts, blocks and plotter pen color/line thickness settings on CD-ROM. Also

- submit one set of full size reproducible plots on vellum and three sets of prints.
2. Before Contract Completion, deliver corrected and completed prints to the OAR. Delivery of project record documents to the OAR does not relinquish responsibility of furnishing required information omitted from project record documents.
- C. Operation and Maintenance Manuals:
1. Submit operation and maintenance manuals in required form and content. If no revisions are required, furnish one additional copy. If revisions are required, one copy shall be returned with instructions for changes; perform such changes and return manuals. Manuals shall be bound in accordance to Section 017000. Deliver manuals to the OAR. Submit an electronic copy of the entire manual in PDF file format.
 2. Contents of Manual:
 - a. Title sheet with Project name, including names, addresses and telephone number of Contractor, installer, and related equipment suppliers.
 - b. Manufacturer's operating instructions including, but not limited to, the following:
 - 1) Identification of components and controls.
 - 2) Pre-start checklist and start-up procedures.
 - 3) Normal operation settings and checklists.
 - 4) Pre-shut down checklist and shut down procedures.
 - 5) Trouble shooting checklist and guidelines.
 - 6) Recommendations for optimum performance.
 - 7) Warnings and safety precautions on improper or hazardous operational procedures or conditions
 - c. Manufacturer's product data and parts and maintenance booklet for each item of equipment furnished under Division 23 that includes the following as a minimum:
 - 1) Manufacturer's model, identification and serial numbers.
 - 2) Exploded view of assembly drawings identifying each component or part with the relevant part number.
 - 3) Directory of manufacturer's representatives, service contractors and part distributors.
 - 4) Maintenance and trouble-shooting instructions, including schedule for preventive maintenance, periodic inspection and cleaning criteria.
 - d. Project Record Drawings: Complete set of mechanical and control system drawings in 50 percent reduced print format shall be furnished with the manual. Submit the above record drawings on

CD-ROM in AutoCAD and, if available, BIM, complete with external reference drawings, fonts, blocks, and plotter pen color/line thickness settings.

- e. Testing, Adjusting, and Balancing reports: Submit as specified in Section 01 4525.
- f. South Coast Air Quality Management District (SCAQMD) permits to install and operate boilers, water heaters and other fuel burning equipment and third-party source test reports as required by SCAQMD to allow start-up and operation of equipment.
- g. Los Angeles County industrial waste permits.
- h. Valve directory complete with location, function, size, and model of each valve with reference to the project record drawings.
- i. Equipment and component identification chart complete with location, function, size, and model of each equipment or component with reference to the project record drawings.

1.05 COORDINATION

- A. Contract Documents indicate extent and general arrangement of Work under Division 23. Contractor shall coordinate work in accordance with Section 013000 requirements and make adjustments as required to provide maximum headroom, a neat arrangement to keep passageways and openings clear to provide accessibility and provisions for maintenance, and to meet code requirements.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Delivery and Storage: Deliver materials to Project site in their original unopened containers with labels intact and legible at time of delivery. Store in strict accordance with manufacturer's recommendations.
- B. Do not store plastic pipe or materials in direct sunlight.

1.07 PRELIMINARY OPERATION

- A. OAR may require any portion of mechanical Work to be operated before Substantial Completion. Such operation shall be in addition to regular tests, demonstrations and instructions required under the Contract Documents, and shall be performed as required.
- B. Notify the Project Inspector at least 24 hours in advance of lighting or re-lighting pilots.

1.08 TRAINING OF OWNER PERSONNEL

- A. Training of Owner's personnel shall include:
 - 1. A minimum of 8 hours of on-site overview of the overall Mechanical System.
 - 2. Refer to Division 23 sections for specific training on each of the components of the Mechanical System.
 - 3. A minimum of 8 hours of on-site overview identifying location and function of all Control Valves and Actuator assemblies.

4. A minimum of 40 hours of (in classroom) software training for a minimum of 20 LAUSD personnel on EMS/BMS if such systems are utilized in the project. Training shall be conducted at control contractor training facility with computer setup for each person attending.
 - B. Contract shall include the cost of training Owner operation and maintenance personnel in operating, adjusting, maintenance, trouble-shooting, and Project site repair of each component, equipment, or system provided under this Contract.
 - C. Operational and maintenance training shall be conducted on the Project site, unless indicated otherwise.
 - D. Upon completion of Owner training, a completion certificate indicating the nature of the training and a description of the systems, complete with equipment and component lists shall be issued to each trainee. The certificate should be issued in duplicate with one copy retained by OAR.
 - E. An attendance sheet with the names and signatures of all participants attending the training shall be submitted to the OAR and kept as part of the project documents.
- 1.09 GUARANTEES AND DAMAGE RESPONSIBILITY
- A. Sound of water flowing in piping shall not be transmitted to building structure. Operation of mechanical system shall not produce operational sounds that can be heard outside of rooms enclosing apparatus or equipment.

PART 2 – PRODUCTS

2.01 MATERIALS AND EQUIPMENT

- A. Unless otherwise specified, materials and equipment shall be new, in good and clean condition. Equipment, materials, and components shall be of the make; type and model number noted on Drawings or specified. Pieces of equipment of the same type shall be by the same manufacturer.
- B. Whenever an item is listed by a single proprietary name, with or without model number and type, it shall be for purpose of design only, to indicate characteristics and quality desired. Proprietary designation listed on Drawings, or listed first in Specifications, is used as a basis for design to establish a standard for quality and performance and space requirements.
- C. HVAC equipment products from different manufacturers are never identical. Equipment approved as being equal is interpreted as being equivalent in capacity, performance and quality. The dimensions, weight, configuration and utility requirements could be quite different from the equipment used as the basis of design. Due to these differences, additional coordination and adjustments by the Contractor are required. For the equipment to be deemed truly equal, the additional coordination and adjustments by the Contractor should not incur any additional cost to the Owner and any additional labor to the design team.
- D. Equipment and materials indicated or required to be installed outdoors shall be of the type that is designed, manufactured, listed or approved by authorities having jurisdiction for outdoor installation by being resistant to the adverse effects of weather. All the additional protective measures against outdoor weather required

by the manufacturers' installation instructions and prevalent practice shall be provided.

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

PART 3 – EXECUTION

3.01 SERVICE INTERRUPTIONS, OFF-SITE, GAS AND WATER

- A. Schedule Work so there shall be no service interruptions of existing systems or systems during normal hours of operation of affected systems and facilities.
- B. When service interruptions are mandatory, arrange in advance with the OAR as to time and date of such interruptions.
- C. Systems, which are interrupted, shall be returned back into operation in such manner that they will function as originally intended.

3.02 CUTTING, NOTCHING, AND BACKING

- A. Conform to California Building Code, Title 24, Part 2, for notches and bored holes in wood and for pipes and sleeves embedded in concrete and for cuts in steel, as detailed on structural Drawings.
- B. Where pipes or ducts pass through, or are located within one inch of any construction element, install a resilient pad, 1/2 inch thick minimum, to prevent contact.
- C. Furnish all necessary provisions for recesses, chases, and accesses and provide blocking and backing as necessary for proper reception and installation of mechanical Work.

3.03 LOCATION OF PIPING AND EQUIPMENT

- A. Location of piping, apparatus and equipment as indicated on Drawings is approximate and shall be altered to avoid obstructions, preserve headroom, and provide free and clear openings and passageways.
- B. Trenches parallel to footings shall not be closer than 18 inches to the face of footings and shall not be below a plane having a downward slope of 2 horizontal to one vertical, from a line 9 inches above bottom of footing.
- C. Pipe in tunnels shall be installed close to one side of tunnel to provide maximum space for passage. Pipe shall not be installed through crawl hole unless otherwise specified or detailed on Drawings.
- D. Place equipment in locations and spaces indicated, disassemble and/or reassemble equipment as required by Project conditions.

3.04 TESTS AND TESTING

- A. Tests shall be as required under the applicable sections of Division 23, including this Section.
- B. Tests required by other sections of the Contract Documents include the following:
 - 1. Test and balance of mechanical equipment and systems: Refer to Section 01 4525: Testing, Adjusting, and Balancing for HVAC.

- 2. Hydrostatic test of boilers: Refer to Section 01 4525: Testing, Adjusting, and Balancing.
 - 3. Test of smoke and fire detectors: Refer to Division 26: Electrical.
- C. Additional tests may be required in the case of products, materials, and equipment if:
- 1. Submitted items are altered, changed, or cannot be determined as exactly conforming to the Contract Documents.
 - 2. Performance testing and results may also be required on certain items which are as specified, including fan, and pump performance.
- D. Piping Tests:
- 1. Perform tests required to demonstrate that operation of mechanical systems and their parts are in accordance with Specifications covering each item or system, and furnish materials, instruments and equipment necessary to conduct such tests. Tests shall be performed in presence of the Project Inspector, and representatives of any governmental agency having jurisdiction. Work shall not be concealed or covered until required results are provided.
 - 2. If required tests are not performed, Owner may provide in accordance with the Contract Documents.
 - 3. Pressure gages furnished in testing shall comply with CPC. Air shall be bled from lines requiring hydrostatic or water tests.
 - 4. Systems shall be pressure-tested in accordance with pipe testing schedule below. Pipe test shall indicate no loss in pressure after a minimum duration of 4 hours at test pressures indicated. Where local codes require higher test pressures than specified herein for fire sprinkler systems, local codes shall govern.
 - 5. Fuel gas lines shall be first tested with piping exposed, before backfilling trenches or lathing; second with piping in finished arrangement, backfilled and paved where required, and walls finished.
 - 6. Refrigerant piping may be tested with a halide detector or calibrated electronic testing equipment.
 - 7. Piping systems may be tested as a unit or in sections, but entire system shall successfully meet requirements specified herein, before final testing by the Project Inspector.
 - 8. Repair of damage to pipes and their appurtenances or to any other structures resulting from or caused by these tests, shall be provided.

E. Pipe Testing Schedule:

System Tested	Test Pressure (psig)	Test With:
Steam piping, hot water heating system piping and chilled water piping	150	Water

Vacuum pump or condensate pump discharge and condensate return piping	150	Water
Refrigeration piping		
R-22	400	Dry nitrogen
R-134a	300	Dry nitrogen
R-401a	300	Dry nitrogen
R-401b	300	Dry nitrogen
R-404a	500	Dry nitrogen
R-407c	500	Dry nitrogen
R-410a	600	Dry nitrogen
R-507	500	Dry nitrogen
Radiant panel piping	150	Water

F. Equipment Performance Assurance Tests:

1. Before operating any equipment or systems, a thorough check shall be performed to determine that systems have been flushed and cleaned as required and that equipment has been properly installed, aligned, lubricated, and serviced. Factory instructions shall be checked to verify installations have been completed and recommended lubricants have been installed in bearings, gearboxes, crankcases, and similar equipment. Particular care shall be furnished in lubricating bearings to avoid damage by over-lubrication and blowing out seals. Equipment shall also be checked for damage that may have occurred during shipment, after delivery, or during installation. Damaged equipment, products, and materials shall be replaced or repaired as required.
2. Upon completion of the above, adjust the system settings to within normal operating conditions to prevent the system from being damaged upon start-up.
3. Run-test the equipment after start-up for five consecutive days. Tests shall include operation of heating, ventilating, and air conditioning equipment and systems for a period of not less than two 8 hour periods at 90 percent of the full specified heating and cooling capacities. If equipment passes, install new filters. If equipment fails, it shall be adjusted and retested until system meets all applicable codes.
4. Equipment Start-up Reports: For each equipment or system on which start-up is performed, submit 8 copies of start-up report for review by the Architect.
 - a. The start-up report shall include the manufacturer's standard start-up form completed and signed by the start-up technician.
5. Provide, maintain, and pay costs for equipment, instruments, and operating personnel as required for specified tests.
6. Provide electric energy and fuel required for tests.
7. Final adjustment to equipment or systems shall meet specified performance requirements.

8. Equipment, systems, or Work deemed defective during testing shall be replaced or corrected as required. Test until satisfactory results are provided.
- G. Specific Coordinated Plan for Test and Balance:
1. Provide a narrative of the operational intent that clearly describes the function and sequence of operation of each component, equipment, or system installed. Instruct designated Owner personnel in the operation of the installed systems.
 2. Prior to final test and balance, mechanical equipment and systems shall be operated and tested as indicated in Paragraph 3.04.F above to demonstrate satisfactory overall operation of the installed systems.
 3. Immediately before starting tests, air filter media shall be cleaned or renewed. Roll-type filters shall be advanced to provide new clean media. Cleanable type media shall be thoroughly cleaned and re-oiled with new, clean oil as recommended by manufacturer if they are of viscous impingement type. Disposable type filters shall be replaced with new filters. Replaceable media shall be replaced with new media.
 4. An accurate means of measuring airflow and temperatures shall be furnished to balance air supply, return, and exhaust systems so uniform temperatures occur in every room and design airflow is obtained through registers, diffusers, and grilles.
 5. Systems shall be adjusted to provide airflows indicated including maximum fresh air and maximum return air. Dampers shall be checked for proper settings and operation. Air and water inlet and leaving temperatures at coils shall be checked. Complete operational data including airflows, room temperatures, fan speeds, motor currents, plenum, and duct static pressures shall be tabulated.
 6. Welding performed as part of this Division may be subject to radiographic inspections at random in accordance with requirements specified in Section 23 0513: Basic HVAC Materials and Methods.

3.05 NOISE AND VIBRATION REDUCTION

- A. Correct noise or vibration caused by mechanical systems. Provide all necessary adjustments to specified and installed equipment and accessories to reduce noise to the lowest possible level
- B. Correct noise or vibration problems caused by failure to install work in accordance with Contract Documents. Include all labor and materials required as a result of such failure. Pay for re-testing of corrected noise or vibration problems by the project acoustical consultant including travel, lodging, test equipment expenses, etc.

3.06 PROTECTION, CARE AND CLEANING

- A. In addition to storage criteria of the General Conditions, and provisions under Section 01 5000: Construction Facilities and Temporary Controls, the following shall be provided:

1. Provide for the safety and good condition of materials and equipment until Substantial Completion. Protect materials and equipment from damage.
2. Protect installed Work.
3. Replacements: In case of damage, immediately provide repairs and/or replacements as required.
4. Protect covering for bearings, open connections to tanks, pipe coils, pumps, compressors and similar equipment.
5. Interior of ductwork shall be maintained free of dirt, grit, dust, loose insulation, and other foreign materials.
6. Air handling equipment shall not be operated until building is cleaned and air filters are installed.
7. Fixtures, piping, finished brass or bronze, and equipment shall have grease, adhesive, labels, and foreign materials removed. Chromium, nickel plate, polished bronze or brass Work shall be polished. Glass shall be cleaned inside and out.
8. Before initial start-up and again before Substantial Completion, piping shall be drained and flushed to completely remove grease and foreign matter. Pressure regulating assemblies, traps, strainers, boilers, flush valves, and similar items shall be thoroughly cleaned. Tag system with an information tag listing responsible party and date of element, before initial start-up and again before Substantial Completion. Compressed air, oil, and gas piping shall be blown out with oil-free compressed air or inert gas. Refrigerant piping shall be cleaned as specified.

END OF SECTION

SECTION 23 05 13

BASIC HVAC MATERIALS AND METHODS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. This Section prescribes basic materials and methods generally common to the Work of Division 23.

B. Related Requirements:

1. Division 01: General Requirements.
2. Division 23: Heating, Ventilating, and Air-Conditioning.
3. Division 26: Electrical.
4. Section 014525: Testing, Adjusting, and Balancing for HVAC.

1.02 SUBMITTALS

- ###### A.
- Provide in accordance with Division 01, Section 23 0500 and specific requirements of each section of Division 23.

1.03 QUALITY ASSURANCE

- ###### A.
- Standards: Comply with applicable national, state, and local codes and standards: ASTM, ASME, and ANSI. Federal Specifications, AWWA, CISPI, NFPA, FM Global, UL, CPC (California Plumbing Code), CMC (California Mechanical Code), CSA.

- ###### B.
- Qualifications of Manufacturer: Products used in the Work of this Section shall be produced by manufacturers regularly engaged in manufacture of similar items and with a history of successful production as reviewed by the Architect.

1.04 COORDINATION

- ###### A.
- Coordinate related Work in accordance with provisions of Section 012100: Contractors Use of Project Site and Section 013000: Submittals.

PART 2 – PRODUCTS

2.01 GENERAL

- A. Provide the following products if they are indicated in the Contract Documents or if they are required for the proper installation, function or operation of equipment, systems or components indicated in the Contract Document.
- B. Provide the following products as a complete assembly with required accessories for a complete and functioning entity in compliance with governing codes and applicable standards as specified in Section 23 0500, manufacturer's instructions or as required.
 - 1. Omission of minor details in the Contract Documents does not waive and/or otherwise relinquish compliance with the above requirements.

2.02 MANUFACTURERS AND MATERIALS

- A. Air Compressor: (Not Used)
- B. Air and Dirt Separators: (Not Used)
- C. Balancing Valves: (Not Used)
- D. Boiler Blow-Off Valve: (Not Used)
- E. Ball Valves: Bronze, 2 inches and smaller:

BV-1 Class 150, 600 psi, CWP, 2 piece construction reinforced Teflon seats, full port, adjustable packing gland, stainless ball and stem, threaded ends.

Hammond UP-8303A/UP-8305/UP-8513, NIBCO T-685-80-LF/TS-685-66-LF, Milwaukee UPBA400S/450S, or equal.

BV-2 Class 150, 600 psi CWP, 2-piece construction, bronze body, reinforced Teflon seats, adjustable packing gland, (no threaded stem designs allowed), threaded ends.

Hammond UP8301A, NIBCO T-585-70, Milwaukee BA-400, or equal.

Ball Valves in Insulated Piping: Use extended operating handle of non-thermal conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation and memory stops that are fully adjustable after insulation is applied. NIBCO Nib-Seal Handle.

- F. Butterfly Valves: (Not Used)
- G. Check Valves:
 - 1. Bronze, 2-inch and smaller:

CHV-1 Class 125, 200 CWP swing check, Teflon disc, threaded ends. .
NIBCO T-413-Y, Milwaukee 509-T, Hammond IB-940, or equal.

CHV-2 (Not Used)

2. Cast Iron 2-1/2 and larger:

CHV-3 Class 125, 200 psi, CWP, IBBM, renewable seat and disc, bolted cap, threaded ends:

Crane 372, Stockham G-927, NIBCO T-918-B, or equal.

CHV-4 Class 125, 200 psi, CWP, IBBM, renewable seat, bronze or cast iron disc, bolted cap, flanged ends:

Stockham G-931, Crane 373, NIBCO F-918 B, Milwaukee F-2974-M, Hammond IR-1124-HI, or equal.

CHV-5 (Not Used)

CHV-6 (Not Used)

CHV-7 (Not Used)

H. Expansion Tank: (Not Used)

I. Flow Control Valve – Manual: (Not Used)

J. Venturi Flow Measuring Device: (Not Used)

K. Electronic Flow Readout Meter: (Not Used)

L. Gate Valves:

1. Bronze, 2 inches and smaller:

GV-1 Class 125, 200 psi CWP, bronze body and bonnet non-rising stem, inside screw, screw-in bonnet, solid disc, threaded ends:

Hammond IB645, Crane 1701, Milwaukee 105, American 3F, NIBCO T-113, or equal.

GV-2 Same as GV-1, except solder ends:

NIBCO S 113, Milwaukee 115, Hammond IB 647, or equal.

GV-3 Class 125, 200 psi WOG, rising stem, inside screw, screw-in bonnet, solid disc, threaded ends:

Stockham B-100, Crane 428, NIBCO T-111, Milwaukee 148, Hammond IB-640, or equal.

GV-4 (Not Used)

GV-5 (Not Used)

GV-6 (Not Used)

2. Iron Body Gate Valves; 2 1/2 inches and larger:

GV-7 Class 125, O S and Y, IBBM, bolted bonnet, solid disc, flanged ends:

Hammond IR1140HI, Stockham G623, Crane 465-1/2, NIBCO F-617-0, Milwaukee F 2885M, or equal.

GV-8 (Not Used)

M. Globe Valves:

1. Bronze, 2-inch and smaller:

GLV-1 Class 125, 200 psi, CWP, screw-in bonnet, Teflon disc, threaded ends:

Hammond IB440, Milwaukee 502, Stockham B-13-T, NIBCO T-211-Y, Crane 5TF, or equal.

GLV-2 Class 125, 200 psi, CWP, screw in bonnet, Teflon disc, solder ends.

Hammond IB-418, Milwaukee 1502, NIBCO S-211-Y, or equal.

GLV-3 (Not Used)

GLV-4 (Not Used)

2. Iron Globe Valves, 2 1/2-inch and larger:

GLV-5 Class 125, 200 psi, CWP, OS&Y, IBBM, renewable seat and disc, bolted bonnet, flanged ends:

Hammond IR116 HI, Stockham G-512, Crane 351, Milwaukee F2981 M, NIBCO F-718-B, or equal.

GLV-6 (Not Used)

N. Heater Vent Pipe:

1. Schedule Number:

HVP-1 Shall be UL approved for service specified. Concealed heater vent pipe, including pipe in or through attic spaces, shall be Los Angeles City approved double wall metal vent pipe. For recessed wall heaters, furnish B.W. type. All others may be Type B, or B.W. Clearances must comply with Los Angeles City code and conditions of UL listing.

American Metal Products Co., Inc., Simpson Dura-Vent, AmeriVent, Hart & Cooley Mfg. Co., Metalbestos, or equal.

O. Liquid Level Gage:

LLG-1 Refrigerant type, carbon steel with stainless steel trim or all forged steel construction, back-seating standard design. Upper and lower valve furnished with ball check valves; 1/2 inch diameter glass on center. Four 3/16 inch diameter gage glass guard rods or slotted steel guard.

Peneberthy, Henry, Conbraco, or equal.

P. Piping:

1. Piping shall be continuously and permanently marked with manufacturer's name, type of material, size, pressure rating, and the applicable ASTM, ANSI, UL, or NSF listing. On plastic pipe, date of extrusion must also be marked.

2. Underground non-ferrous pressure pipes shall be installed with proper color tracer wires. Refer to color code provisions in Section 23 0553: HVAC Identification.

Q. Pipe Isolators:

PLA-1 Absorption pad shall be not less than 1/2 inch thick, unloaded. Pad shall completely encompass pipe.

Holdrite, LSP, Stoneman, Potter-Roemer, Trisolator, PR-Isolator, or equal.

PLA-2 Plastic cushion to form an insulating liner and eliminate metal to metal contact when securing copper tubes and pipes in air conditioning and refrigeration insulation preventing galvanic erosion. (Acoustical Type for Sound Absorption)

Hydra-Zorb Cushion Clamps, LSP Products Group Acousto Clamp, or equal.

R. Pressure Gage: Aluminum or steel case, minimum 4-1/4 inches dial; pressure type or combination vacuum-pressure type, with provisions for field calibration. Dial indicator to indicate pressure in psi with accuracy to within plus or minus 0.5 percent of maximum dial reading. Furnish gages with restriction screw, size 60, to eliminate vibration impulses. Black case and ring, bourdon tube of seamless copper alloy with brass tip and socket. Three way gage cock, constructed of brass with stuffing box, 1/2 inch couplings, with fixed or movable cap nut to shut off pressure gage.

PG-1 Pressure type, black drawn steel case, 4 1/2-inch glass dial, range approximately twice line pressure.

Marsh Keckley, Trerice, Weksler, Weiss, or equal.

S. Safety Relief Valves:

SRV-1 Combination temperature and pressure relief type. CSA approved. Set to open at 125 psi pressure.

Watts 40L, Cash-Acme NCLX-1, Wilkins TP220, or equal.

SRV-2 Same as SRV-1, except provide on storage type water heater with anode in dip tube.

Watts 10 x L, CashAcme NCLX-1, Wilkins TP220, or equal.

SRV-3 (Not Used)

T. Strainers:

STR-1 Description: Wye type with monel or stainless steel strainer cylinder (manufacturer's standard mesh), and gasketed machine strainer cap. Where indicated on Drawings, provide with valved (globe valve) blowout piping, same size as blowout plug.

1. 2-inch and smaller:
C.M. Bailey No.100-A, 250 lb., cast iron body, threaded, Keckley 'B', Spirax Sarco Y-type, or equal.
2. 2 ½-inch and larger:
C.M. Bailey No.100-A, 125 lb., cast iron body, flanged, or Victaulic style 732, 300 psi, ductile iron body, grooved, fusion bonded epoxy coated.
C.M.Bailey, Armstrong, Muessco, Keckley 'A', or equal.

STR-2 Y pattern cast iron bodies, 125 psi, monel screen. Open area at least twice the cross-sectional area of IPS pipe in which strainer is installed and may be woven wire or perforated type. Screwed ends for sizes up to 2 inches, flanged ends fusion bonded epoxy coated for 2 1/2 inches and larger perforations, in accordance with the following:

1. Steam service - 40 square mesh.
2. Other services - 16 square mesh.

Bailey No.100, Armstrong, RP&C, Keckley, or equal.

U. Temperature Control Valves:

TCV-1 Motor-operated valve, Forged brass bodies rated at no less than 400 psi working pressure; Chrome plated brass ball and stem, female NPT union ends, dual EPDM lubricated O-rings and TEFZEL characterizing disc.

Operated by Electronic Valve Actuator, manufactured, brand labeled or distributed by Belimo, TA, Honeywell, or equal.

TCV-2 Valves, automatic, electric, 3-way control.

Packed type bronze body and trim. Metal-to-metal seats designed for tight shut-off. Constant total flow throughout full plug travel. Valve designed for 150 psig steam working pressure. Valve operated by spring return motor with gear train. Valves screwed for sizes 2 inches and smaller.

Honeywell, Powers, Barber-Colman, Leonard, or equal.

TCV-3 (Not Used)

V. Thermometers

1. Industrial:

T-1 Straight type with fixed or ratable stem, extruded or cast brass or cast aluminum case and brass separable well 6 inches minimum scale, angle or straight type range 30 degrees - 240 degrees F.

Weksler, Terice, Weiss, Ashcroft, Marshalltown, or equal.

T-2 Round type 3 ½-inch minimum dial range of 100 between 30 degrees and 155 degrees F, color coded red above 150 degrees F. Brass chrome plated case.

Ashcroft, U.S. Gage, Marsh, Weiss, or equal.

2. Remote:

T-3 Liquid-filled capillary type with bulbs as required for remote and insertion mounting dials of 3 ½-inch minimum diameter, non-ferrous internal parts, external means for re-calibration, glass or plastic lens and steel or non-ferrous case suitable for wall, duct or panel mounting range 30 degrees to 240 degrees F.

W. Traps: (Not Used)

X. Valves (Air Vent):

VAV-1 Hot or chilled water air release valves shall be cast brass rated for 150 psig design pressure and 270 F operating temperature.

Spirotherm, Bell & Gossett, Taco, or equal.

VAV-2 Hot or chilled water space heating system air valve, brass with nickel trim 1/4 inch connection, disc type for manual or automatic venting.

Hoffman 500, Spirotherm, Watts, or equal.

VAV-3 Brass petcock, 1/4 inch connection by 1/4 inch copper tube to high point of coil or line by means of a tapped cap on top of 6 inches vertical nipple. Petcock to be installed approximately 5 feet 6 inches above finish floor.

Amtrol, Watts, Dole, or equal.

Y. Vacuum Valves:

VV-1 Vacuum valves; for vacuum serve, 125 psig working pressure, cast iron body, spring loaded lubricated plug type.

General Controls, Honeywell, Val-Matic, or equal.

Z. Flanges: Flanges shall be furnished and installed at each flanged connection of each type of equipment, tanks, and valves. Faces of flanges being connected shall be furnished alike. Connection of a raised face flange to a flat-faced flange is not permitted. Flanges shall conform to following schedules:

TYPE OF PIPE	FLANGE
Screwed black or galvanized grooved steel pipelines.	125 pound black cast iron screwed flange, flat faced or grooved flange adapters, Victaulic Style 741, Tyco-Grinnell Fig. 71, Gruvlok Fig. 7401, or equal.
Welded or grooved steel pipe, except high pressure steam lines.	150 pound black forged steel welding flanges, 1/16 inch raised face ASTM A105, Grade II or grooved flange adapters, Victaulic Style 741, Tyco-Grinnell Fig. 71, Gruvlok Fig. 7401, or equal.
Copper and brass pipe or tubing.	150 pound cast bronze, flat-faced flange with solder end or grooved flange adapters, Victaulic Style 641, Tyco-Grinnell Fig. 61, Gruvlok Fig. 6084, or equal.

1. Gasket material for flanged connections shall be full faced or ring type to suit facing on flanges and shall be furnished in accordance with following schedule

<u>SERVICE</u>	<u>TYPE</u>
Cold water	1/16 inch thick neoprene
Steam, hot water	1/16 inch Teflon

Grooved end flange adapters supplied with pressure responsive elastomeric Gaskets supplied with grooved flange adapters shall be pre-lubricated by the manufacturer. Grade of gasket to suit intended service.

AA. Unions:

1. Unions shall be furnished and installed in accordance with the following requirements (unless flanges are furnished):
 - a. At each threaded or soldered connection to equipment and tanks, except in Freon or fuel gas, piping systems, whether indicated or not.
 - b. Immediately downstream of any threaded connection to each manually operated threaded valve or cock, and each threaded check valve, yard box or access box except those in Freon piping systems, whether indicated or not.
 - c. At each threaded connection to threaded automatic valves (except those in Freon piping systems) such as reducing valves and temperature control valves, whether indicated or not.

- d. If grooved piping is used, couplings shall serve as unions. Additional unions are not required
2. Unions shall be located so that piping can be easily disconnected for removal of equipment, tank, or valve.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Examine areas and conditions under which Work of this Section shall be performed. Correct conditions detrimental to proper and timely completion of Work. Do not proceed until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Provide all materials and equipment for the Work. Furnish and install necessary apparatus, parts, materials, and accessories.
- B. Pipe Installation:
 1. Install piping parallel to wall and provide an orderly grouping of proper materials and execution.
 2. Piping shall clear obstructions, preserve headroom, provide openings and passageways clear, whether indicated or not. Verify the Work of other Divisions to avoid interference.
 3. If obstructions or the Work of other Divisions prevent installation of piping or equipment as indicated by the Drawings, perform minor deviations as required by the Architect.
 4. Install piping after excavation or cutting has been performed. Piping shall not be permanently enclosed, furred in, or covered before required inspection and testing is performed.
 5. Exposed polished or enameled connections from fixtures or equipment shall be installed with no resulting tool marks or threads at fittings. Residue or exposed pipe compound shall be removed from exterior of pipe.
 6. Piping shall be concealed in chases, partitions, walls, and between floors, unless otherwise directed or specifically noted on Drawings. When penetrating wood studs, joists, and other wood members, provide such members with reinforcement steel straps of Continental Steel & Tube Co., ULINE, Independent Metal Strap, or equal.
 7. Reduce fitting where any change in pipe size occurs. Bushings shall not be furnished unless specifically reviewed by the Architect, or indicated on Drawings.

8. Piping subject to expansion or contraction shall be anchored in a manner, which permits strains to be evenly distributed. Swing joints or expansion loops shall be installed. Seismic restraints shall be installed so as not to interfere with expansion and contraction of piping. Seismic loops required at all building separations.
9. Immediately after lines have been installed, openings shall be capped or plugged to prevent entrance of foreign materials. Caps shall be left in place until removal is necessary for completion of installation.
10. Couplings shall not be installed except where required pipe runs between other fittings are longer than standard length of type of pipe being installed and except where their installation is specifically reviewed by the Architect.
11. Water piping shall be installed generally level, free of traps, unnecessary offset, arranged to conform to building requirements, clear of ducts, flues, conduits, and other Work. Piping shall be arranged with valves installed to provide for complete drainage and control of system. Piping shall not be installed which causes an objectionable noise from flow of water therein under normal conditions. Refer to Section 23 0500: Common Work Results for HVAC.
12. Water lines may be installed in same trench with sewer lines, provided bottom of water line is 12 inches minimum above top and to the side of sewer line.
13. Hot and chilled water circulating piping installed for space heating or cooling shall pitch up to a high point at a slope of 1/4 inch in 10 feet in the direction of flow. Where supply and return lines are exposed, both lines shall pitch in same direction. Otherwise, where possible, lines shall pitch up toward compression tank.
14. Changes in pipe sizes shall be furnished with eccentric reducers, flat on top. Offsets to clear obstruction shall not be installed so as to produce air pockets.

C. Pipe Sleeves and Plates:

1. Provide and install pipe sleeves of Schedule 40 black steel pipe or Schedule 40 PVC plastic pipe in concrete or masonry walls, footings, and concrete floors below grade. Provide and install adjustable submerged deck type sleeves at locations where pipes pass through concrete floors, except concrete slab floors on grade, and at locations where soil pipe for floor type water closets passes through concrete floors.
2. Sleeves shall provide 1/2 inch clearance around pipes, except plastic pipe shall have 1-inch clearance. Caps of deck type sleeves shall be removed just prior to installation of pipe. Area around sleeves shall be smooth and without high or low spots. Sleeves in walls shall not extend

beyond exposed surface of wall. Sleeves in concrete floors and walls shall be securely fastened to forms to prevent movement while concrete is being placed.

3. Piping installed on a roof shall clear the roof surface by 10 inches minimum, with or without insulation. Bottom of individual fittings may infringe on 10 inches clear space but not groups of fittings or fittings located within 27 inches of each other.
4. Stiles shall be provided to facilitate crossing of piping when parallel piping runs are laterally greater than 12 inches out-to-out, or any pipe is higher than 18 inches, and more than 40 feet long or runs between 2 or more major pieces of equipment or housings greater than 20 feet apart. Stiles shall be not less than 20 inches wide with a minimum tread depth of 10 inches. Where stiles are required, they shall be located so greatest obstructed distance is 30 feet.
5. Where pipes pass through waterproofed walls, floors, or floors on grade, sealant with Link-Seal Modular Seals, or equal, between pipe and sleeve to provide a waterproof joint. Where earth is in contact with pipe on both sides of a wall or foundation, the waterproof joint is not required. Commercial rubber compression units may be furnished instead of sealed sleeves if reviewed by the Architect.
6. A swing joint, or other required device, shall be furnished and installed in hot water lines with 10 feet of sealant or compression joint to allow for expansion.
7. Pipe sleeves shall be provided where pipes intersect footings or foundation walls and sleeve clearances shall provide for footing settlement, but not less than one inch all around pipe.

D. Welding of Pipe and Qualifications of Welder:

1. Joints above grade or accessible conduit or tunnels in steel piping may be either welded or screwed unless specifically indicated otherwise on Drawings or specified. Joints in below grade steel piping, whether in insulation or not, shall not be welded, unless otherwise indicated.
2. Welded joints in pipe shall be continuous around pipe and shall comply with ASME B31: Code for Pressure Piping, unless otherwise specified.
3. Each pipe weld shall be stamped with welder's identification mark. Welding shall be performed by welders possessing a valid certificate of qualification for welding carbon steel welding pipe in horizontal position (2G) and horizontal fixed position (5G) in accordance with the requirements of Section IX of the ASME Boiler and Pressure Vessel Code, by an Owner-recognized, DSA approved testing laboratory.

4. Before any welder performs welding on the Work, furnish the Project Inspector with a copy of welder's valid qualification papers and obtain verification. Welder qualification is not valid unless it has been issued while welder was performing work for current employer, and has performed type of work described by qualification in the preceding 3 months.
 5. Welding performed under these Specifications is subject to special tests and inspections including rigid Ultra Sonic Testing (UT) and radiographic inspection at random, in accordance with Technique for Radiographic Examination of Welded Joints by an Owner recognized, DSA approved testing laboratory.
- E. Unacceptable Welds and Repairs to Welding:
1. Welds containing any of the following types of imperfections shall be deemed defective Work:
 - a. Cracks of any type.
 - b. Zones of incomplete (in excess of 1/32 inch) fusion or penetration.
 - c. Elongated slab inclusions longer than 1/4 inch.
 - d. Groups of slag inclusions in welds having an aggregate length greater than thickness of parent metal in a length 12 times the thickness of the parent metal.
 - e. Undercuts greater than 1/32 inch.
 - f. Overlaps, abrupt ridges or valleys.
 2. When a defective weld is detected by examination as outlined above, two additional welds shall be radiographed at locations selected by the Project Inspector. If the two selected welds demonstrate compliant welding, then the two tested welds shall be deemed to be in compliance. Welding revealed by radiographs to be defective Work shall be removed, repaired, and tested by radiograph.
 3. If either of the two selected welds demonstrates welding deemed to be defective Work, all welding in that portion of the Work shall be deemed defective Work and either: all welds shall be cutout, prepare new ends for welding and weld to comply with this Specification, or radiograph all welds, removing and repairing only such welding deemed to be defective Work.
 4. Repair welding shall be performed in a manner in full compliance with ASME B31. The welded joints or repairs shall be spot examined with UT or radiographic tests in accordance with foregoing requirements.

5. Owner shall cause to be performed additional random UT and radiographic examinations of welds. Owner shall be responsible for the costs of any UT and radiographic examinations found to be in compliance with specified requirements.
 6. Installer shall be responsible for the costs of UT and radiographic re-examinations of welds deemed defective Work and not in compliance with this Specification, and shall repair or replace said welds in accordance with specified requirements.
- F. Welding Rods: Submit a written list of materials and proposed type of welding rods for review by the Architect.
- G. Backing Rings: Backing rings may be submitted for installation provided the Product Data is submitted with the material list.
- H. Qualification Tests for Low-pressure Welding:
1. Tests shall be performed on 3-inch standard weight pipe ASTM A53, Grade A, and shall be welded by acetylene and electric arc. Each sample shall consist of two pieces, each 10 inches long, with 30-degree bevel at point weld.
 2. Two 20-inch samples shall be performed in the 2G and two 20-inch samples in the 5G positions, with positions defined in Section IX, ASME Boiler and Pressure Vessel Code. Welds shall have the reinforcement ground or machined flush to the surface of the pipe before testing. Samples shall be tested as full section tensile.
 3. Weld shall develop a load of 90 percent of 50,000 psi, i.e., 45,000 psi or shall develop a fracture in parent metal.
 4. Each qualified welder shall carry an identification card listing welder's name, date of test, and type of welding tests passed; signed by the welder and the laboratory.
 5. A valid certificate of qualification issued in compliance with requirements of the ASME Boiler Pressure Vessel Code Section IX shall qualify a welder for issuance of a certificate for low-pressure pipe welding.
- I. Certificates of Qualification for Welding of Unfired Pressure Vessels:
1. Certificates of qualification shall be issued by a laboratory recognized by the Owner in compliance with the requirements of the ASME Boiler Pressure Vessel Code Section IX. Qualifications shall be for both acetylene and arc welding of Schedule 40 ASTM A53, Type B, steel welded or seamless pipe in the Horizontal Position (2G) and the Horizontal Fixed Position (5G) as defined by said code.

NOTE: Certificate described above is not valid unless it has been issued while welder was working for his current employer, and unless welder has performed type of work

described by certificate in the preceding three months. Requirements for possession of a valid certificate shall not be waived for welders fabricating unfired pressure vessels when the Specifications require compliance with ASME code or when welding pipe carries working pressures greater than 75 psi and temperatures greater than 250 degrees F.

J. Pipe Joints and Connections:

1. Pipe and tubing shall be cut per IAPMO Installation Standards. Pipe shall have rough edges or burrs removed so that a smooth and unobstructed flow shall be provided.
2. Threaded Pipe: Joints in piping shall be installed according to the following service schedule:
 - a. Refrigerant and Soap Piping: Litharge and glycerine, or Expando, Gasoila, or equal.
 - b. All other services Furnish sealant, suitable and as reviewed by the Architect.
3. Threads on pipe shall be cut with sharp, clean, unblemished dies and shall conform to ANSI/ASME B1.20.1 for tapered pipe threads.
4. Joint compounds shall be smoothly placed on male thread and not in fittings. Threaded joints shall be installed tight with tongs or wrenches and sealant of any kind is not permitted. Failed joints shall be replaced with new materials. Installation of thread cement or sealant to repair a leaking joint is not permitted.
5. Sharp-toothed Stillson, or similar wrenches, is not permitted for the installation of brass pipe or other piping with similar finished surfaces.

K. Copper Tubing and Brass Pipe with Threadless Fittings:

1. Silver brazed joints shall be used for attaching fittings to non-ferrous metallic refrigerant piping.
2. Non-pressure gravity fed condensate lines may be soldered with 95/5 solder.
3. Silver brazing alloy, Class BCUP-5. Surfaces to be joined shall be free of oil, grease, and oxides. Socket of fitting and end of pipe shall be thoroughly cleaned with emery cloth and wiped to remove oxides. After cleaning and before assembly or heating, flux shall be installed to each joint surface and spread evenly. Heat shall be applied in accordance with instructions in the Copper Tube Handbook issued by Copper Development Associates. Joints constructed of rough bronze fittings shall be provided as recommended by manufacturer.
4. Do not overheat piping and fittings when installing silver brazing.

5. Joints in non-ferrous piping for services not covered above shall be installed with solder composed of 95/5 tin/antimony, ASTM B32, Grade 5A. Surfaces to be jointed shall be free of oil, grease, and oxides. Sockets of fitting and end of pipe shall be thoroughly cleaned with emery cloth to remove oxides. Solder flux shall be sparingly installed and solder added until joint is completely filled. Do not overheat. Excess solder, while plastic, shall be removed with a small brush in order to provide an uninterrupted fillet completely around joint. Random inspection of joints shall be conducted by Project Inspector to ensure joints are lead-free.
 6. Grooved end joints for copper piping shall be assembled in accordance with the latest manufacturer recommendations. Pipe ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove for proper gasket sealing. Grooving tools shall be as manufactured by Victaulic, RIDGID, MAG Tool, or equal.
- L. Ring-Type Pipe: Joints shall be installed in accordance with manufacturer's instructions with grooved couplings, fittings and rubber rings. Couplings and pipe shall be compatible and of the same manufacturer. Rings shall be accurately located and installed by grooves in coupling. Pipe shall be installed with zero deflection unless otherwise specified. Pressure pipe shall be furnished with thrust blocks at each offset point.
- M. Welded Pipe Joints:
1. Joints in welded steel pipelines shall be installed by oxyacetylene or electric arc process. Welding shall be continuous around pipe and provided as specified.
 2. Butt welds shall be of the single V-type, with ends of pipe and fittings beveled approximately $37 \frac{1}{2}$ degrees. Piping shall be aligned before welding is started with the alignment maintained during welding.
 3. Welds for flanges and socket fittings shall be of the fillet type with a throat dimension not less than pipe wall thickness.
- N. Grooved End Pipe Joints: Grooved end joints for carbon steel piping shall be assembled in accordance with the latest manufacturer recommendations. Pipe ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove for proper gasket sealing. Grooving tools shall be as manufactured by Victaulic, RIDGID, MAG Tool, or equal.
- O. Joints shall be Vic-Press 304TM, or equal, made with Victaulic Series 'PFT' tools and the appropriate sized jaw. Pipe shall be certified for use with Vic-Press 304TM system, and shall be square cut, properly deburred and cleaned, and marked at the required location to insure full insertion into the fittings and/or couplings.
- P. Valves: Valves shall conform to the following:

1. Piping systems shall be furnished with valves at points indicated on Drawings and specified, arranged to provide complete regulating control of piping system throughout building and the Project site.
 2. Valves shall be installed in a neat grouping, so that parts are easily accessible and maintained.
 3. Pressure Independent Characterized Control valve type shall be suitable for service on which installed.
 4. Valves shall be full size of line in which they are installed, unless otherwise indicated on Drawings or otherwise specified, and shall be one of types specified.
 5. Provide chain operators on valves 2-inch and larger located 7 feet or more above the servicing floor level.
 6. Valves for similar service shall be of one manufacturer.
 7. Except where otherwise specified, valves shall be Belimo, Victaulic, Stockham, Crane, Jenkins, Milwaukee, Hammond, American Valve, NIBCO, Hoffman, or equal.
 8. Ball valves below grade in yard boxes shall have stainless steel handles.
 9. Temperature relief valves and combination temperature and pressure relief valves shall be as specified and furnished as set forth in this Section. Discharge pipe from relief valves shall be not less than discharge area of valve or valves it connects, based on discharge area of valves, and shall terminate as indicated and free of any traps. Valves shall be installed at following locations:
 - a. A combination temperature and pressure relief valve or combination of valves on each heating hot water boiler. Temperature sending element shall extend into water inside boiler.
 10. Manual air vent valve assemblies shall be installed at each high point of hot water space heating and chilled water piping systems. Valves shall discharge through 1/4 inch diameter copper tubing and drain to nearest floor sink. Automatic type air vent valve shall only be installed where specifically indicated. Radiator, convectors, and finned pipe convectors shall be fitted with packless radiator valves, angle or straight pattern. Each convector or radiator installed as part of a space hot water heating system shall be furnished with a manual-type air vent valve.
- Q. Strainers: Strainers shall be installed on each water main (except for fire line) downstream of the meter, above grade, when a pressure regulator assembly is not installed. Main strainer shall be of Y-flange or groove type. On closed loop chilled and heating hot water systems pump systems, a strainer shall be installed

at each pump inlet and upstream of each flow control valve assembly. The control valve assembly may include a modulating temperature control valve and a flow-limiting valve, manufactured by Griswold, AutoFlow, Flow Control Industries, Inc., or equal.

R. Hangers and Supports:

1. Piping shall be securely fastened to building structure by approved iron hangers, supports, guides, anchors, and sway braces to maintain pipe alignment to prevent sagging and to prevent noise or excessive strain on piping due to uncontrolled or seismic movement under operating conditions. Hangers and supports shall conform to Manufacturer's Standardization Society Specification SP-69. Hangers shall be relocated as required to correct unsatisfactory conditions that may become evident when system is placed into operation. Appliances, heat exchangers, storage tanks, and similar equipment shall be securely fastened to structure in accordance with seismic requirements. Outdoor metal hangers and supports shall be hot-dipped galvanized steel, unless otherwise specified.
2. Piping shall not be supported by wire, rope, wood, plumbers' tape, or other non-recognized devices.
3. Hangers and supports shall be designed to support weight of pipe, fittings, weight of fluid and weight of pipe insulation, and shall have a minimum factor of safety of 5, based on ultimate tensile strength of material installed.
4. Burning or welding of any structural member under load is not permitted. Field welding not specified on Drawings or reviewed Shop Drawings is not permitted without review by Architect and DSA.
5. Burning holes in beam flanges or other structural members is not permitted without review by the Architect and DSA.
6. Pipe hangers on piping covered with low temperature insulation shall be installed on outside of insulation and not in contact with pipe unless otherwise detailed on Drawings. Insulation shall be protected by 18 gage galvanized steel shield, with a minimum length of 10 inches, installed completely around pipe covering between covering and hanger. Installing hangers directly on pipe and butting adjoining sections of insulation against hanger is permitted provided void and hanger rod are properly insulated and sealed so that no sweating occurs at hangers.
7. Hanger rods shall be fastened to structural steel members with suitable beam clamps. Clamps shall be Tolco, Carpenter & Patterson, Fee and Mason, or equal, as follows:
 - a. Tolco I beam, Fig.62 for maximum 1000 lbs.

- b. Tolco I or WF beam, Fig. 329, for maximum of 1290 lbs.
8. Hanger rods shall be fastened to concrete inserts in concrete slabs or beams. Inserts shall be Tolco, Carpenter & Patterson, Fee and Mason, or equal, as follows:
 - a. Tolco Fig.310 for maximum of 600 lbs.
 - b. Tolco Fig. 309 for maximum of 1140 lbs.
9. For fastening to wood ceilings, beams, or joists, furnish Anvil Fig. 128R, Anvil Fig. 153, Tolco 78, or equal pipe hanger flange fastened with drive screws. Under wood floors, 3/8 inch hanger rods shall be hung from 2-inch by 2-inch by 1/4 inch angle clips 3-inch long, with two staggered 10d nails, clinched over joist.
10. Hanger rod sizes for copper, iron, or steel pipe: 3/8 inch for pipe sizes 1/2 inch through 2-inch, 1/2 inch for pipe sizes 3-inch, 4-inch and 5-inch, 5/8 inch for pipe size 6-inch, and 3/4 inch for 8-inch and 10-inch pipe.
11. Turnbuckles, if furnished, shall provide a load carrying capacity equal to that of the pipe hanger with which they are being installed.
12. Pipe hangers shall be of same size, or nearest larger manufactured size available, as pipe or tubing on which they are being installed.
13. Hangers, clamps, and guides furnished for support of non-metallic pipe shall be padded with 1/8 inch thick rubber, neoprene, or soft resilient cloth.
14. Where special pipe-supporting requirements in the Specifications conflict with any standard requirements specified herein, the Specification requirements shall govern.
15. Vertical Piping:
 - a. Vertical pipe risers shall be securely supported with riser clamps of recognized type. Risers in reinforced concrete buildings shall be furnished with extension clamps fastened to pipe above each concrete floor slab with extended arms of clamp to rest on slab. Clamps shall be provided with lead or Teflon liners when installed on copper tubing. Clamps shall be plastic-coated when installed on non-ferrous pipe or tubing.
 - b. Copper tubing in sizes 1 1/2-inches and larger and steel pipelines passing up through building shall be supported at each floor of building or every 15 feet whichever is less.
 - c. Copper tubing sizes 1 1/4-inch and smaller shall be supported at not intervals not more than 6 feet on center. Special provisions

shall be installed for vertical lines subject to expansion and contraction caused by operating temperature differences.

- d. Vertical cast iron pipelines shall be supported from each floor and at its base. Malleable iron or steel pipe clamps with minimum thickness of 1/4 inch shall be furnished and fastened around pipe for support.

16. Horizontal Piping:

- a. Pressure piping on roofs shall be supported from stands, trapezes, or structures so that the bottoms of pipes clear the roof surface by 10 inches.
- b. Insulated steam and space heating hot water supply and return piping shall be supported with Tolco Figure 4, B-Line Figure B3140, Anvil Figure 212, or equal, steel hangers with welded eye rods to permit hinge movement at point of attachment of hangers. Hinge movement at point of support shall be provided by welded eye linked rods Tolco Figure 101L, B-Line Figure B3211X, Anvil Figure 278X, or equal.
- c. Chilled water supply and return piping, condenser water piping, insulated refrigerant piping may be supported with Tolco Figure 1, B-Line Figure B3100, Anvil Figure 260, or equal, hangers with rods, turnbuckles and inserts suitable for above hangers.
- d. Maximum hanger and support spacing shall conform to CPC schedule for horizontal piping installed above grade.

17. A hanger or support shall be installed close to the point of change in direction of a pipe run, in either a horizontal or vertical plane.

18. When practicable, supports and hangers for cast iron soil pipe shall be installed as close as possible to joints and when hangers or supports are not located within one foot of a branch line fitting, an additional hanger or support shall be installed at fitting.

19. In systems where grooved piping is used, couplings shall be provided with angle pattern bolt pads to comply with support and hanging requirements of ANSI/ASME B31.1, ANSI/ASME B31.9, and NFPA Pamphlet 13.

S. Flashings:

1. Each pipe, duct, or gas-fired equipment vent passing through roof shall be installed with waterproof flashing.
2. Flashing or flanges on pipes, vents, and ducts passing through a tile or slate roof shall be constructed of sheet lead. Flashing for pipes and heater vents passing through a roof shall be 4 pound soft sheet lead.

Flashing and flanges for ducts and heater vents passing through exterior walls shall be 22 gage sheet metal. Flanges and flashing shall be installed waterproof at point of connection with pipe or duct. No soldered joints on roof flashings will be allowed.

3. Lead flashing and flanges shall be constructed of 4 pound sheet lead with burned joints. Flange of lead flashing or lead flange on a duct shall extend out onto roof a minimum of 12 inches from pipe or duct. Lead flashing shall extend up the pipe or duct not less than 7 inches.
 4. Sheet metal flashing shall be constructed of 24 gage galvanized sheet steel. Flanges on these flashings shall extend out onto roof a minimum of 10 inches from pipe or duct. Flanges on ducts through exterior walls shall extend out from duct a minimum of 2 ½ inches. Flanges on gas-fired equipment single-wall vents shall be of ventilated type. Type B gas vents through a roof shall be furnished with non-ventilated flashing as per NFPA Pamphlet 211.
 5. Cast iron, steel, brass, and copper pipe, which terminate less than 18 inches above roof, shall be furnished with a combination counter-flashing and vandal-proof hood for protection against water, birds and foreign matter. Cast iron, steel, brass and copper pipe, which does not terminate within 18 inches of roof, shall be furnished with a counter-flashing sleeve. Pipe, which terminates more than 18 inches above roof, shall be furnished with protection against entrance of water, birds, and foreign matter.
 6. Counter-flashing and combination counter-flashing sleeves and vandal-proof hoods shall be cast iron, vandal-proof, threaded, sealed or approved gas-heated sleeve type. Counter-flashing sleeves on each of these items shall extend down over flashing a minimum of 3/4 inch.
 7. Flashing and flanges on ducts shall be installed waterproof at point of connection to the duct by riveting and soldering. Storm collars shall be securely screwed and installed waterproof around appliance vent pipe immediately above flashing.
 8. Vent piping above roof shall be furnished with a combination counter-flashing sleeve and vandal-proof hood.
- T. Equipment Installation: Install roof or floor mounted equipment on level platforms, housekeeping pads or curbs and provide sound, vibration and seismic control measures per Section 23 0548, unless indicated otherwise whether indicated on drawings or not.

END OF SECTION

SECTION 23 05 48 - HVAC SOUND, VIBRATION AND SEISMIC CONTROL

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes: Reduction or elimination of excessive noise or vibration within building due to operation of equipment, machinery, piping, and ductwork as specified.
 - 1. Vibration isolators.
 - 2. Seismic restraint devices.
 - 3. Duct silencers.
 - 4. Lining and enclosing ductwork.
 - 5. Acoustic louvers.
 - 6. Sound attenuation boots at supply, return, exhaust and transfer air inlets, outlets and openings.
 - 7. Flexible ducts, conduits and piping.
- B. Related Requirements:
 - 1. Division 01: General Requirements.
 - 2. Section 01 4525: Testing, Adjusting, and Balancing for HVAC.
 - 3. Section 23 0500: Common Work Results for HVAC.
 - 4. Section 23 0513: Basic HVAC Materials and Methods.
 - 5. Section 23 3000: Air Distribution.
 - 6. Section 23 3813: Kitchen Ventilation System.
 - 7. Section 23 8000: Heating, Ventilating and Air Conditioning Equipment.

1.02 GENERAL REQUIREMENTS

- A. Provide vibration isolators to eliminate or reduce the transmission of vibration noise to any part of building and mitigate vibration frequency and load imposed by equipment. Vibration isolators, base frames, inertia bases and seismic restraints shall be of sufficient size, flexibility and load distribution configuration to assure that deflection, stability and seismic restraint requirements are met without permitting excessive movement when starting. For typical units, no fewer than four isolators shall be provided. Isolators shall be provided to deflect uniformly under operating gravity and equipment thrust loadings to within plus or minus 10 percent of specified deflection values.

- B. Static deflections specified are based on the anticipated equipment characteristics. In the event the equipment proposed by the Contractor has characteristics other than those indicated, particularly the rated rpm, the static deflection shall be re-evaluated and the proper mountings and other devices shall be provided.
- C. Where fabricated vibration isolator units are indicated, furnish manufacturer's standard catalog products with printed loading ratings or certified submittals
- D. Seismic Requirements:
 - 1. Refer to Seismic Restraint Manual: Guidelines for Mechanical Systems, published by SMACNA and approved by DSA, for minimum seismic restraints required on mechanical components design and construction details.
 - 2. Provide seismic restraints for mechanical equipment or components specified. Where equipment is specified with proprietary names, design for seismic restraints is for first proprietary name listed.
 - 3. Provide restraints, bracing and anchorage as required for the mechanical equipment, electrical equipment and components specified in the Contract Documents. Restraints, bracing and anchorage shall be installed to resist the total design earthquake or wind loads in any direction in accordance with CBC and SMACNA guidelines.
 - 4. Provide restraints, bracing, and anchorage for the mechanical equipment and components.
 - 5. For rigidly mounted liquid filled steel pipe, comply with the following:
 - a. Provisions of NFPA Pamphlet 13, section for sway bracing.
 - b. Provisions of NFPA Pamphlet 13, section for earthquake protection.
 - c. Hanger spacing as specified in Section 23 0513 under Hanger Spacing Schedule.
 - d. SMACNA Seismic Restraint Manual: Guidelines for Mechanical Systems and approval by DSA.
 - 6. For flexibly mounted liquid filled steel pipe, comply with the following:
 - a. Provisions of the California Building Code for flexibly mounted equipment.
 - b. Provisions of VISCMA (Vibration Isolation and Seismic Control Manufacturer's Association) Seismic Control Device Installation, Best Practices Manuals.
 - c. Installer may provide a DSA or OSHPD approved system such as the SMACNA Seismic Restraint Manual with Addendum No. 1, the Mason Industries Seismic Restraint Guidelines or other proprietary pre-approved system.

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

1.03 SUBMITTALS

A. Provide in accordance with Division 01.

1. Catalog cuts and data sheets on specific vibration isolators, seismic restraints, and anchors demonstrating compliance with the Specifications.
2. Shop Drawings for each piece of equipment including dimensions, structural member size, support point, vibration, and seismic restraints.
3. Written approval of frame design to be furnished by the equipment manufacturer.
4. Drawings indicating methods for suspension, support, seismic restraints, guides, etc., for piping, ductwork, etcetera.
5. Drawings indicating methods for isolation of pipes, ducts etcetera, piercing slabs, beams, etcetera.

B. Vibration Test Reports: At completion of installation, submit the following documents. Submission of these documents must be complete before final acceptance of vibration isolation systems is given. Assistance from the vibration isolation equipment Manufacturer may be required.

1. Complete tabulation showing for each vibration isolator:
 - a. Actual static deflection measured at the project.
 - b. Specified minimum static deflection.
2. Report certifying:
 - a. Each piece of operative rotating mechanical equipment does not exceed the specified vibration displacement level.
 - b. Each piece of isolated equipment or equipment component (ducts, pipes, conduit, etcetera) is not short-circuited by any means.
 - c. Requirements of Part 2 are satisfied for equipment.

1.04 QUALITY ASSURANCE

A. Standards and Codes: Comply with applicable codes and standards having jurisdiction including, but not limited to:

1. NFPA, Pamphlet 13.
2. ASHRAE Handbook: HVAC Systems and Equipment.
3. SMACNA Seismic Restraint Manual: Guidelines for Mechanical Systems.

4. California Building Code.
5. VISCMA
 - a. Installing Seismic Restraints for Mechanical Equipment.
 - b. Installing Seismic Restraints for Duct and Pipe.
- B. Qualifications of Manufacturer and Installers: Comply with provisions as set forth in Section 23 0500: Common Work Results for HVAC.

PART 2 – PRODUCTS

2.01 GENERAL

- A. Furnish and install vibration dampers, sound isolation pads, flexible connections and similar equipment required to prevent sound of water flowing in pipes, vibration of motors, and motor operated equipment from being transmitted to building structure; and, in case of fans, from being transmitted along ducts. Piping shall be isolated from vibrating equipment by furnishing required flexible connectors.
- B. Pumps and similar motor operated equipment shall be installed on anti-vibration units.
- C. Fans, except curb-mounted roof-type exhaust fans and wall mounted propeller fans, shall be installed with anti-vibration units, whether indicated on Drawings or not. Fans built into air handling units may be furnished with independent anti-vibration mountings or whole unit may be installed on an external vibration isolation system.
- D. Other equipment shall be installed on anti-vibration bases, pads, or hangers, unless specifically noted otherwise on Drawings. Package units, furnished with built in anti-vibration bases, do not require unit bases unless otherwise specified.
 1. Unless specified otherwise, anti-vibration bases shall be Mason Industries, M.W. Sausse & Co., the VMC Group, or equal, of the Model Number specified or indicated on the drawings. Furnished base including sub-base, shall be manufactured by same company with fan and integral motor base. Seismic restraints may be incorporated into bases or furnished separately.
 2. Inertia anti-vibration bases shall conform to requirements indicated.
 3. Unless noted otherwise, furnished anti-vibration bases, including supporting units for inertia bases, shall be of the spring type.
 4. Selection of bases or supporting units shall be in accordance with manufacturer's recommendations based on following installed minimum effective isolation efficiencies (where not provided with each piece of equipment):
 - a. Centrifugal fans, packaged fan and coil units and cooling towers, less than 800 RPM 80 percent
 - b. Centrifugal fans over 800 RPM 90 percent

- c. Centrifugal pumps 95 percent
- d. Reciprocating compressors 95 percent
- E. Flexible duct connections shall be provided at inlet and outlets of each fan or HVAC unit, except curb-mounted roof exhaust fans whether indicated on the drawings or not.
- F. Flexible pipe or conduit connections shall be provided at piping and conduit connections to HVAC units, pumps, compressors and other moving (reciprocating or rotating) mechanical or electrical equipment provided under this Section whether indicated on the drawings or not.
- G. Flexible connections for Freon piping shall be seamless flexible metal hoses of type and length recommended by manufacturer and suitable for system operating pressure.
- H. Flexible connections for all other piping shall be flexible metal hose or spool type with flanged ends, unless otherwise specified. Metal hose shall be covered with protective braiding in areas where physical abrasion may occur, or for personnel safety.
- I. Spool types shall be similar to American Rubber Co., Mercer Rubber Co., PROCO Products, Inc., or equal, and hose types shall be similar to DME, Inc., U.S. Flex, Pennflex, Anaconda Flexpipe, Keflex, or equal with any required modifications to meet specified requirements. Flanges shall be furnished with steel retaining rings. Units installed on discharge side of pumps shall be furnished for a suitable working pressure of not less than 100 psig, and those on suction side for working pressures of 50 psig or 30 inches Hg vacuum.
- J. Units installed in cold water lines (less than 125 degrees F) shall furnish a minimum temperature rating of 180 degrees F and those installed in hot water lines (above 125 degrees F) shall be constructed of special heat resistant materials and be furnished for a minimum temperature rating of 220 degrees F, continuous operation. Units shall be able to withstand a maximum lateral deflection of 3/8 inch. Temperature and pressure ratings shall be molded into body of each spool unit so they are easily identified. Spool types shall be for straight in flow only.
- K. Spool type units shall be furnished with control units comprised of a minimum of two tie-rods and anchor plates or internal guide sleeves to prevent excessive elongation or misalignment. Rubber washers shall be provided under bolt heads and rubber grommets in bolt holes to prevent any metal to metal contact between bolts and flanges.
- L. Where hose type units are furnished, restraining anchors or braces shall be provided if excessive or undesirable pipe movement occurs when system is operated.

2.02 GENERAL PROPERTIES OF VIBRATION ISOLATORS.

- A. Shall be provided with markings so that, after adjustment, when carrying their load, deflection under load can be verified; thus determining that load is within proper range of device and that correct degree of vibration isolation is being provided according to the design.

- B. Isolators to operate in direct proportion to their load versus deflection curve. Load versus deflection curves shall be furnished by manufacturer and must be linear over a deflection range of 50 percent above design deflection.
- C. Wave motion through isolator shall be reduced to following extent: Isolation above resonant frequency shall follow theoretical prediction based upon an un-dampened single degree of freedom system with a minimum isolation of 50 decibels above 150 cycles per second.
- D. Vibration isolator spring diameters shall be no less than their deflected height. Furnish spring with a 50 percent overload safety factor.
- E. Unless otherwise indicated, equipment installed on vibration bases shall provide a minimum operating clearance of one inch between structural steel base and floor or support base. Provide flexible connectors in piping and flexible conduit in power wiring to minimize transmission of vibration.
- F. Isolators and springs exposed to weather shall be hot-dipped galvanized or powder coated after fabrication and before installation. Hot-dipped zinc coating shall be not less than two ounces per square foot by weight complying with ASTM A123. In addition, provide limit stops to resist wind velocity.
- G. Where indicated, provide structural steel bases with height saving brackets, and minimum of three points of support. Isolators shall be furnished with a method for leveling.
- H. Design isolators and seismic restraints for positive anchorage against uplift and overturning.
- I. Provide and install, under this Section of the Specifications, structural steel required to properly support equipment and steel required to support horizontal thrust arrestors.

2.03 ISOLATOR TYPES

- A. Type A: Steel Spring Isolators: Un-housed steel spring isolators, laterally stable and unrestrained. Design springs so that ratio of horizontal to vertical spring (stiffness) constant is between 0.9 and 1.3. Natural frequency of isolator must be 1/3 to 1/4 of driving frequency that is to be controlled. Isolators to provide a minimum additional travel to solid equal to 50 percent of rated deflection. Isolators shall be furnished with built-in leveling bolts complete with sound isolation pads type B. Static deflection as specified.
- B. Type B: Sound Isolation Pad: Provide under each spring isolator a sound isolation pad, utilizing high quality durable neoprene pad material, loaded to 40 psi. Build sound pad up to 2 layers of 1/4 inch thick neoprene material; separate layers with a 16 gage galvanized sheet metal plate. Top layer shall provide a hardness of 40 durometers and the bottom layer shall be 40 durometers. Cold bond sound pads together and to isolator baseplate.
- C. Type C: Neoprene-in-Shear Isolators: Isolator shall be neoprene-in-shear type as recommended by manufacturer. Isolator shall provide a static deflection under rated load at 1/4 inch.

2.04 EQUIPMENT FRAMES

- A. Provide mounting frames and brackets to carry load of equipment without causing mechanical distortion or stress to the equipment.

- B. Type A Frame: Wide flange members, rigidized structural steel frame with brackets. Maximum allowable deflection at any point on load frame relative to unloaded frame shall be 0.005 inch. Members to be constructed of wide flange beams, with a depth of not less than 1/10 of length of span between isolators. Frame shall be M.W. Sausse & Co. type RMSB-W, as basis of design, or Mason Industries, Caldyn, or equal.
- C. Type B Frame: Channel members, rigidized structural steel frame with brackets. Frame to be constructed of channel steel with section depth equal to 1/10th length of longest structural member. Frame shall be M.W. Sausse & Co. type RMSB-C, as basis of design, or Mason Industries, Caldyn, or equal.
- D. Type C Frame: Steel gusset or bracket welded or bolted directly to machine frame in order to accommodate isolator. Frame shall be M.W. Sausse & Co. type RMSG, as basis of design, or Mason Industries, Caldyn, or equal.
- E. Type D Frame: Fabricated of rectangular channel steel forms for floating foundations to be filled with concrete on the Project site. Channel depth to be a minimum of 1/12th of longest dimension, but in no case less than 6 inches. Form shall include 1/2 inch reinforcing bars installed each way in a layer 1 ½ inches above bottom and drilled steel members with sleeves mounted below holes to receive equipment anchor bolts. Weight of concrete and frame shall be two times or more than the weight of the unit it supports. Frame shall be M.W. Sausse & Co. type RMSBI, as basis of design, or Mason Industries, Caldyn, or equal.

2.05 MATERIALS AND CONSTRUCTION

- A. Duct Silencers: Provide factory fabricated duct silencers of tubular or rectangular type, for low or medium velocity service, with arrangements, sizes, and capacities as indicated on the Drawings.
 - 1. Construction:
 - a. Fabricate silencers of galvanized steel with casing seams sealed or welded to be airtight at a pressure differential of 8 inches water gage between inside and outside of unit, and stiffen or brace as necessary to prevent structural failure or deformation at same condition, or audible vibration during normal operation. Outer casings of rectangular silencer modules shall be made of 22 gage galvanized steel in accordance with ASHRAE Guide of recommended construction for high-pressure rectangular ductwork. Seams shall be lock formed and mastic filled. Outer casings of tubular silencers shall be made of galvanized steel in 18 to 22 gage. Internal acoustic elements of rectangular silencers shall incorporate integral die formed entry and exit to minimize pressure drop and self-noise. Interior partitions for rectangular silencers shall be fabricated of not less than 26 gage galvanized perforated steel. Interior construction of tubular silencers shall be compatible with the outside casings.
 - b. Filler material shall comply with the following:
 - 1) Fire Safety Standards: NFPA 90A and NFPA 90B.
 - 2) Temperature: ASTM C411.

- 3) Air velocity: ASTM C1071, UL 181.
 - 4) Fire Hazard Classification: ASTM E84, UL 723-Class 1, NFPA 255.
 - 5) Corrosion Resistance: ASTM C739, C665.
 - 6) Fungi Resistance: ASTM G21.
 - 7) Water Vapor Sorption: ASTM C1104, less than 1 percent by weight.
 - 8) Formaldehyde, Phenolic Resins or other Volatile Organic Compounds: 0 percent.
- c. Airtight construction shall be provided by furnishing a duct sealing compound installed on the Project site. Silencers shall not fail structurally when subjected to a differential air pressure of 8 inches w.g. inside to outside of casing.
2. Acoustic Performance: Silencer ratings shall be determined in a duct-to-reverberant room test facility, which provides for airflow in both directions through the test silencer in accordance with ASTM Standard E477. The test facility shall be accredited by the National Voluntary Laboratory Accredited Program for the ASTM E477 test standard. Data from a non-accredited laboratory is not permitted. The test set-up and procedure shall eliminate effects due to end reflection, directivity, flanking transmission, standing waves, and test chamber sound absorption. Acoustic ratings shall include dynamic insertion loss (DIL) and self-noise (SN) power levels both for forward flow (air and noise in same direction) and reverse flow (air and noise in opposite directions). Data shall be for test silencers no smaller than the following cross-sections:
- Rectangular, inches - 24 by 24, 24 by 30, or 24 by 36
Tubular, inches - 12, 24, 36, and 48
- a. Noise reduction values (dynamic insertion loss) in decibels reference 10-12 watts, shall not be less than (of the model, size and length) indicated on Drawings.
 - b. Self generated noise in decibels reference 10 to 12 watts, shall not be more than of the model, size and length indicated on Drawings.
3. Aerodynamic performance: Airflow measurements shall be performed in accordance with ASTM specification E477 and applicable portions of ASME, Air Movement and Control Association (AMCA), and Air Diffusion Council (ADC) airflow test codes. Tests shall be reported on the identical units for which acoustic data is presented. Air pressure drops shall not exceed those (of the model, size and length) indicated on Drawings.
4. Certification: With submittals, provide certified test data on dynamic insertion loss, self-noise power levels, and aerodynamic performance for reverse and forward flow test conditions. Test data shall be for a standard product. Rating tests shall be conducted in the same facility, shall utilize the same silencer, and shall be open to inspection if required by the Architect.

5. Rectangular silencers shall be Industrial Acoustics Company of the model number indicated on the drawing, as basis of design, or Vibro-Acoustics, Dynasonics, SEMCO Silentair, TranSonics, Inc., or equal.
- B. Duct Liner: As indicated in Section 23 0700: HVAC Insulation.
- C. Flexible Ducts: As indicated in Section 23 0700: HVAC Insulation.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Provide isolators, flexible pipe connectors, flexible electrical conduit and flexible duct connectors at all moving mechanical system components to prevent transmission of vibration noise to any part of building whether indicated on the drawings or not.
- B. Install isolators to suit imposed load and the vibration frequency to be absorbed. Isolator units shall furnish adequate strength and flexibility to exhibit proper resiliency under machine load and impact without permitting excessive movement when starting.
- C. Where commercial vibration isolator and seismic restraint units are specified, furnish manufacturer's standard catalog products with printed loading ratings, or provide substantiating calculations.
- D. Install vibration isolators and seismic restraints in accordance with manufacturer's printed installation instructions.
- E. Where equipment is belt driven and motor is not installed on equipment, install motor and driven equipment on unitized support, and install entire support isolators. Unitized support to be provided with adjustable slide rails sized for motor weight and frequency. Support shall be Mason Industries type WF, M.W. Sausse & Co., type RMSF, Caldyn, or equal.
- F. Do not install any equipment, piping, conduit, ductwork, etc., that makes rigid contact with building or its structural members, unless reviewed by the Architect.
 1. Coordinate Work with other trades to avoid rigid contact with building.
 2. Correct, before installation, any conflict with other Work that would result in solid contact to equipment or piping due to inadequate space.
 3. Obtain inspection from the Project Inspector for concealed Work before enclosure.
 4. Notify manufacturer before installation of vibration isolation devices so that manufacturer may instruct and demonstrate technique for proper installation.
- G. The furnishing or installation of vibration isolators must not cause any change of position or alignment of equipment, ductwork, or piping, resulting in stresses in piping or ductwork, connections, or misalignment of shafts or bearings. Equipment, piping, and ductwork shall be maintained in a rigid position during installation. Load shall not be transferred to isolator until installation is complete and under full operational load.

- H. Air Compressors, Water Chillers, Pumps, Boilers with Integral Combustion Fans and Miscellaneous Equipment, mounted on roof or raised floors: Install each unit with its motor on a vibration isolated base utilizing type B frames, except where a type D frame is indicated on Drawings. Install steel support frame furnished by equipment manufacturer, utilizing equipment anchor bolt templates and isolator height saving brackets. Provide springs as specified for type "A" isolator; static deflection shall be a minimum of 2 inches.
- I. Fans (2000 rpm or higher) Air Compressors and Miscellaneous Equipment, mounted on grade: As specified for grade mounted boilers except furnish type C isolators.
- J. Air Handling, Air Conditioning Units, Floor Mounted Fans, and Cabinet-Installed Fans: Install entire casing including filters, mixing box, fan section, coil sections, etc., on a continuous, integral, structural steel base, as indicated. Furnish type A, B, or C frames, reinforced as necessary to prevent distortion of frame. Furnish isolator type A; static deflection shall be a minimum of 1 ½ inches.
- K. Suspended Fans and Air Conditioning Unit Fan Coils and Unit Ventilators: Suspend each integral unit from overhead structure on steel spring and elastomer hanger isolators. Support deflection under rated load of 3/8 inch. Provide spring static deflection as follows:

Fan RPM	Min. Deflection
200 – 400	3 inches
400 – 700	2 inches
Above 700	1 inches

- L. Pipe Isolation: Where indicated and as required, furnish and support each pipe from an isolator. Isolator for the first five support locations away from vibrating equipment shall have the same deflection as the equipment isolators. After that, isolators shall be a neoprene-in-shear type of size as recommended by manufacturer; except where indicated on Drawings, pipe hanger rod shall be furnished with a steel spring isolator and elastomeric element, with lower rod capable of 30 degrees total misalignment without contact on spring housing.
- M. Seismic Restraints: Floor or pad mounted equipment that do not require vibration isolators, shall be bolted to floor or other support. Floor mounted equipment with vibration isolators shall be provided with lateral and vertical restraining devices on all sides of base to restrict displacement of equipment. On all sides of suspended equipment, provide bracing for rigid supports and provide aircraft cable restraints for resiliently supported equipment.
- N. Ductwork, duct acoustical lining, manual volume dampers and flexible ducts: Do not reduce length of duct runs, duct acoustical lining, manual volume dampers and flexible ducts for economy.
- O. Installation of flexible ducts at air inlets and outlets: Do not attach flexible ducts directly to air inlets and outlets unless a straight, smooth and uniform air flow can be achieved with sufficient space to make an elbow with a radius of at least three times the diameter of the duct. If sufficient space is not available to make such an elbow, provide a rigid elbow or a lined plenum.
- P. Placement of Air Devices: Do not relocate air devices without the Architect's approval.

3.02 EXAMINATION

- A. Arrange for the services of a certified representative of isolation manufacturer to visit the Project site for inspecting installation of devices. In the event the isolators do not meet specified requirements perform necessary revisions. Submit a written report to the Architect, signed by above representative, indicating all devices are properly installed and are operating as specified or required by isolation manufacturer.

END OF SECTION

SECTION 23 05 53 - HVAC IDENTIFICATION

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes: Marking and identification required on mechanical piping systems, ducts, controls, valves, apparatus, etc.
- B. Related Requirements:
 - 1. Division 01: General Requirements.
 - 2. Section 23 0513: Basic HVAC Materials and Methods.
 - 3. Section 23 0900: HVAC Instrumentation and Controls.
 - 4. Section 23 3000: Air Distribution.
 - 5. Section 23 8000: Heating, Ventilating and Air Conditioning Equipment.

1.02 SUBMITTALS

- A. Submit in accordance with Division 01 and Section 23 0500: Common Work Results for HVAC.
- B. Submit product data and installation instructions for each item specified.
- C. Submit Samples of materials.

1.03 QUALITY ASSURANCE

- A. Comply with provisions of:
 - 1. Section 23 0500: Common Work Results for HVAC.
 - 2. ANSI/ASME A13.1: Scheme for the Identification of Piping Systems.
 - 3. APWA: Uniform Color Code.Or
 - 4. IAPMO: Uniform Plumbing Code (UPC).

PART 2 – PRODUCTS

2.01 MATERIALS

- A. General: Piping systems, controls, valves, apparatus, etc., except those that are installed in inaccessible locations in partitions, walls, and floors, shall be permanently identified.

2.02 VALVES

- A. Furnish prepared chart or diagram for each piping system, indicating by identifying letter or model number of each valve in the system, its location, and function.
- B. Install charts in aluminum frame with clear glass front and secure on wall where designated by the Project Inspector.
- C. Bind copies of each chart in operating instructions manual.
- D. Provide each valve with a brass, aluminum, or plastic disc, not less than 1-1/4 inches diameter bearing engraved numbers corresponding to those indicated on chart. Fasten discs to valve with No. 14 brass wire.
- E. Provide an additional tag for safety valves and other valves that could be hazardous to safety and health of occupants. Distinguish these tags from regular valve tags by color (such as yellow with black letters, and marked "Danger"); submit Sample tag to the Architect for review.

2.03 INSTRUMENTS AND CONTROLS

- A. Identify panel-mounted instruments and controls with engraved bakelite nameplates permanently affixed to panel boards.
- B. Identify alarm indicating devices and alarm reset devices by nameplates.
- C. Identify damper motors and automatic valves, flow switches, pressure switches, etc., with embossed aluminum or plastic tape affixed to controller, indicating service and setting.

2.04 EQUIPMENT

- A. Identify each major piece of equipment with engraved bakelite nameplates permanently affixed to the equipment, indicating the room numbers it services, Equipment identification designation shall be the same to its designation indicated on the "As-Built Drawings". Room numbers in the nameplates shall correspond to the final room numbers.

2.05 ABOVE GRADE PIPE IDENTIFICATION

- A. Identify pipes by means of colored labels with directional flow arrows and identification of the pipe content, in conformance to ANSI/ASME A13.1 or the UPC.
- B. Materials: Precoiled acrylic plastic with clear polyester coating, all-temperature, self-adhering, as manufactured by Brady, Brimar Industries, Seton, Stranco, Inc., or equal.
- C. Size:

Outside Diameter of Pipe or Insulation	Length of Color Field	Size of Letter
¾ to 1 ¼-inch	8-inch	½-inch
1 ½ to 2-	8-inch	¾-inch

inc h		
2 ½ to 6- inc h	12-inch	1 ¼-inch"
8 to 10-inch	24-inch	2 ½-inch"
over 10- inc h	32-inch	3 ½-inch

D. Colors: As indicated in schedule.

E. Locations:

1. On accessible piping, whether insulated or not (including mechanical rooms, attic and ceiling spaces); except that labels shall be omitted from piping where contained material is obvious due to its connection to fixtures (such as faucets, water closets, etc.).
2. Near each valve and branch connection in such accessible piping.
3. At each pipe passage through wall or floor.
4. At not more than 20 feet spacing on straight pipe run between bands required in 2 and 3 above.
5. At each change in direction.

F. Application: Install on clean surfaces free of dust, grease, oil, or any material that will prevent proper adhesion. Replace non-adhering or curling labels with new labels, as required by the Project Inspector.

G. Schedule:

Content of Pipe	Legend	Backgro und Color	Lette ring Color
Steam	Steam	Yellow	Black
Steam condensate	Stm. Cond.	Yellow	Black
Chilled water supply	Chill water supply	Green	White
Chilled water return	Chill water return	Green	White
Instrument air	Inst. Air	Green	White
Heating hot water supply	Heating hot water supply	Yellow	Black
Heating hot water return	Heating hot water return	Yellow	Black
Air conditioning condensation drain	A/C condensate drain	Green	White

2.06 UNDERGROUND PIPE

A. Detectable Marking Tape:

1. Provide and install detectable marking tape along buried piping. Tape shall be specifically manufactured for marking and locating underground utilities with electronic equipment. Tape shall be acid and alkali resistant, and manufactured with integral wires or foil backing, encased with protective cladding. Tape shall be a minimum of two inches in width.
2. Manufacturer: Reef Industries, Inc., Advantage Brands, Inc., Northtown Company, Mutual Industries, Inc., or equal.
3. Detectable marking tape shall be color-coded per APWA Color Code:
 - a. Yellow: Steam.
 - b. Blue: Water.
 - c. Red: Electric power lines, cables, conduit and lighting cables. By Division 26.
 - d. Orange: Communication, alarm or signal cables. By Divisions 26 and 27.

B. Tracer Wire:

1. Solid copper wire type THWN, 12 AWG gage, with heat and moisture resistant insulation.

2.07 IDENTIFICATION OF AIR CONDITIONING EQUIPMENT

A. Provide identification markers to locate air conditioning equipment above T-bar ceilings. Install 3/4 inch to one inch diameter colored self-adhesive dots to T-bar ceiling grid indicating point of access. The following identification markers shall be recorded on the project record documents:

1. Fire Damper and Combination Fire/Smoke Fire Damper: Red.
2. Manual Volume Dampers, Relief Dampers, Motorized Volume Dampers: Blue.
 - a. Supply air: Full dot.
 - b. Return air: Half dot.
3. Fan coil unit: Green.
4. Filter Location if separate from fan coil: Yellow.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Correct detrimental conditions prior to commencing the Work of this Section. Install markers and identification tags as specified with materials and installation procedures recommended by manufacturer.
- B. Place tracer wire on top of non-metal utility lines allowing some slack. Do not wrap tracer wire around pipe. Fasten tracer wire in place at approximately 10 feet on centers with non-metal ties.
- C. Install underground detectable pipe marking tape continuously buried 8 to 10 inches above the buried utility pipe. Wrap tape on pipe risers up to a height of 12 inches above grade.

3.02 CLEANUP

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

END OF SECTION

SECTION 23 07 00 - HVAC INSULATION

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Condensate drain piping from air conditioning equipment.
2. Refrigerant piping.
3. Supply and return air ducts for heating and cooling systems air ducts.

B. Related Requirements:

1. Division 01: General Requirements.
2. Section 23 0500: Common Work Results for HVAC.
3. Section 23 0513: Basic HVAC Materials and Methods.
4. Section 23 0553: Mechanical Identification.
5. Section 23 3000: Air Distribution.
6. Section 23 8000: Heating, Ventilating and Air Conditioning Equipment.

1.02 REFERENCES

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

1. ASTM C167 - Standard Test Methods for Thickness and Density of Blanket or Batt Thermal Insulations.
2. ASTM C302 - Standard Test Method for Density and Dimensions of Preformed Pipe-Covering-Type Thermal Insulation.
3. ASTM C411 - Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
4. ASTM C423 - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
5. ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.
6. ASTM C534 - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
7. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation.
8. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.

9. ASTM C739 - Standard Specification for Cellulosic Fiber Loose-Fill Thermal Insulation.
 10. ASTM C1071 - Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material).
 11. ASTM C1104 - Standard Test Method for Determining the Water Vapor Sorption of Unfaced Mineral Fiber Insulation.
 12. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
 13. ASTM E795 - Standard Practices for Mounting Test Specimens During Sound Absorption Tests.
 14. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
- B. Underwriters Laboratories Inc.:
1. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors.
 2. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials.
- C. National Fire Protection Association:
1. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems .
 2. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.
 3. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.

1.03 SUBMITTALS

- A. Submit in accordance with Division 01 and Section 23 0500: Common Work Results for HVAC.
1. Complete material list of items to be furnished and installed under this Section.
 2. Manufacturer's specifications and other data required demonstrating compliance with the specified requirements.
 3. Shop Drawings, catalog cuts and manufacturer's data indicating insulation, jacketing, adhesives, and coating. Insulating materials shall be certified by manufacturer to comply with the California quality standards for insulating materials.
 4. Display sample cutaway sections.
 5. Manufacturer's recommended method of installation procedures, which will become part of this Section.

QUALITY ASSURANCE

- A. Qualifications of Manufacturer and Installer, Materials, Fabrication, Execution, and Standard of Quality: Comply with provisions stated under Section 23 0500: Common Work Results for HVAC and Section 23 0513: Basic HVAC Materials and Methods.
- B. Insulation Work shall be in accordance with the California Building Energy Efficiency Standards, CBC, and Uniform Mechanical Code.
- C. Test Ratings:
 - 1. Comply with provisions stated under Section 23 0500 and 23 0513 with emphasis on ASTM E84, NFPA 255, or UL 723. ASTM C167, ASTM C302, UL label or listing of satisfactory test results from the National Institute of Standards and Technology, or a satisfactory certified test report from an acceptable testing laboratory. Approval by the State Fire Marshal is required.
 - 2. Furnish labels, legibly printed with the name of the manufacturer or listings indicate that fire hazard ratings do not exceed those specified for materials proposed for installation. Flame spread index of not more than 25 and smoke developed rating not exceeding 50.
 - 3. Tests shall be performed on each item individually when insulation, vapor barrier covering, wrapping materials, or adhesives are installed separately at the Project site.
 - 4. Test insulation, vapor barrier covering, wrapping materials and adhesives as an assembly when they are factory composite systems.
- D. Regulatory Requirements: Insulation furnished and installed under this Section shall meet minimum legal requirements of the Building Energy Efficiency Standards adopted and incorporated in the California Energy Commission, Title 24, Part 2, Chapters 2 through 53, unless otherwise noted, for the piping, ductwork, and equipment.
- E. All chemically based products such as sealers, primers, fillers, adhesives, etc. must meet the California air quality regulations.

1.05 PRODUCT HANDLING

- A. Protection, Replacement, Delivery and Storage: Comply with provisions stated under Sections 23 0500: Common Work Results for HVAC and 23 0513: Basic HVAC Materials and Methods.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. General:
 - 1. Insulating material shall be fire resistant, non-corrosive, shall not break, settle, sag, pack or disintegrate under vibration, nor absorb more than 1 percent moisture by weight.
 - 2. Insulating material shall be furnished with thickness indicated in Table 1, and shall furnish thermal resistance in the range of R-4.0 to 4.6 in accordance with inch at 75

degrees F. For any other value of R, insulation thickness shall be calculated accordingly and submitted for review.

3. Asbestos in any quantity in insulating material is not permitted.
4. Provide insulation materials, adhesives, coatings, sealants, fitting covers, and other accessories with a fire hazard rating not to exceed 25 for flame spread, 25 for fuel contributed and 50 for smoke developed, except for materials listed as follows:
 - a. Nylon anchors for installing insulation to ducts or equipment.
 - b. Treated wood blocks.
5. Flame-proofing treatments subject to moisture damage are not permitted.

TABLE 1 - MINIMUM PIPING INSULATION THICKNESS (1)

Insulation Thickness Required (in inches)
 Space Heating Systems (Steam, Steam Condensate and Hot Water)

Piping System Type	Temp. Range (degrees F)	Run-outs up to 2 (2)	1 and less	1.25 to 2	2.5 to 4	5 to 6	8 and larger
Hi Pres Temp	Above 350	1.5	2.5	2.5	3.0	3.5	3.5
Med Pres Temp	251 to 305	1.5	2.0	2.5	2.5	3.5	3.5
Low Pres Temp	201 to 250	1.0	1.5	1.5	2.0	2.0	3.5
Hot Water	Up to 200	0.5	1.5	1.5	1.5	1.5	1.5
Steam Cond.	-	0.5	1.0	1.0	1.0	1.5	1.5
Service Water Heating Systems (recirculating, piping supply and return)							
Hot Water	Up to 180	0.5	1.0	1.0	1.5	1.5	1.5
Space Cooling Systems (Chilled water, Brine and Refrigerant)							
Chilled Water	40-60	0.5	0.5	0.75	1.0	1.0	1.0
Refrigerant/Brine	Below 40	1.0	1.0	1.5	1.5	1.5	1.5
Condensate Drain	1/2 inch Minimum insulation thickness.	0.5	0.5	0.5	0.5	0.5	0.5
From Air Conditioning Equipment:	Insulate condensate drain lines within building, in room, inside walls and above ceilings.	0.5	0.5	0.5	0.5	0.5	0.5

NOTES: (1) For piping exposed to ambient temperatures, increase thickness by 0.5 inch.

(2) Run-outs to individual terminal units, not exceeding 12 feet in length.

B. Lagging Adhesives: Shall be nonflammable and fire-resistant and shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E84. Insulation finished with canvas shall be provided with laps adhered in accordance to manufacturer's recommendation. A finish coat of same material shall be applied to entire outer surface of lagging cloth at coverage specified by manufacturer.

- C. Canvas Jackets: Furnish 6 ounce in accordance with square foot minimum, 48 by 48 thread count canvas jacketing.

- D. Insulation Jackets:
 - 1. Exterior insulation exposed to weather shall be weatherproofed with Childers aluminum jacketing as basis of design, or Pabco, RPR, or equal. Jacketing shall be manufactured from 1100, 3105 or 5010 aluminum alloy with 3/16 inch corrugations. Smooth or embossed jackets may be permitted in special situations to match an existing installation. Jacketing shall be furnished with an integrally bonded moisture barrier over entire surface in contact with insulation. A minimum thickness of 0.016 aluminum jacketing is to be provided on ducts and piping. A minimum thickness of 0.020 shall be provided on tanks, equipment, and heat exchangers.
 - 2. Insulated elbows, of 90 degrees and 45 degrees, with a nominal iron pipe size of ½ inch to 8 inches shall be provided with Childers aluminum Ell-Jacs insulation covers as basis of design, or Pabco, RPR, or equal, manufactured from 1100 aluminum alloy of 0.024 inch thickness. Insulated elbows with a nominal pipe size of 10 inches to 18 inches shall be provided with Childers 4-piece aluminum Ell-Jacs as basis of design, or Pabco, RPR, or equal.
 - 3. Tees, Flanges, and Valve Insulation in Conjunction with Aluminum Jacketing: Furnish Childers Aluminum Special Fabrications Insulation Covers as manufactured by Childers Products Company, Pabco, RPR, or equal.

- E. Adhesives: Adhesives shall be water based, UL Classified, meet the requirements of NFPA 90A and NFPA 90B, have been tested according to relevant ASTM requirements, and be acceptable to the State Fire Marshal. Name, type and method of installation shall be submitted for review.

- F. Valve and Fitting Cover: When installed in conjunction with PVC jacketing, furnish Zeston 25/50 rated polyvinyl chloride fitting covers as manufactured by Johns Manville, Knaf Insulation, Speedline, or equal.

2.02 SPACE HEATING PIPING SYSTEM

(Not Used)

2.03 COOLING PIPING SYSTEM INSULATION

- A. General: Insulate refrigerant piping.

- B. Materials:
 - 1. Classes of Insulation:
 - a. Class A: Expanded polystyrene pipe insulation, self-extinguishing type, either molded or extruded; Dow Chemical Co. STYROFOAM, ITW Insulation Systems XPS PIB, Foam-Control EPS, or equal.
 - b. Class B: Glass fiber molded pipe insulation ASTM C547. Pipe insulation shall be one piece, preformed, and provide a minimum R factor of 4 at 75 degrees F mean temperature. Insulation shall be faced with all-purpose fire retardant vapor barrier jacket. Pipe insulation shall be Johns Manville Micro-Lok, CertainTeed Snap-On, Owens Corning FIBERGLAS SSL II-ASJ, or equal.

- c. Class C: Expanded (foamed) urethane (polyurethane) or polyisocyanurate pipe insulation of self-extinguishing type molded or fabricated, Dyplast Products, LLC ISO-C1/2.0, ITW Trymer, Specialty Products & Insulation Co. Polyisocyanurate Pipe Insulation, Armacell Armalok, or equal.
 - d. Class D: Foamed plastic pipe insulation, self-extinguishing type, ASTM C534 Type 1 - tubular. Pipe insulation shall be one-piece preformed, flexible tubing type and provide a maximum K factor of 0.28 at 75 degrees F mean temperature. Pipe insulation shall be Armacell Armaflex, Aeroflex Aeroce, Rubatex INSUL-TUBE 180, or equal.
2. Locations and Class of Insulation Required: For thickness required, refer to Table 1 of this Section.

TABLE 3 – SERVICE, LOCATION AND CLASS OF INSULATION REQUIRED

<u>SERVICE</u>	<u>LOCATION</u>	<u>CLASS OF INSULATION</u>
Condensate drains from air conditioning equipment	Indoors at all locations including above ceilings and between stud walls	D
Refrigerant suction Liquid line as required	All locations except underground	D
All other piping, except underground	All locations except underground	A, B, C

3. Adhesives:
- a. Polystyrene adhesives: Synthetic rubber and resin adhesives specifically designed to adhere extruded and expanded rigid polystyrene and urethane insulation to themselves and to other porous and non-porous substrates.
 - b. Vapor barrier laps and penetrations: Furnish protective coating and lagging adhesive on butt joints of foil-faced vapor barriers, and where pins and staples puncture facings.

2.04 HIGH TEMPERATURE EQUIPMENT INSULATION
 (Not Used)

2.05 LOW TEMPERATURE EQUIPMENT INSULATION
 (Not Used)

2.06 DUCTWORK AND PLENUM INSULATION

- A. General: Insulate ductwork and plenums with not less than the amount of insulation tabulated in Table 4. Insulation may be omitted under the following conditions:
- 1. Exposed return air ductwork in conditioned space.
 - 2. Return air ductwork between wall studs inside an interior wall.

TABLE 4 - INSULATION OF DUCTS AND PLENUM

INSULATION TYPES

<u>Duct Location</u>	<u>Heating and Cooling</u>
On roof or exterior of building	L2
Attics, Garages, and Crawl Spaces	F-3 or L-2 See Note 3
In walls, within floor-ceiling spaces	F-1 or L-1 See Note 3
Hot and cold plenums	F-2 or L-2 See Note 3
Within unconditioned space or in basement	F-3 or L-2 See Note 3

B. Insulation Types:

1. F-1: 1 ½ inch blanket fiberglass, factory-laminated with all-service jacket vapor barrier.
2. F-2: 2 inch blanket fiberglass, factory-laminated with all-service jacket vapor barrier.
3. F-3: 3 inch blanket fiberglass, factory-laminated with all-service jacket vapor barrier.
4. L-1: 1 inch internal duct lining. Flexible type for ducts and rigid board for plenums.
5. L-2: 2 inch internal duct lining. Flexible type for ducts and rigid board for plenums. Duct joints shall be waterproofed.

C. Notes:

1. Minimum insulation provided shall be as required by the current California Administrative Code Title 24 for the most restrictive condition.
2. Refer to the materials indicated in this section for external insulation and internal lining.
3. External insulation shall be replaced with internal duct lining (of equivalent thermal resistance value unless noted otherwise) where indicated on the drawings or specified elsewhere for sound attenuation.
4. Provide internal duct lining (1 inch unless noted otherwise) where indicated on the drawings or specified elsewhere for sound attenuation.

D. Materials:

1. Fire-Resistive Insulation Materials and Coatings: Submit State Fire Marshal pre-approved materials only.
2. Adhesives: See Paragraph 2.01.E for applicable products.
3. External Insulation: Provide glass fiber blankets that are factory-laminated with Foil Reinforced Kraft (FRK) vapor barrier facing; Johns Manville Microlite, Owens-Corning SOFTR Duct Wrap, Knauf Insulation Friendly Feel Duct Wrap, or equal.

Provide a minimum installed R value as required by the CEC Building Energy Efficiency Standards; but not less than scheduled below:

TABLE 5
INSULATION OF DUCTS AND PLENUM INSTALLED
THERMAL RESISTANCE R VALUES

Type	Labeled Thickness	Installed R Value (hr.ft ² .°F/Btu)
F1	1 ½-inch"	4.2
F2	2-inch	5.6
F3	3-inch	8.3
L1	1-inch	4.2
L2	2-inch	8.3

4. Internal Lining: Acoustic duct liner and liner board, or equal; Johns Manville Permacote Linacoustic, Johns Manville Spiracoustic Plus, Owens Corning QuietR Rotary Duct Liner, or equal. Internal lining shall conform to:
 - a. Fire Safety Standards: NFPA 90A and 90B.
 - b. Operating Temperature: ASTM C411.
 - c. Air velocity: ASTM C1071, UL 181.
 - d. Fire Hazard Classification: ASTM E84, UL 723-Class 1, NFPA 255.
 - e. Corrosion Resistance: ASTM C739 and ASTM C665.
 - f. Fungi Resistance: ASTM G21.
 - g. Water Vapor Sorption: ASTM C1104, less than 1 percent by weight.
 - h. Formaldehyde, Phenolic Resins or other Volatile Organic Compounds: 0 percent.
 - i. Minimum R value as required by the latest edition of the California Energy Efficiency Standards, but not less than 4.0 at 75 degrees F.
 - j. Acoustical Performance: ASTM C423 & ASTM E795 Minimum NRC of 0.75 for interior spaces, minimum NRC of 0.90 for exposed to weather.
 - k. Hot and cold plenums separated by single partition: Minimum NRC of 0.75, both sides.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Except as specified herein, install material in accordance with recommendations of manufacturer. Do not install insulation materials until tests specified in other sections are completed. Remove foreign material such as rust, scale, or dirt. Surfaces shall be clean and dry. Maintain insulation clean and dry at all times.

- B. On cold surfaces where a vapor barrier must be provided and maintained, insulation shall be installed with a continuous, unbroken moisture and vapor seal. Hangers, supports, anchors, or other projections that are fastened to cold surfaces shall be insulated and vapor sealed to prevent condensation.
- C. Surface finishes shall be extended in such a manner as to protect raw edges, ends, and surfaces of insulation.
- D. Pipe or duct insulation shall be continuous through walls, ceiling or floor openings, or sleeves; except where fire-stop or fire-safing materials are required.
- E. Metal shields shall be installed between hangers or supports and the piping insulation. Rigid insulation inserts shall be installed between the pipe and the insulation shields. Inserts shall be of equal thickness to adjacent insulation and shall be vapor sealed accordingly.
- F. Insulation shall not be installed in the following locations unless otherwise noted:
 - 1. On vacuum return lines less than 50 feet long.
 - 2. On unions, flanged connections or valve handles.
 - 3. Over edges of any manhole, clean-out hole, clean-out plug, access door or opening to a fire damper, so as to restrict opening or identification of access.
 - 4. Over any label or stamp indicating make, approval, rating, inspection, or similar data, unless provision is made for identification and access to label or stamp.

3.02 INSTALLATION OF HEATING PIPING SYSTEM INSULATION

(Not Used)

3.03 INSTALLATION OF COOLING PIPING SYSTEM INSULATION

- A. General: Refrigerant piping and condensate drain lines, after having been tested, shall be cleaned and insulated.
- B. Application: Insulation on refrigerant suction lines and liquid lines, if indicated, and air conditioner interior drain lines shall be jacketed with fire-resistant vapor barrier of laminated aluminum foil consisting of 2 plies with glass-yarn reinforcing. Jacket joints shall be lapped and sealed with an approved adhesive. Insulation shall be secured with aluminum bands not less than 0.005 inch thick by 3/4 inches wide, spaced not over 12 inches on centers, or as recommended by manufacturer.
 - 1. Longitudinal Seams: Butt hinged sections of covering tightly together and seal down jacket flap with adhesive, or with factory-applied, self-sealing lap with pressure-sensitive sealer protected with release paper.
 - 2. End Joints: Wrap joint with a 3-inch wide (minimum) self-sealing tape.
 - 3. Fittings and Valves: Fittings and valves shall be covered with same material of same thickness as pipe insulation, sealed with an approved, vapor-sealing tape or compound and covered with Johns Manville Zeston polyvinyl-chloride cover, Knauf Insulation Proto PVC Fitting Cover, Speedline Polyco Smoke Safe, or equal.
 - 4. Pipe hangers shall be insulated or attached to pipe by an insulating insert, butted between adjoining insulation sections.

1. Exposed Indoor Insulation: Cover with 26 gage galvanized sheet metal jacket to 8 feet above floors, except in mechanical equipment rooms and accessible pipe tunnels.
2. Exposed Outdoor Insulation: In addition to canvas or fiberglass cloth cover, provide 0.016 inch thick aluminum jacket with one inch wide aluminum bands and seals. Install appropriate jackets on valves and fittings.

3.04 INSTALLATION OF HIGH TEMPERATURE EQUIPMENT INSULATION

(Not Used)

3.05 INSTALLATION OF LOW-TEMPERATURE EQUIPMENT INSULATION

(Not Used)

3.06 INSTALLATION OF DUCTWORK AND PLENUM INSULATION

A. External Covering:

1. Before installing duct insulation, sheet metal ducts shall be clean, dry, and tightly sealed at joints and seams.
2. Duct exterior insulation shall be firmly wrapped around ductwork with joints lapped a minimum of 2 inches. Insulation shall be securely fastened with 18 gage copper-lined steel wire, or 16 gage soft-annealed galvanized wire spaced approximately 12 inches on centers and at loose ends, presenting a neat and workmanlike appearance. Where duct width is such that wiring will not fasten insulation firmly against duct an adhesive shall be furnished to fasten insulation to duct with wiring being installed at ends of insulation segment.
3. Duct insulation in finished rooms shall be covered with wrapped fiberglass cloth cover. Install on each corner of duct 26 gage galvanized steel small nose, wide flange corner bead of appropriate height. In unfinished rooms, the insulation shall have a vinyl or similar coating. In all rooms, insulation shall be fastened to the ducts with an approved adhesive instead of wire. Corners shall be cut and formed instead of bending the insulating material. Raw edges shall be taped.
4. Insulation on ductwork transporting conditioned air, both supply and return, and outside air intake ducts shall be furnished with a factory-applied, fire-resistant vapor barrier.
5. Exposed Ducts or Plenum:
 - a. Install insulation to ducts or plenum furnished with butt joints, without voids and with adhesive over entire surface of duct. Cover insulation with canvas jacket, fastened tightly to insulation with lagging adhesive. Install 2 finish coats of undiluted adhesive.
 - b. When installing jacket, finished covering shall be even and level, without humps, with constant diameters on round ducts maintained.

- c. For non-lined insulated ducts or plenums exposed to weather: Insulation finish shall be 0.016 inch thick aluminum sheet with joints lapped not less than 3 inches, sealed, and secured with 6 gage by 3/8 inches aluminum sheet metal screws, or aluminum handgun-type rivets.

 - B. Lining General:
 - 1. Floors of cold plenums and fan enclosure plenums shall not be insulated.
 - 2. Cover short damper sections on lined ducts on outside to permit free operation of dampers and linkage.
 - 3. Dimensions of ducts indicated are net inside dimensions and must include thickness of duct liners to obtain the required duct size.
 - 4. Install insulation in square turns, where required, to cover interior surfaces before duct turns are installed.

 - C. Interior insulation (lining) of ducts shall be as specified in above.
 - 1. Liner material installed during fabrication of duct with sealed face only exposed to air stream. Insulation shall be fastened to sheet metal with an approved fire-retardant adhesive, with minimum 90 percent coverage and edges firmly adhered. Mechanical fasteners shall supplement the adhesive on top sections of ducts more than 12 inches wide and on sides of ducts more than 24 inches high, and shall be spaced on 16-inch centers maximum. Fastener posts shall be cut off approximately ¼ inch from metal disc.

 - D. Interior insulation in ducts or plenums shall not have exposed edges. Edges open to entering or leaving air streams shall be covered, secured in place and sealed with approved duct liner edge sealers.
- 3.07 CLEANUP
- A. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.
- 3.08 PROTECTION
- A. Protect the Work of this Section until Substantial Completion.

END OF SECTION

SECTION 23 08 00 - HVAC SYSTEMS COMMISSIONING

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. General requirements for Commissioning (Cx) of HVAC systems and equipment including installation, start-up, testing, documentation, and training according to the Construction Documents.
2. Standard procedures for the execution of commissioning work shall be in conformance with Division 01, Section 01 9113: General Commissioning Requirements. Coordinate work with the Commissioning Agent (CxA).

B. Related Requirements:

1. Division 01: General Requirements.
2. Section 01 4523: Testing and Inspection.
3. Section 01 4525: Testing, Adjusting, and Balancing for HVAC.
4. Section 01 7900: Maintenance and Operations Staff Demonstration and Training.
5. Section 01 9113: General Commissioning Requirements.
6. Section 23 0500: Common Work Results for HVAC.
7. Section 23 3000: Air Distribution.
8. Section 23 3813: Kitchen Ventilation System.
9. Section 23 8000: Heating, Ventilating and Air Conditioning Equipment.
10. Section 26 0500: Common Work Results for Electrical.
11. Section 26 0513: Basic Electrical Materials and Methods.
12. Section 26 0519: Low Voltage Wires (600 Volt AC).
13. Section 26 0526: Grounding and Bonding.
14. Section 26 0586: Motors and Drives.
15. Section 26 0800: Electrical Systems Commissioning.
16. Section 26 2913: Adjustable Frequency Drives.
17. Project Commissioning Plan (CxP).

1.02 REFERENCES

A. Applicable codes, standards, and references: inspections and tests shall be in accordance with the following applicable codes and standards:

1. InterNational Electrical Testing Association – NETA.
2. National Electrical Manufacturers Association – NEMA.
3. American Society for Testing and Materials – ASTM.
4. Institute of Electrical and Electronics Engineers – IEEE.

5. American National Standards Institute – ANSI.
6. National Electrical Safety Code – NESC.
7. California Building Code – CBC.
8. California Electrical Code – CEC.
9. California Mechanical Code – CMC.
10. Insulated Cables Engineers Association – ICEA.
11. Occupational Safety and Health Administration – OSHA.
12. National Institute of Standards and Technology – NIST.
13. National Fire Protection Association – NFPA.
14. American Society of Heating and Air-Conditioning Engineers – ASHRAE
(The HVAC Commissioning Process, ASHRAE Guideline).
15. Associated Air Balance Council – AABC (National Standards for Total System Balance).

1.03 SUBMITTALS

A. Submittals package shall include the following:

1. Commissioning required submittals in accordance with Division 01 Specification Sections.
2. Copy of the Architect's reviewed and accepted submittals to the CxA via the OAR.
3. List of team members who will represent the Contractor in the Pre-functional Equipment Checks (PEC) and Functional Performance Tests (FPT), at least six weeks prior to the start of Pre-functional Equipment Checks.
4. Detailed manufacturer installation and start-up, operating, troubleshooting and maintenance procedures, a copy of full details of Owner-contracted tests, full factory testing reports, if any, and Warranty information, including responsibilities of Owner to keep Warranty in force clearly defined.
5. Installation and checklist documentation shipped with equipment and field checklist forms to be used by factory or field technicians.
6. Detailed manufacturer's recommended procedures and schedules for PECs, supplemented by Contractor's specific procedures, and FPTs, at least four weeks prior to the start of PEC.

1.04 MEETINGS, SEQUENCING AND SCHEDULING

A. Meetings: Attend the Cx meetings as required under Section 01 9113 and Cx Plan.

B. Sequencing and Scheduling: The work described in this Section shall begin only after work required in related Divisions 23 and 26 Sections has been successfully completed and tests, inspection reports, and Operation and Maintenance manuals required have been submitted and accepted. The start-up and PEC shall be completed and submitted to the Owner at least two weeks prior to beginning FPT.

1. Coordinate HVAC work with the work of other trades prior to scheduling of any Cx procedures.

2. Coordinate the completion of HVAC testing, inspection, and calibration prior to start of Cx activities.

1.05 QUALITY CONTROL

- A. Comply with Division 01 quality control specifications.
- B. Incorporate manufacturer's recommended Cx procedures for the systems and equipment to be commissioned under this Section.
- C. Comply with Section 01 4525: Testing, Adjusting, and Balancing for HVAC.

1.06 EQUIPMENT AND SYSTEMS TO BE COMMISSIONED

- A. Split Systems.
- B. Make Up Air Units, with gas fired heat and evaporative cooling.
- C. Fan Coil Units.
- D. Single Package Gas Heating Electric Cooling Units.
- E. Variable Volume and Temperature System.
- F. Exhaust Fans.
- G. Ventilators.
- H. Pumps.
- I. Water Heaters, Gas and Electric.
- J. Air Conditioning Units.

PART 2 – PRODUCTS

2.01 TEST EQUIPMENT

- A. Equipment to be utilized in the commissioning process shall meet the following requirements:
 1. Provide test equipment as necessary for the testing of the equipment and systems to be commissioned.
 2. Provide testing equipment and accessories that are free of defects and certified for use.
 3. Provide testing equipment with current calibration labels as per NIST Standards.
 4. Equipment shall be calibrated on the manufacturer's recommended intervals with calibration tags affixed to the instrument. In the absence of calibration tags, calibration documentation shall be submitted to the CxA at least thirty days prior to use; this documentation shall include description and serial number of instrument and calibration data and date.
 5. Testing equipment shall be maintained in good operating condition for the duration of the project.

PART 3 – EXECUTION

3.01 COMMISSIONING PROCESS REQUIREMENTS

- A. Work to be performed prior to commissioning:

1. Complete phases of the work so the system(s) can be started, tested, adjusted, balanced, and otherwise commissioned.
 2. If modifications or corrections to the installed system(s) are required to bring the system(s) to acceptance levels due to Contractor's incorrect installation or defective materials, such modifications shall be made at no additional cost to the Owner.
 3. Normal start-up services required to bring each system into full operational state:
 - a. Testing, motor rotation check, control sequences of operation, full and part load performance.
 - b. Commissioning shall not start until each system is complete and start-up has been performed.
- B. Pre-Commissioning responsibilities:
1. Inspection, calibration and testing of the equipment required to commission the following systems:
 - a. HVAC System(s).
- C. Commissioning Process Requirements:
1. Refer to Section 01 9113: General Commissioning Requirements and related Sections for information on meetings, start-up plans, Pre-Functional and FPT, operations and maintenance data, training requirements, and other Cx activities.
- 3.02 PREPARATION
- A. Provide certified HVAC technicians as required, with tools and equipment necessary to perform Cx activities specified.
 - B. Provide certified testing agency personnel and equipment factory representatives as require in the Cx plan and other related Sections.
 - C. Verify that work required in this Section and in Section 01 9113 is complete prior to starting of FPT.
 - D. Verify that complete operational manuals have been reviewed and accepted by the CxA as specified before starting FPT.
- 3.03 TESTING
- A. Testing procedures shall include the following minimum information:
1. Test number.
 2. Equipment used for the test, with manufacturer and model number and date of last calibration.
 3. Date and time of the test.
 4. Indication of whether the record is for a first test or retest following correction of a problem or issue.
 5. Identification of the system, subsystem, assembly, or equipment.
 6. Conditions under which the test was conducted, including (as applicable); ambient conditions, set points, override conditions, status, and operating conditions that impact the results of the test.
 7. Systems and assemblies test results and performance and compliance with contract requirements.

8. Issue number, if any, generated as the result of the test.
9. Name(s) and signature(s) of witnesses and the person(s) performing the test.
- B. Contractor shall participate and perform Cx related testing requirements as specified.
- C. General Requirements for Mechanical, Controls, and Testing and Balance:
 1. Construction and Acceptance Phases:
 - a. Provide assistance to CxA in preparing FPT procedures specified. Sample test forms are include in the project Cx Plan.
 - b. Develop full startup and initial checkout plan using manufacturer's start-up procedures and Cx checklists for commissioned equipment. Submit to CxA for review and approval prior to startup.
 - c. During startup and initial checkout process, execute mechanical-related portions of PEC for the equipment and systems to be commissioned.
 - d. Perform and clearly document completed startup and system operational checkout procedure. Providing four copies of the results to the Owner.
 - e. Resolve any open punch list items before FPT. Air testing and balance shall be completed with discrepancies and problems remedied before FPT of respective air -related systems.
 - f. Provide skilled technicians to execute starting of equipment and to execute PFT. Ensure that technicians are available and present during agreed upon schedules and for sufficient duration to complete necessary tests, adjustments, and solutions to identified problems.
 - g. Maintain a log of events and issues of tests and related Cx activities. Submit handwritten reports of discrepancies, deficient or uncompleted work by others, contract interpretation requests, and lists of completed tests as specified.
 - h. Correct open issues and re-test as needed to prove compliance with system operational standards.
 - i. Prepare Operation and Maintenance Manuals and provide training for the Owner maintenance personnel and end-users per Section 01 7900.
 - j. Coordinate with equipment manufacturers to determine specific requirements to maintain validity of Warranty and notify the Owner.
 - k. Execute simulated seasonal FPT, witnessed by the Owner and the CxA, as specified. Document results and perform corrections as needed for system acceptance and make necessary adjustments to Maintenance and Operations Manuals and Record Drawings.

3.04 SENSOR CALIBRATION

- A. Field-installed temperature, relative humidity, CO₂, pressure sensors, pressure gages, and actuators (dampers and valves) shall be calibrated using the methods described below. Calibration procedures shall be documented during execution of the Start-up and the PEC. Alternate methods may be used, if approved by the CxA.
- B. Test instruments shall have had a NIST certified calibration within the last 12 months. Sensors installed in the unit at the factory with provided calibration certification need not be field calibrated.
- C. Sensors:

1. Verify that sensor locations are appropriate and away from causes of erratic operation.
2. Verify that sensors with shielded cable are grounded only at one end.
3. For sensor pairs that determine a temperature difference, make sure they are reading within 0.2 degrees F of each other.
4. For sensor pairs that determine a pressure difference, make sure they are reading within 2 percent of each other.
5. Calibration: Put the equipment in operation. Make a reading with a calibrated test instrument within six inches of the site sensor. Verify that the sensor reading (via the permanent thermostat or gage) is within the tolerance listed in the table below of the instrument-measured value. If not, calibrate or replace sensor.
6. Tolerances:

<u>Sensor</u>	<u>Required Tolerance (+/-)</u>
AHU wet bulb or dew point	2.0 degrees F
Outside air, space air, duct air temps	0.4 degrees F
Watt-hour, voltage, and amperage	1 percent of design
Pressures, air, water and gas	3 percent of sensor range (inc. design value)
Flow rates, air	10 percent of sensor range (inc. design value)
Flow rates, natural gas	5 percent of sensor range (inc. design value)
Relative humidity	4 percent
CO ₂ monitor	100 ppm
Sound level	5 db - Type 1 meter (Per Calibrator Mfg.)
Domestic Hot Water Temperature	1.5 degrees F
Domestic Hot Water Pressures Water and Gas	3 percent of sensor range (inc. design value)
Flow Rates, Domestic Water	4 percent of sensor range (inc. design value)
Flow Rates	5 percent of sensor range (inc. design value)

3.05 ADJUSTING

- A. Perform work required to rectify installations not meeting contract requirements at no additional cost to the Owner.
- B. Corrective work shall be completed in a timely manner to permit completion of the Cx process.
- C. If systems' Cx deadline, as defined in the Project Schedule, goes beyond the scheduled completion without resolution of the problem(s), the Owner reserves the right to obtain supplementary services or equipment to resolve the problem.

3.06 TRAINING

- A. Provide training plan for systems to be commissioned as required in applicable Division 23 specification sections and Section 01 7900.

END OF SECTION

SECTION 23 08 13 - ENVIRONMENTAL CONTROLS AND ENERGY MANAGEMENT SYSTEMS
COMMISSIONING

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. General requirements for the Commissioning (Cx) of the Environmental Controls and Energy Management System (ECEMS), and interfacing with other systems such as, lighting controls and HVAC systems interconnection, including installation, start-up, testing and documentation according to Construction Documents and Commissioning Plan (CxP).
2. Standard procedures for the execution of commissioning work shall be in conformance with Division 01, Section 01 9113: General Commissioning Requirements. Coordinate work with the Commissioning Agent (CxA).

B. Related Requirements:

1. Division 01: General Requirements.
2. Section 01 4523: Testing and Inspection.
3. Section 01 7700: Contract Closeout.
4. Section 01 7900: Maintenance and Operations Staff Demonstration and Training.
5. Section 01 9113: General Commissioning Requirements.
6. Section 23 0500: Common Work Results for HVAC.
7. Section 23 0513: Basic HVAC Materials and Methods.
8. Section 23 0800: HVAC Systems Commissioning.
9. Section 23 0900: Instrumentation and Controls.
10. Section 23 0923: Environmental Controls and Energy Management Systems.
11. Section 23 3000: Air Distribution.
12. Section 23 3818: Kitchen Ventilation System.
13. Section 23 8000: Heating, Ventilating and Air Conditioning Equipment.
14. Section 26 0500: Common Work Results for Electrical.
15. Section 26 0513: Basic Electrical Materials and Methods.
16. Section 26 0519: Low Voltage Wires (600 Volt AC).
17. Section 26 0526: Grounding and Bonding.
18. Section 26 0586: Motors and Drives.
19. Section 26 0800: Electrical Systems Commissioning.
20. Section 26 2419: Motor Control Centers and Motor Control Devices.
21. Section 26 2913: Adjustable Frequency Drives.
22. Project Commissioning Plan.

1.02 REFERENCES

A. The latest version of applicable codes, standards, and references: Inspections and tests shall be in accordance with the following applicable codes and standards, except as provided otherwise herein:

1. National Electrical Manufacturers Association – NEMA.
2. American Society for Testing and Materials – ASTM.
3. American National Standards Institute – ANSI.
4. California Electrical Code – CEC.
5. Occupational Safety and Health Administration – OSHA.
6. National Institute of Standards and Technology – NIST.
7. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE). – Building Management and Energy Management Systems Commissioning, ASHRAE Guideline.
8. California Building Code – CBC.
9. California Mechanical Code – CMC.
10. InterNational Electrical Testing Association (NETA) Acceptance Testing.

1.03 SUBMITTALS

A. Submittals shall include the following:

1. Required Cx submittals in accordance with Division 01 Specifications.
2. Copy of the Architect's reviewed and accepted submittals to the CxA via the OAR.
3. List of team members who will represent the Contractor in the Pre-functional and Functional Performance Testing, at least two weeks prior to the start of Pre-functional Equipment Checks.
4. Detailed manufacturer installation and start-up, operating, troubleshooting and maintenance procedures, checklist documentation and field checklist forms to be used by factory or field technicians, and a copy of full details of Owner-contracted tests, full factory testing reports, if any, and Warranty information, including responsibilities of Owner to keep Warranty in force, clearly defined.
5. Detailed manufacturer's recommended procedures and schedules for Pre-functional Equipment Checks, supplemented by Contractor's specific procedures, and Functional Performance Tests, at least four weeks prior to the start of Pre-functional Performance Tests.
6. System logic documentation and sequence of operations for review and approval.
7. Provide Level 1 passwords.
8. After facility's commission is complete, submit completed Pre-functional Equipment Checklists and Functional Performance Test checklists organized by system and by subsystem. Bind information in a single package. The results of failed tests shall be included along with a description of the corrective actions taken.

1.04 MEETINGS, SEQUENCING AND SCHEDULING

A. Meetings: Attend Cx meetings as required under Section 01 9113, any other related Sections and the CxP.

- B. Sequencing and Scheduling: The work described in this Section shall begin only after work required in related Division 23 and 26 Sections have been successfully completed, and tests, inspection reports and Operation & Maintenance manuals required have been submitted and reviewed. The start-up and Pre-functional Equipment Checklists shall be completed and submitted to the Owner's Authorized Representative (OAR) prior to the Functional Performance Tests.
1. Coordinate electrical work with the work of other trades prior to scheduling of any Cx procedures.
 2. Coordinate the completion of electrical testing, inspection, and calibration prior to start of Cx activities.
 3. Cx activities shall be scheduled in accordance with project's Section 01 9113 and Cx plan.

1.05 QUALITY CONTROL

- A. Comply with Owner's Quality Control Specifications.
- B. Incorporate manufacturer's recommended Cx procedures for the systems and equipment to be commissioned under this Section.
- C. Typical quality control procedures include but are not limited to the following:
1. Attend CxA progress and coordination meetings.
 2. Establish trend logs of system schedules as required in Section 23 0923.
 3. Demonstrate system operation and compliance with contract documents.
 4. Manipulate systems and equipment to facilitate testing.
 5. Provide instrumentation necessary for verification and performance testing.
- D. Provide ECEMS technician(s) to work at the direction of the CxA for software optimization assistance for a minimum of 8 hours. Refer to Part 3 for a description of the software optimization.
- E. Compensation for Retesting: Compensate Owner for site time necessitated by incompleteness of systems or equipment at time of Functional Performance Testing (FPT). Testing failures, which require on-site time for retesting, will be considered actual damages to the Owner. Parties under contract with the Owner who are affected by the retesting shall be included in the contract modification.
- F. Allow sufficient time before final commissioning dates to complete electrical testing, inspection, and calibration to avoid delays in the commissioning process.
- G. During the commissioning activities, provide labor and materials to make corrections when required, without undue delay.

1.06 COORDINATION

- A. Coordinate the completion of electrical testing, inspection, programming and calibration prior to start of commissioning activities.
- B. Coordinate factory field-testing per the requirements of this Section.
- C. Coordinate commissioning efforts with CxA prior to commencing any activities.

PART 2 – PRODUCTS

2.01 TEST EQUIPMENT

- A. Equipment to be used in the commissioning process shall meet the following requirements.

1. Provide test equipment as necessary for start-up and commissioning of the EMS system.
 2. Provide testing equipment and accessories that are free of defects and are certified for use.
 3. Provide testing equipment with current calibration labels as per NIST Standards; Equipment shall be calibrated on the manufacturer's recommended intervals with calibration tags affixed to the instrument. In the absence of calibration tags, calibration documentation shall be submitted to the CxA at least thirty days prior to use; this documentation shall include description and serial number of instrument and calibration date and time.
 4. Testing equipment shall be maintained in good operating condition for the duration of the project.
 5. Testing equipment shall be UL Listed.
- B. Instrumentation required to verify readings and test the system and equipment performance shall be provided by the Contractor and made available to CxA. Generally, no testing equipment will be required beyond that required to perform Contractor's work under contract documents.

2.02 TESTING AND AIR BALANCING AND COMMISSIONING

- A. Provide a portable operator's terminal or hand-held device to facilitate testing, adjusting, and calibration of controls. This device shall support functions and allow querying and editing of parameters required for proper calibration and start up.
- B. Connections shall be provided local to the device being calibrated. For instance, for VAV boxes, connection of the operator's terminal shall be either at the sensor or at the terminal box. Otherwise, a wireless system shall be provided to facilitate this local functionality.

PART 3 – EXECUTION

3.01 COMMISSIONING PROCESS REQUIREMENTS

- A. Work prior to commissioning:
 1. Complete phases of the work so the system(s) can be started, tested, adjusted, balanced, and otherwise commissioned.
 2. If contractual modifications are required to bring the system(s) to acceptance levels, such modifications shall be made at no additional cost to the owner.
 3. Normal start-up services required to bring each system into full operational state:
 - a. Testing, motor rotation check, control sequences of operation, full and part load performance.
 - b. Commissioning will not start until each system is complete and start-up has been performed.
- B. Pre-Commissioning responsibilities:
 1. Inspection, calibration and testing of the equipment required to commission the following systems:
 - a. Environmental Controls and Energy Management Systems.
 - b. Interface and connections of EMS system with lighting controls, electric utility meter, gas meter, photo voltaic system, or as otherwise indicated in contract documents.
- C. Commissioning Process Requirements:

1. Refer to Section 01 9113: General Commissioning Requirements and related Sections for information on meetings, start-up plans, Functional Performance Testing (FPT), operations and maintenance data, training requirements, and other Commissioning activities.

3.02 PREPARATION

- A. Provide certified EMS technicians as required, with tools and equipment necessary to perform Cx activities specified.
- B. Provide certified testing agency personnel and equipment factory representatives as required in the Cx plan and other related Sections.
- C. Verify that work required in this Section and in Section 01 9113 is complete prior to starting of FPT.
- D. Verify that complete operational manuals have been reviewed and accepted by the CxA as specified before starting FPT.

3.03 START-UP, TESTING, ADJUSTING, AND CALIBRATION

- A. Work or systems installed shall be fully functioning prior to Demonstration and Acceptance Phase. Start, test, adjust, and calibrate work as described below:
 1. Inspect the installation of devices. Review the manufacturer's installation instructions and validate that the device is installed in accordance with them.
 2. Verify proper electrical voltages and amperages, and verify that circuits are free from faults.
 3. Verify integrity/safety of electrical connections.
 4. For AHUs that use a throttled outside air damper position when minimum outside air is required, mark the minimum outside air damper position.
 5. Coordinate with testing and air balance (TAB) subcontractor to obtain, Cx and fine-tune control settings that are determined from balancing procedures. Record the following control settings as obtained from TAB Contractor, and note any TAB deficiencies in the ECEMS Start-up report:
 - a. Optimum duct static pressure setpoints for VAV air handling units.
 - b. Minimum outside air damper settings for air handling units.
 - c. Optimum differential pressure setpoints for variable speed pumping systems.
 - d. Calibration parameters for flow control devices such as VAV boxes and flow measuring stations.
 6. Test, calibrate, and set digital and analog sensing and actuating devices. Test equipment shall be 50 percent more accurate than the field device over the same range. Calibrate each instrumentation device by making a comparison between the ECEMS display and the reading at the device. (e.g., if field device is plus or minus 0.5 percent accurate, test equipment shall be plus or minus 0.25 percent accurate over the same range). Record the measured value and displayed value for each device in the ECEMS start-up report.
 7. Check and set zero and span adjustments for transducers and transmitters.
 8. Dampers and Valves:

- a. Check for adequate installation including free travel throughout range and adequate seal.
 - b. Where loops are sequenced, check for proper control with overlap.
9. Actuators:
 - a. Check to insure that device seals tightly when the appropriate signal is applied to the operator.
 - b. Check for appropriate fail position, and that the stroke and range is as required.
10. Check each digital control point by making a comparison between the control command at the central command unit and the status of the controlled device. Check each digital input point by making a comparison of the state of the sensing device and the ECEMS display. Record the results for each device in the ECEMS start-up report.
11. For outputs to reset other manufacturer's devices (for example, VSDs) and for feedback from them, calibrate ranges to establish proper parameters. Coordinate with representative of the respective manufacturer and obtain their approval of the installation.
12. Verify proper sequences by using the checklists to record results and submit with ECEMS start-up report. Verify proper sequence and operation of specified functions.
13. Verify that safety devices trip at appropriate conditions. Adjust setpoints accordingly.
14. Tune control loops to obtain the fastest stable response without hunting, offset or overshoot. Record tuning parameters and response test results for each control loop in the ECEMS start-up report. Except from a startup, maximum allowable variance from setpoint for controlled variables under normal load fluctuations shall be as follows. Within 3 minutes of any upset (for which the system has the capability to respond) in the control loop, tolerances shall be maintained (exceptions noted):
 - a. Duct air temperature: plus or minus 1 degree F.
 - b. Space temperature: plus or minus 2 degrees F.
 - c. Hot water temperature: plus or minus 3 degrees F
 - d. Duct pressure: plus or minus 0.25 inches w.g.
 - e. Water pressure: plus or minus 1 psid.
 - f. Air flow control: plus or minus 5 percent of setpoint velocity.
 - g. Space pressurization: plus or minus 0.05 inches w.g.
15. For interface and DDC control panels:
 - a. Ensure devices are properly installed with adequate clearance for maintenance and with clear labels in accordance with the record drawings.
 - b. Ensure that terminations are safe, secure and labeled in accordance with the record drawings.

- c. Check power supplies for proper voltage ranges and loading.
- d. Ensure that wiring and tubing are run in a neat and workman-like manner, either bound or enclosed in trough.
- e. Check for adequate signal strength on communication networks.
- f. Check for standalone performance of controllers by disconnecting the controller from the LAN. Verify that the controlling LAN reconfigures as specified in the event of a LAN disconnection.
- g. Ensure that outputs and devices fail to their proper positions/states.
- h. Ensure that buffered or volatile information is held through power outage.
- i. With system and communications operating normally, sample and record update/annunciation times for critical alarms fed from the panel to the Operator Interface.
- j. Check for adequate grounding of DDC panels and devices.

16. Operator Interfaces:

- a. Verify that elements on the graphics are functional and are properly bound to physical devices or virtual points, and that hot links or page jumps are functional and logical.
- b. Output specified ECEMS reports for review and approval.
- c. Verify that the alarm printing and logging is functional and per requirements.
- d. Verify that trends are archiving to disk and provide a sample to the CxA and owner for review.
- e. Verify that e-mail alarm annunciation is functional.
- f. Verify that functionality of remote operator interfaces.
- g. Verify that required third party software applications required with the bid are installed and are functional.
- h. Verify proper interface with fire alarm, lighting control system, photo voltaic system, gas and electrical meters.

- B. Submit start-up test report: Report shall be completed, submitted, and reviewed prior to Substantial Completion.

3.04 SENSOR CHECKOUT AND CALIBRATION

- A. General Checkout: Verify that sensor locations are appropriate and are away from causes of erratic operation. Verify that sensor with shielded cable are grounded only at one end.
- B. Calibration: Calibrate sensors using one of the following procedures:
 - 1. Sensors Without Transmitters – Standard Application: Make a reading with a calibrated test instrument within 6 inches of the site sensor at various points across the range. Verify that the sensor reading (via the permanent thermostat, gage, or ECEMS) is within the tolerances specified for the sensor. Where sensors are subject to wide variations in the sensed variable, calibrate sensor within the highest and lowest 20 percent for the expected range.

- C. Sensor Tolerance: Sensors shall be within the tolerances specified for the device.
- 3.05 COIL VALVE LEAK CHECK
- A. Verify proper close off of the valves. Ensure that valve seats properly by simulating the maximum anticipated pressure difference across the circuit. Calibrate air temperature sensor on each side of coil to be within 0.5 degrees F of each other. Via the Operator Interface, command the valve to close. Energize fans. After five minutes observe air temperature difference across coil. If a temperature difference is indicated, and the piping surface temperature entering the coil is within 3 degrees F of the water supply temperature, leakage is probably occurring. If it appears that it is occurring, close the isolation valve to the coil to ensure the conditions change. If they do, this validates that the valve is not closing. Remedy the condition by adjusting the stroke and range, increasing the actuator size/torque, replacing the seat, or replacing the valve as applicable.
- 3.06 VALVE STROKE SETUP AND CHECK
- A. For valve and actuator positions check, verify the actual position against the ECEMS display.
 - B. Set pumps to normal operating mode. Command valve closed, verify that valve is closed, and adjust output zero signal as required. Command valve open, verify position is full open and adjust output signal as required. Command the valve to various few intermediate positions. If actual valve position does not reasonably correspond, replace actuator.
- 3.07 ECEMS DEMONSTRATION
- A. Demonstrate the operation of the ECEMS hardware, software, and related components and systems to the satisfaction of the CxA and Owner. Schedule the demonstration with the Owner's representative two weeks in advance. Demonstration shall not be scheduled until hardware and software submittals and the start-up test report are reviewed. If the work fails to be demonstrated to conform with contract specifications, so as to require scheduling of additional site visits by the CxA and Owner's representative for re-demonstration, reimburse owner for reasonable local costs of subsequent CxA site visits as detailed elsewhere in these specifications.
 - B. Supply personnel and equipment for the demonstration, including, but not limited to, instruments, ladders, etcetera. Contractor-supplied personnel shall be competent with and knowledgeable of project-specific hardware, software, and the HVAC systems. Training documentation and submittals shall be at the job site.
 - C. Demonstration shall typically involve small representative samples of systems and equipment randomly selected by the owner and CxA.
 - D. The system shall be demonstrated following the same procedures used in the start-up test by using the Commissioning checklist. Demonstration shall include, but not necessarily be limited to, the following:
 - 1. Demonstrate that required software is installed on ECEMS workstations. Demonstrate that graphic screens, alarms, trends, and reports are installed as submitted. Demonstrate directory structure and file system matches that submitted.
 - 2. Demonstrate that points specified and shown can be interrogated or commanded (as applicable) from workstations, as specified, in less than the maximum response time.

3. Demonstrate correct calibration of input/output devices using the same methods specified for the start-up tests. A maximum of 10 percent of I/O points shall be selected at random by the CxA or owner for demonstration. Upon failure of any device to meet the specified end-to-end accuracy, an additional 10 percent of I/O points shall be selected at random by CxA for demonstration. This process shall be repeated until 100 percent of randomly selected I/O points have been demonstrated to meet specified end-to-end accuracy.
 4. Demonstrate that DDC and other software programs exist at respective field panels. The DDC programming and point database shall be as submitted.
 5. Demonstrate that DDC programs accomplish the specified sequences of operation including failure sequences.
 6. Demonstrate that the panels automatically recover from power failure, as specified. Demonstrate alarms as specified.
 7. Demonstrate that the stand-alone operation of panels meets the requirements of these Specifications. Demonstrate that the panels' response to LAN communication failures meets the requirements of these Specifications.
 8. Identify access to equipment selected by CxA or by the owner. Demonstrate that access is sufficient to perform required maintenance.
 9. Demonstrate that required trend graphs and trend logs are set up per the requirements. Provide a sample of the data archive. Indicate the file names and locations.
- E. ECEMS demonstration shall be completed and prior to Substantial Completion.
- F. Tests successfully completed during the demonstration will be recorded as passed for the Functional Performance Testing (FPT) and will not have to be retested.

3.08 RESOLUTION OF DEFICIENCIES

- A. Maladjustments, misapplied equipment, or deficient Contractors performance may result in additional work being required for Cx acceptance.
1. Perform work required to correct the installations not meeting contract requirements at no additional cost to the Owner.
- B. Corrective work shall be completed in a timely manner to permit completion of the Cx process.
1. Refer to Article 3.07 above, Section 01 9113, and Cx plan for retesting requirements necessary to achieve required system performance.
 2. If the system's Cx deadline, as defined in the CxP, goes beyond the scheduled completion of Cx without resolution of the problem, the Owner reserves the right to obtain supplementary services or equipment to resolve the problem.

3.09 ECEMS ACCEPTANCE PERIOD

- A. After approval of the ECEMS demonstration and prior to contract close-out acceptance phase shall commence. Acceptance period shall not be scheduled until HVAC systems are in operation and have been accepted, required cleaning and lubrication has been completed (i.e., filters changed, piping flushed, strainers cleaned, and the like), and Testing and Balancing report has been submitted and reviewed. Acceptance Period and its approval will be performed on a system-by-system basis if mutually agreed upon by the Contractor and the owner.
- B. Operational Test: At the beginning of the Acceptance Phase, the system shall operate properly for two weeks without malfunction, without alarm caused by control action or device failure, and with smooth and stable control of systems and equipment in

conformance with these specifications. At the end of the two weeks, forward the trend logs to the CxA for review and acceptance. CxA shall determine if the system is ready for Functional Performance Testing (FPT) and document any problems requiring Contractor attention.

1. If the systems are not ready for Functional Performance Testing (FPT), correct problems and provide notification to the owner's representative that problems have been corrected. The acceptance period shall be restarted at the mutually scheduled time for an additional one-week period. This process shall be repeated until CxA issues notice that the ECEMS is ready for Functional Performance Testing (FPT).
- C. During the acceptance period, maintain a hard copy log of alarms generated by the ECEMS. For each alarm received, diagnose the cause of the alarm, and list on the log for each alarm the diagnosed cause of the alarm, and the corrective action taken.
- 3.10 TREND LOGS
- A. Configure and analyze trends required under Section 23 0923.
- 3.11 TREND GRAPHS
- A. Trend graphs as specified in Section 23 0923 shall generally be used during the acceptance phase to facilitate and document testing. Prepare controller and workstation software to display graphical format trends during the acceptance period. Trend graphs shall demonstrate compliance with contract documents.
- B. Each graph shall be clearly labeled with HVAC subsystem title, date, and times.
- 3.12 WARRANTY PHASE
- A. Trending: Throughout the Warranty phase, trend logs shall be maintained as required for the acceptance period. Forward archive trend logs to the CxA and Owner for review. CxA or Owner will review these and notify Contractor of Warranty work required.
- 3.13 SOFTWARE OPTIMIZATION ASSISTANCE
- A. Provide the services of an ECEMS technician at the project site to be at the disposal of the CxA and Owner. The technician is to make changes, enhancements, and additions to control unit or workstation software that has been identified by the CxA or Owner during the Construction and Commissioning of the project and that are beyond the specified contract requirements. The cost for this service to include a total of 40 hour will be included with the bid. Request for assistance shall be for contiguous or non-contiguous 8 hour days, unless otherwise mutually agreed upon by the Contractor, CxA, and OAR. The Owner Authorized Representative (OAR) shall notify Contractor two days in advance of each day of requested assistance.
- B. The ECEMS technician provided shall be trained in the programming and operation of the controller and workstation software. If the ECEMS technician provided cannot perform every software task requested by the CxA or Owner in a timely fashion, provide additional qualified personnel at the project site as requested by the CxA or Owner.

END OF SECTION

SECTION 23 09 00 - HVAC INSTRUMENTATION AND CONTROLS

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes: Temperature controls for air conditioning, heating, and ventilating systems as indicated. Work includes, but is not be limited to, the following:
1. Automatic control valves and automatically operated dampers.
 2. Pneumatic or electric relays (magnetic starters excluded), electric or mechanical linkages, duct sensors, thermostats, dampers and motorized valves, and appurtenances and accessories.
 3. Wiring outlet boxes and conduits for control systems, including wiring to connect magnetic starters to control systems.
 4. Air compressor and receiver tank for pneumatic control systems, with appurtenances and air piping, including pressure regulator, automatic moisture eliminators, air line filters, relief valves, pressure gages and shut-off valves, drains, pneumatic piping distribution to control equipment, etcetera.
 5. Testing and adjusting temperature control system.
 6. Furnishing record drawings and operational data of systems as installed and finally adjusted.
 7. Formal instruction of Owner personnel in operation of equipment.
- B. Following items are specified in other Sections:
1. Magnetic starters, contacts, power relays and variable resistors or controllers for motors, and other electrical devices.
 2. Load carrying wiring for above listed devices and wiring for starting switches not interconnected with temperature control system. (Division 26: Electrical).
 3. Electrical power to control panels and other equipment. (Division 26: Electrical).
 4. Installing automatic valves in pipelines.
 5. Installing automatic dampers.
 6. Automatic controls and valves not connected with comfort heating, ventilating, and air conditioning systems.
 7. Packaged self contained equipment specified complete with temperature controls.
 8. DDC control equipment specified in Section 23 0923: Environmental Control and Energy Management Systems.

- C. Related Requirements:
 - 1. Division 01: General Requirements.
 - 2. Division 26: Electrical.
 - 3. Section 23 0500: Common Work Results for HVAC.
 - 4. Section 23 0513: Basic HVAC Materials and Methods.
 - 5. Section 23 0800: HVAC Systems Commissioning.
 - 6. Section 23 0923: Environmental Control and Energy Management Systems.
 - 8. Section 23 3000: Air Distribution.
 - 9. Section 23 3813: Kitchen Ventilation System.
 - 10. Section 23 8000: Heating, Ventilating and Air Conditioning Equipment.

1.02 SUBMITTALS

- A. Provide in accordance with Division 01 and Section 23 0500: Common Work Results for HVAC.
 - 1. Complete list of items proposed to be furnished and installed under this Section.
 - 2. Manufacturer's specifications and other data required to demonstrate compliance with specified requirements.
 - 3. Manufacturer's printed installation procedures.
- B. Shop Drawings: Provide Shop Drawings, in the same size as the Drawings, prepared, signed and sealed by a mechanical engineer licensed in the State of California. Shop Drawings shall indicate temperature control diagrams, complete with equipment appurtenances required for system. Include sequence of operation description for each system. Submit in accordance with of Division 01.
- C. Sequence of Operation: Provide complete, detailed, step-by-step sequence of operation for each item of equipment.
- D. Operating Instructions: Comply with provisions of Section 23 0500: Common Work Results for HVAC. Explain and demonstrate operation of system to Owner representatives as required.
- E. Guarantee: Refer to Section 23 0500: Common Work Results for HVAC.

1.03 QUALITY ASSURANCE

- A. Manufacturer and Installer Qualifications: Comply with provisions stated under Section 23 0500: Common Work Results for HVAC.

1.04 PRODUCT HANDLING

- A. Production, Replacement, Delivery and Storage: Refer to Section 23 0500: Common Work Results for HVAC and Section 23 0513: Basic HVAC Materials and Methods.

PART 2 – PRODUCTS

2.01 TEMPERATURE CONTROLS

- A. Provide temperature controls of pneumatic, electric, electronic microprocessor - DDC type, or a combination thereof, as indicated on Drawings, to provide required sequences or operational control.

2.02 MANUFACTURERS

- A. Equipment in system shall be of same manufacturer or their standard furnished items. Testing, initial start-up, and adjusting of control system shall be under continuous observation of the mechanical engineer responsible for Shop Drawing preparation.
- B. Electronic, or direct digital microprocessor based control equipment shall be one of following manufacturers, unless otherwise noted:
 - 1. Honeywell, Inc.
 - 2. Johnson Controls, Inc.
 - 3. Invensys.
 - 4. Equal.

2.03 PNEUMATIC EQUIPMENT AND ACCESSORIES

(Not Used)

2.04 ELECTRIC EQUIPMENT AND ACCESSORIES

- A. Electric control equipment and accessories include, but are not limited to, the following:
 - 1. Electric control devices as indicated on Drawings and described herein, including thermostats, temperature controllers, valve and damper operators, switches, relays, and control panels for instruments as required to provide a complete and operable system.
 - 2. Wiring and conduit, unless otherwise noted, or control systems including wiring required, to connect magnetic starters, specified in other sections, to control systems.
- B. Room Thermostats:
 - 1. Thermostats for unitary air conditioning units shall be as specified in Section 23 8000: Heating, Ventilating and Air Conditioning Equipment. Thermostats located on outside walls shall be installed on insulated backplates or as specified by unit manufacturer.

2. Provide the following room thermostats for each specific application as follows, where manufacturer's thermostats are not specified in Section 23 8000:
 - a. Honeywell, Johnson Controls, Invensys, or equal, for heating only; Honeywell, Johnson Controls, Invensys, or equal, for cooling only.
 - b. Honeywell, Johnson Controls, Invensys, or equal, microelectronic commercial thermostat with sub-base for electronic control of 18 to 30 VAC single zone HVAC equipment. Thermostat is either stand alone, or arranged in a temperature averaging network consisting of 2, 3, 4, 5, or 9 sensors for corresponding rooms or zones.
 - c. Honeywell, Johnson Controls, Invensys, or equal, proportional thermostat, low-voltage, 3-wire controller for valve, damper motors and balancing relays. Unit manufacturer may specify or recommend optional thermostat.
 - d. Provide tamper-proof locking thermostat guards for items specified above. Covers shall be opaque beige plastic in student occupied areas, clear plastic cover in administrative areas. Provide Honeywell, Johnson Controls, Invensys, or equal, universal thermostat guards or as recommended by thermostat manufacturer.
- C. Duct-Mounted Thermostats: Duct-mounted thermostats shall be modulating or 2-position as required to accomplish sequence of operation.
- D. Valve and Damper Motors: Damper motors shall be furnished with oil-immersed gear trains and ample capacity to handle required loads under normal operating conditions. Where indicated, spring return type motors are to be provided. Valve motors to be 2-position or proportional, spring return or now spring return.
- E. Time Clocks:
 1. TC-1: Time clock shall be solid-state digital electronic type capable of 28 on/off set points to be distributed through the week, complete with a day repeat feature, time and set points to be adjustable to nearest minute with a minimum on duration of one minute and a maximum of 7 days. UL Listed, enclosed in standard case NEMA Type 1, Intermatic, Tork, Paragon, or equal, with battery operated carry-over.
 2. TC-2: Interval timer (bypass), except for window units, shall be manually set and spring operated type, 0 to 6 hours, and without hold feature. Provide Intermatic, M.H. Rhodes, Paragon, or equal.
 3. TC-3: Bypass timer for window type air conditioner units shall be DPDT switch configuration, 12 hours, and without hold feature. Provide M.H. Rhodes, Intermatic, Tork, or equal. Provide double gang box as specified in Division 26: Electrical.
- F. Wiring: Wiring in connection with control systems regardless of voltage, except power supply circuits, is part of the Work of this Section. Wiring shall comply with Division 26: Electrical.
- G. See Section 23 0923 for DDC/Electronic controls.

PART 3 – EXECUTION

3.01 TEMPERATURE CONTROL SYSTEM INSTALLATION

- A. Control system shall be installed in accordance with control manufacturer's instructions and reviewed Shop Drawings.

3.02 PNEUMATIC SYSTEM

(Not Used)

3.03 CONTROL PANELS OR CABINETS

- A. Switches, clocks, temperature control instruments, and remote bulb thermometers, whose capillary tubes are less than 25 feet in length, shall be mounted in control panels with required wiring, piping, and tubing behind panel. Control panels shall be galvanized steel sheet metal, with light gray hammertone enamel finish, not lighter than 14 gage. Control panels shall be UL Listed. Panels shall be attached to wall at locations indicated, or as required. Adjustable apparatus shall be provided with P-Touch, or equal, labels to indicate function. A clear space of 30 inches in front shall be maintained.
- B. Control cabinets shall be provided with door locks. Door locks shall be the flush type, latched, 5/8 inch for metal door, keyed to a Corbin Cat. No. 60 key. Cabinet shall be prime coated and finish painted as specified in Section 09 9000: Painting and Coating. Cabinet shall be flush mounted.

3.04 ROOM THERMOSTAT

- A. Room thermostats shall be wall mounted at a height of approximately 4 feet. Room thermostats are not permitted on outside walls, at marker boards, between shelving, in recesses or above heat producing equipment. Units shall be installed as close to edge of tack board as possible. Room thermostats shall be furnished with tamperproof cover. Thermostats shall be furnished with set point windows and integral thermometers. Office thermostats shall be furnished with extended adjustment knobs; others shall have key adjustments. Room thermostats shall be furnished with non-switching sub-bases.

3.05 COORDINATION

- A. Coordinate this Work with other aspects of system balancing to obtain a complete operating mechanical system in accordance with design intent, including coordinating with balancing of the system.
- B. Coordinate this Work with all aspects of alarm, fire alarm, and smoke detector, specified in Division 26: Electrical.

3.06 SEQUENCE OF OPERATION

- A. Each system, pneumatic, electric, electronic, or direct digital control shall operate as graphically and described on Drawings and in accordance with reviewed sequence of operation.

3.07 CONTROL SYSTEM ADJUSTMENTS

- A. Perform adjustments under operating conditions to provide sequence of operation for controls indicated. If required operating conditions cannot be obtained before Substantial Completion, due to outdoor seasonal temperatures, return to the Project site when requested by the Owner and readjust control system when outdoor temperatures will permit proper operating conditions. Start readjustment within seven calendar days after notification. Final settings of controls and pressure ranges indicated by gages shall be indicated on project record documents.

3.08 RUNNING TIME METERS

(Not Used)

3.09 PROTECTION

- A. Protect the Work of this Section until Substantial Completion.

3.10 CLEANUP

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

END OF SECTION

SECTION 23 09 23 - ENVIRONMENTAL CONTROLS AND ENERGY MANAGEMENT SYSTEMS

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes: Environmental controls and energy management systems, including equipment, materials, installation, start-up, testing, documentation and training according to construction documents. The project drawings establish the scope of HVAC controls work in conjunction with the scope of work indicated in Section 23 0900: HVAC Instrumentation and Controls. This Section complements the requirements of Section 23 0900, and construction drawings for controls and system communications.
- B. Related Requirements:
1. Division 01: General Requirements.
 2. Section 01 4523: Testing and Inspection.
 3. Section 01 7900: Maintenance and Operations Staff Demonstration and Training.
 4. Section 01 9113: General Commissioning Requirements.
 5. Section 21 1313: Fire-Suppression Sprinkler Systems.
 6. Section 23 0500: Common Work Results for HVAC.
 7. Section 23 0513: Basic HVAC Materials and Methods.
 8. Section 23 0800: HVAC Systems Commissioning.
 9. Section 23 0813: Environmental Controls and Energy Management Systems Commissioning.
 10. Section 23 3000: Air Distribution.
 11. Section 23 3813: Kitchen Ventilation System.
 12. Section 23 8000: Heating, Ventilating and Air Conditioning Equipment.
 13. Section 26 0500: Common Work Results for Electrical.
 14. Section 26 0513: Basic Electrical Materials and Methods.
 15. Section 26 0519: Low-Voltage Wires (600 Volt AC).
 16. Section 26 0526: Grounding and Bonding.
 17. Section 26 0923: Lighting Control Systems.
 18. Project Commissioning Plan (CxP).

1.02 REFERENCES

A. The latest version of applicable codes, standards, and references. Inspections and tests shall be in accordance with the following applicable codes and standards, except as provided otherwise herein.

1. International Electrical Testing Association – NETA.
2. National Electrical Manufacturers Association – NEMA.
3. American Society for Testing and Materials – ASTM.
4. Institute of Electrical and Electronics Engineers – IEEE.
5. American National Standards Institute – ANSI.
6. National Electrical Safety Code – NESC.
7. California Building Code – CBC.
8. California Electrical Code – CEC.
9. California Mechanical Code – CMC.
10. Insulated Cables Engineers Association – ICEA.
11. Occupational Safety and Health Administration – OSHA.
12. National Institute of Standards and Technology – NIST.
13. National Fire Protection Association – NFPA.
14. American Society of Heating, Refrigerating, and Air-Conditioning Engineers – ASHRAE
(The HVAC Commissioning Process, ASHRAE Guideline).
15. International Building Code – IBC.
16. International Mechanical Code – IMC.
17. InterNational Electrical Testing Association (NETA) Acceptance Testing.

1.03 SUBMITTALS

- A. Provide in accordance with Division 01 and Section 23 0500: Common Work Results for HVAC.
- B. Shop Drawings shall include but not limited to:
1. Cover page with legend, common notes, symbol schedule, and drawing index.
 2. Complete point to point environmental controls and energy management network communication diagram(s) for Distributed Digital Controls (DDC) of each system:
 - a. Identify all components.
 - b. Indicate conduit and wire characteristics, sizes and quantities.

- c. Provide bill of materials.
3. Floor plans showing control panels and intercommunication wiring.
 - a. Show system(s) interface connections.
4. Valve Schedules where required.
5. Operations and Maintenance Manuals.
6. As-built submittal drawings.
7. Installation Instructions of each control device.
8. PC Workstation.
9. Software flow diagram of each unique system sequence of operation.
10. Software licenses and electronic keys.
11. Supplemental local or factory training schedule for post warranty support.
12. A complete list of recommended spare parts with pricing for the Owner's use in keeping the environmental control system downtime to a minimum.
13. Composite CD-ROM with AutoCAD drawings in a ".dwg" format.

1.04 QUALITY CONTROL

- A. Contractor shall have adequate experience installing systems of similar size and complexity with the control product line proposed for this project.
 1. Qualifications of Installer: Minimum five years experience installing products and systems of similar scope and complexity.
 2. Installer shall submit certification from the equipment manufacturer indicating that installer is an authorized representative of the equipment manufacturer and is trained on network applications.
 3. Installer shall maintain a fully equipped service organization capable of furnishing repair service to the equipment and shall maintain a spare set of major parts for the system at all times.
 4. Installer shall furnish a letter from manufacturer of equipment certifying equipment has been installed according to factory standards and that system is operating properly.
 5. Contractor shall have completed and commissioned a minimum of 10 service agreements that provide similar support services to those needed for this project.
 6. System startup and testing shall be performed under the direct observation of the Project Inspector and OAR.
- B. Materials and equipment installed shall be new.

- C. System installation shall not begin until Shop Drawings are submitted and reviewed by the Architect or Engineer of Record.
- D. Components for Direct Digital Control (DDC) shall comply with ASHRAE standards.
- E. The installer shall provide the system components required by code and for the life safety of the service personnel.
- F. System shall be able to interface with open protocol BACnet systems.
- G. Provide components required by code for the system to perform the required sequence of operations. Install, test and adjust the system accordingly.
- H. System components shall operate per industry standards. The standards shall be as defined by ASHRAE, SMACNA, AABC, NEBB, TABB, and the literature of the manufacturers listed in this Section.
- I. Provide Field Engineering Tools for user modification of the system.

1.05 WARRANTY

- A. Components, system software, and parts shall be guaranteed against defects in materials, fabrication, and execution for three years from date of system acceptance. Provide labor and materials to repair, reprogram, or replace components at no charge to the Owner during the warranty period. Corrective software modifications shall be updated on user documentation and archived software disks.
- B. The Installer shall provide one year labor warranty.
- C. Provide a list of applicable warranties for equipment and components, this list shall include warranty information, names, addresses, telephone numbers, and procedures for filing a claim and obtaining warranty services.
- D. Respond to the Owner's request for warranty service within four hours during normal business hours. Submit records of the nature of the call, the work performed, and the parts replaced or service rendered.

1.06 TRAINING

- A. Provide a competent instructor who is factory trained and has comprehensive knowledge of system components and operations to provide full instructions to designated personnel in the system operation, maintenance, and programming. Training shall be specifically oriented to installed equipment and systems.
 - 1. Provide four hours of onsite owner familiarization and training for the installed system. Training shall include system overview, time schedules, override commands, emergency operation, and programming and report generation. Owner employees attending this training session shall be provided with the following documentation:
 - a. System layout point to point connection diagram.
 - b. System components cut sheets.
 - c. Operations and maintenance data.

2. Programmer and maintenance training shall include database entry; trend logs application programs, diagnostic routines, reporting, failure recovery and calibration.
 - a. Provide a 16 hours training session as follows:
 - 1) Training session shall accommodate a minimum of 20 personnel and be facilitated at a location no more than 50 miles from the Project Site. Obtain Owner's approval for training locations exceeding 50 miles. In such cases, the Contractor shall be responsible for transportation expenses.
 - 2) Training shall cover instruction, theory, and expose the trainees to system's features, components, architecture, operations, programming, report generation, communications, and any other pertinent information required for the operations and maintenance of the system.
 - 3) Instructor(s) shall give the trainees the opportunity to practice on a simulated or actual (installed) system.
 - 4) The training session shall cover, but not be limited to the following instruction modules or sessions:
 - a) System Architecture:
 - (1) System layout and components interrelations and hierarchical structure.
 - (2) Controllers interfacing and functions.
 - (3) Server functionality and data management, error messages, and alarm conditions.
 - (4) Connectivity and communication losses.
 - b) User Operations:
 - (1) Familiarization and navigation with the EMS operating System.
 - (2) Window panes, menus, navigation buttons, alarm response windows, system passwords and accessibility features and options, monitoring and managing data points (inputs, outputs, numeric values, time and date, strings).
 - (3) Views: Provide sufficient information as to train staff on how and where to access programs, functions, adjust or alter diagnostic points and related data, override messages, reports and actions taken.
 - c) Trending: Setting trend(s) intervals, accessing data trends and history logs for diagnosis points or groups, and reporting. Working with trended data graphical

displays, including but not limited to hiding points, setting display types and colors, viewing and setting scales.

- d) Graphics: Standard symbols and color codes, graphics customization, how and where to access and manage the system with the graphic displays, including changing points and values, using HOA switches and viewing results, mapping to or with other graphic sources and functions, including groups, navigation, sequence of operations, and displays and reports.
- e) Alarms: Reading and interpreting alarms, acknowledging and silencing alarms, routing and setting priorities, viewing and responding e-mailed and paged alarms.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Environmental controls and energy management systems shall be approved products of Alerton, Automated Logic, Honeywell, Johnson Controls, TAC, Trane, Carrier, or equal.

2.02 SYSTEM ARCHITECTURE

- A. The system shall be capable of providing a peer-to-peer network of distributed stand-alone DDC controllers that meet ANSI/ASHRAE Standard 135 for open protocol communications.
- B. The primary network communications bus for DDC systems shall be industry standard Ethernet protocol operating at 100MBPS. Secondary bus configuration shall be MS/TP with a minimum speed of 38Kb. A maximum of 32 controllers shall be connected to any one MS/TP bus.
- C. The supplied computer software shall employ object-oriented technology (OOT) for representation of data and control devices within the system. For each global, system or unitary controller, provide a PICS document showing the installed device's compliance level. Minimum compliance is Level 3 with the ability to support data read and write functionality.
- D. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed three seconds for network connected controllers or user interfaces.
- E. Projects requiring standalone controls shall not include workstations or DDC network controllers.
- F. The system shall be able to interface with subsystems that utilize ANSI/CEA-709.1: Control Network Protocol Specification.

2.03 USER INTERFACE WORKSTATION

- A. The Operator Workstation shall include a computer with an Intel processor, keyboard, mouse, 24 inch LCD color display and the latest version of Microsoft Windows operating system software. The workstation shall connect to the network through an internal 10/100MBPS Ethernet interface card. Provide a Graphical User Interface (GUI) application program for intuitive operation of the network system.

- B. Software licensing shall be provided for local or remote unlimited simultaneous users of the system, unlimited future point expansion, user graphical display generation and non-vendor controllers. Licenses and electronic keys shall be included with the M&O manuals for project acceptance. Conditional Licenses will not be acceptable.
- C. The system shall be programmed to email selected alarms to designated response personnel.
- D. Provide a Web Server to automatically convert system displays on the workstation to an Internet page readable from standard PC browsers. The server shall be a separate device to provide security protection for the building system from outside hackers.
 - 1. Coordinate individual system components IP addresses, switch port assignments, security settings such as but not limited to SNMP alarm delivery, HTTPS/SSL settings, VLAN assignment and authorized IP address ranges with the Owner's Information Technology Division. Coordination activities with ITD shall be executed through the OAR.
 - 2. Provide IP address label on the interior of each cabinet door or equipment.
 - 3. The system shall support the ability to notify school or Owner designated personnel by SMS or Email messages, utilizing the Owner's mail server when problems or situations that require immediate attention arise.
- E. Operator Workstation shall display data associated with the project as called out on drawings or object type list supplied. Graphic files shall be created using digital, full color photographs of system installation, AutoCAD or Visio drawing files of field installation drawings and wiring diagrams from as-built drawings. Operator's workstation shall display data using three-dimensional graphic representations of mechanical equipment. System shall be capable of displaying graphic files, text, trend data and dynamic object data together on each display screen with animation of equipment operation.
- F. Controllers shall be programmed using graphical software tools that allow connection of function blocks for visual sequencing of control logic. Function blocks shall display real time data and be animated to show status of data inputs and outputs when in real time operation. Animation shall also show change of status on logic devices and countdown of timer devices in a graphical format.
- G. Operator Tracking Log shall record operator changes to the system for future review. This shall include, but not be limited to setpoint changes, time schedule overrides, alarm limits, etc.
- H. The system shall be equipped with a battery back-up source capable of providing 30 minutes of operation (computer and monitor) in the absence of normal power, to allow for an orderly shut down and data back-up.

2.04 GLOBAL CONTROLLER

- A. Building controllers shall incorporate the functions of a 3-way BACnet router. Controller shall route BACnet messages between the high-speed LAN (Ethernet 100MHz), master slave token passing (MS/TP) LANs, a point-to-point (PTP/RS-232) connection and telephone modem.
- B. Provide global control strategies for the system based on information from any point objects in the system. Programming shall be object-oriented using graphical control function blocks. Global strategies shall include, but not limited to unit scheduling, electrical demand limiting, optimized start-stop of equipment, central plan reset control, etc.

- C. Battery shall retain static RAM memory and real-time clock functions for a minimum of 1.5 years (cumulative). Battery shall provide up to five minutes of powerless operation for orderly shutdown and data backup.
- D. Each building controller shall support a minimum of 250 BACnet Schedule Objects and 250 BACnet Calendar Objects.
- E. Each building controller shall log a minimum 1,000 trend logs. Any point object in the system (real or calculated) may be logged. Sample time interval shall be adjustable at the operator's workstation. Building controller shall periodically upload trended data to networked operator's workstation for long term archiving if desired. Archived data shall be available for use in third-party spreadsheet or database programs.
- F. Alarms may be generated within the system for any object change of value or state either real or calculated. This includes events such as analog object value changes, binary object state changes and various controller communication failures. Each alarm may be automatically dialed out to a telephone pager or emailed to any Internet PC computer.
- G. Provide a 1.5 KVA UPS with battery back-up capability to provide a minimum of 30 minutes of operation (computer and monitor) for orderly shutdown and data backup. Make connections and test the system for proper operation in the presence of the Project Inspector.
- H. The global controller shall be equipped with electrical demand limiting capacity interface features capable of receiving KW demand pulse signals from the facility utility meter.
 - 1. The system shall include a demand-limiting program with at least two types of load shedding. The following options shall be available:
 - a. Shed/Restore equipment in digital format. It shall include at least 5 priority levels of equipment shedding. Load shedding on a given priority level shall include two methods. In one the loads shall be shed and restored in a "first-off/first-on" mode and in the other; the loads shall be shed/restored in a linear fashion.
 - b. Adjust operator selected control setpoints in analog format based on energy usage when compared to shed and restore settings.
 - c. Shedding may be implemented independently on each and every zone or piece of equipment connected to the system.
 - d. Status of every load shed shall be capable of being displayed on every operator terminal connected to the system. Statuses shall be displayed along with the English description of each load.

2.05 APPLICATION (system and unitary) DDC CONTROLLERS.

- A. Application controllers shall include universal inputs with 10-bit resolution that accept 3K and 10K thermistors, 0 to 10VDC, 0 to 5 VDC, 4 to 20 mA and dry contact signals. Any input on a controller may be either analog or digital with a minimum of three inputs that accept pulses. Controller shall also include support and modifiable programming for interface to intelligent room sensor with digital display. Controller shall include binary and analog outputs on board. Analog outputs shall be switch selectable as either 0–10VDC or 0–20mA. Software shall include scaling features for analog outputs. Application controller shall include a supply voltage to power external sensors.

- B. Program sequences shall be stored in EEPROM or flash memory. No batteries shall be needed to retain logic program. Controller shall execute program sequences 10 times per second and be capable of multiple PID loops for control of multiple devices. Calculations shall be completed using floating-point math. Programming of application controller shall be completely modifiable in the field over the installed BACnet LANs or remotely via modem interface.
- C. Central Plant Controllers shall interface to chiller gateways. Point objects shall reside in the central plant controller. Hand-Off-Auto switches shall be provided for direct wired output control circuits.
- D. Controllers for VAV boxes shall include one onboard airflow sensor microprocessor driven and pre-calibrated at the factory. Pre-calibration shall be at 16 flow points as a minimum. Factory calibration data shall be stored in EEPROM. Calibration data shall be field adjustable to compensate for variations in VAV box type and installation. Calibration parameters shall be adjustable through intelligent room sensor. Operator workstation, portable computers and special hand-held field tools shall not be needed for field calibration. Boxes shall be controlled using pressure independent control algorithms and flow readings shall be in CFM
- E. Controllers for Dual Duct boxes shall include two onboard airflow sensors and function similar to the VAV box controller. Multiple VAV box controllers or controllers with remote airflow sensors are not acceptable.

2.06 TEMPERATURE SENSORS

- A. Temperature sensors shall be 10K ohm thermistor factory-calibrated to within 0.5 degrees F, totally interchangeable with housings appropriate for the application.
- B. Wall sensors shall be installed 48 inches above finished floor. Duct sensors to be installed such that the sensing element is in the main air stream. Immersion sensors to be installed in wells filled with thermal compound. Outside air sensors shall be installed away from exhaust or relief vents, not in an outside air intake and in a location that is in the shade most of the day.

2.07 HUMIDITY SENSORS

- A. The humidity sensor shall be a solid-state device that is factory calibrated to provide a linear output with an accuracy of 3.0 percent from 0 to 90 percent RH. A metal fabric filter shall protect the humidity-sensing element.
- B. Duct humidity sensors shall utilize a sampling tube enclosure that is accessible for maintenance personnel.
- C. Room and duct sensors shall incorporate a temperature sensor in the same enclosure when required.

2.08 PRESSURE SENSORS

- A. Differential and pressure sensors shall have a tensioned stainless steel diaphragm to form a variable capacitor that produces a linear output with an accuracy of 1.0 percent of full scale. The unit shall be able to withstand 10 PSIG over pressurization.
- B. Differential pressure switches shall utilize a diaphragm operated snap-acting switch with a setpoint range of 0.05 to 2.0 inches WC.

- C. Steam pressure sensors shall be mounted on a pigtail siphon with manual shutoff ball valve.

2.09 CARBON DIOXIDE (CO₂) SENSORS

- A. Carbon dioxide concentration levels shall be sensed by non-dispersive infrared technology. A corrosion-free sensing chamber shall be used for accurate, stable CO₂ sensing. An LCD shall display sensed CO₂ concentration.
- B. Sensor shall be gold plated and have a range of 0-3000 PPM at +/- 5 percent accuracy for long-term calibration stability. Both analog and binary relay output circuits shall be available on the sensor. An automatic background calibration algorithm shall reduce required maintenance.
- C. Acceptable Manufacturers: Telaire, Honeywell, Johnson Controls, or equal.

2.10 ELECTRONIC VALVES

- A. Control Valves ½ inch to 2-inch shall be characterized stainless steel ball valves with actuators sized to close off against twice the maximum fluid pressure. Valve body shall be NPT screwed for 2-way or 3-way application. A push button release shall be provided for manual operation.
- B. Control Valves 2 ½-inch and larger shall be butterfly type with actuators sized to close off against twice the maximum fluid pressure. Valve body shall be flanged for 2-way or 3-way application. Contacts shall be provided to mechanically indicate the full open and full closed position of the valve.
- C. Steam Valves shall be globe valves suitable for 35-PSI inlet steam service. Valve bodies shall be NPT screwed or flanged with spring-return normally closed valve actuators.
- D. Acceptable Manufacturers: Belimo, Honeywell, Johnson Controls, or equal.

2.11 DAMPER ACTUATORS

- A. Electric damper actuators (including VAV box actuators) shall be direct shaft mounted and use a V-bolt and toothed V-clamp. The actuator mounting arrangement and spring return feature shall permit normally open or normally closed positions of the damper as required.
- B. Actuators shall be sized for 200 percent of the design torque requirements.
- C. Damper actuators shall incorporate a release mechanism to manually position the damper for maintenance or emergency override.
- D. Damper Actuators located outdoors shall have a clear plastic weather shield specifically designed for the application.
- E. Acceptable Manufacturers: Belimo, Honeywell, Johnson Controls, or equal.

2.12 CURRENT SWITCH

- A. Current sensing switch shall be self-powered with solid-state circuitry and a dry contact output. A multi-turn setpoint adjustment shall set the trip point status. An LED shall indicate the on or off status.

2.13 CONTROL RELAY

- A. The relay shall be contained in a plenum rated NEMA 1 enclosure with a ½" NPT conduit fitting. Coil voltage shall be 24 or 120 VAC with a contact rating of 10A. An LED on the enclosure cover shall indicate the relay is energized.

2.14 ENCLOSURES

- A. Controllers, power supplies and relays shall be mounted in dedicated NEMA enclosures when located in a clean dry indoor environment. Indoor enclosures shall be NEMA 12 when installed in other than a clean environment.
- B. Enclosures for outdoor applications shall be rated NEMA 3R and be mounted on the north exposure of the controlled unit.
- C. Enclosures shall have hinged, locking doors with common keying for control panel on the Project Site.
- D. Enclosures shall have permanently affixed to the door an engraved nametag identifying the equipment served. The nametag shall be a minimum 1 inch by 3-inch with ½ inch lettering.

PART 3 – EXECUTION

3.01 CONTROLS INSTALLATION

- A. Wiring methods for control system shall be as defined in the Division 26 specifications. Wire types shall conform to manufacturers' recommendations.
- B. Mount control panels adjacent to associated equipment on vibration-free walls or freestanding angle iron supports. One cabinet may accommodate more than one system in same equipment room. Control panel assemblies must be UL listed.
- C. Provide software and hardware required to provide controls and monitoring of diagnostic points indicated in specification Section 23 8000.
- D. Coordinate with Division 26 electrical installer so that "Hand/Off/Auto" selector switches are installed to override automatic interlock controls when switch is in the "Hand" position. Safety shutdown interlock wiring shall disable the equipment regardless of the position of the H-O-A switch.

3.02 ROOM SENSORS INSTALLATION

- A. Room sensors shall be wall mounted at a 48-inch height above finished floor. Room sensors are not permitted on outside walls, at chalkboards, between shelving, in recesses or above heat producing equipment. Coordinate with Division 26 for sensor or thermostat mounting adjacent to light switches.

3.03 COORDINATION

- A. Coordinate the work with other aspects of mechanical, electrical, fire-life safety and security systems, and photo voltaic systems to obtain a complete and operating system in accordance with the contract documents.
- B. Meet with the OAR and school principal and other school staff to determine when each zone or building will be occupied so scheduling of the operation of heating, ventilating and air conditioning equipment may be provided at the proper times.

DDC CONTROL SYSTEM ADJUSTMENTS

- A. Make adjustments under operating conditions to provide sequence of operation for each control system per design intent. If required operating conditions cannot be obtained prior to completion date of the contract due to outdoor seasonal temperatures, return to the job site when requested by the Owner and re-adjust control system when outdoor temperatures will permit proper operating conditions. Start re-adjustment within seven calendar days after notification.

3.05 PERFORMANCE AND ACCEPTANCE:

- A. Test and calibrate each device including but not limited to the following for proper operation, connection, signal value or response.
 - 1. Building Controllers.
 - 2. Custom Application Controllers.
 - 3. Application Specific Controllers.
 - 4. Input / Output Devices. (Sensors, actuators and monitoring devices)
 - 5. Operator Interfaces.
- B. Verify that systems are standalone and operable upon network failure.
- C. Verify that systems return to normal operation automatically upon resumption of network operation or return of power.
- D. Test each system for functions of the required control sequence of operation either by normal control operation or forced operation as required. Log and submit results.
- E. Test the network for connectivity, data transmission rates, input/output responses, and other appropriate parameters Failure modes, including network failure, individual control system failure, and power outages, shall be simulated and responses logged, with any effects on network operation noted and corrected.
- F. Test each preprogrammed time and holiday schedule.
- G. Commissioning requirements of Divisions 01, 23, and 26 apply to this Section.
- H. Schedule of Responsibilities: Refer to Appendix A. The schedule identifies the responsibilities of the Contractor for the installation of the environmental controls and energy management system. Deviations and clarifications of this schedule only if allowed by the OAR, provided trade contractor coordination and schedule requirements are met. Submit a record copy of the Schedule of Responsibilities to the OAR at the commencement of this Section's Work.

3.06 WIRING AND INFRASTRUCTURE

- A. Provide necessary wiring, terminations, connections and conduit infrastructure for the complete system as indicated in the construction documents.
- B. Exterior cables whether above or below ground level shall be rated for exterior applications. When entering a building provide a code sized pull box with necessary hardware to transition exterior rated cables to interior applications.
- C. Underground EMS cables are permitted to be installed with lighting control wiring in underground applications. Provide innerduct to separate EMS cables from lighting control system cables.

DATA LOGGING REQUIREMENTS

- A. The system must be capable of storing the system's collected and diagnosis data for a minimum of seven days.
- B. Program the system for a standard seven day schedule including holydays.

3.08 CLEANUP

- A. Remove rubbish, debris and waste materials and legally dispose of off Project Site.

3.09 PROTECTION

- A. Protect Work of this Section until Substantial Completion.

END OF SECTION

APPENDIX A

SCHEDULE OF RESPONSIBILITIES

	ITEM	FURNISH BY	INSTALL BY	POWER BY	CONTROL WIRING BY
1	Magnetic Motor Starters:				
	a. Automatic controlled, with or without HOA switches.	E	E	E	DDC
	b. Manually controlled	E	E	E	N/A
	c. Manually controlled furnished as factory wired unit equipment	M	M	E	E
	d. Special duty type (part winding, multi-speed, etc.)	M	See Note 1	E	See Note 1
	e. Adjustable frequency drives with or without manual bypass.	DDC	E	E	DDC
	f. Domestic booster pump. Motor Controls	M	M	E	See Note 2 DDC
2	Line voltage contactors.	E	E	E	DDC
3	Control relay transformers (other than starters).	DDC	DDC	E	DDC
4	Control and Instrumentation panels	DDC	NI	E	DDC
5	Automatic control valves, automatic dampers and damper operators, solenoid valves, insertion temperature and pressure sensors including wells	DDC	M	E	DDC
6	Control interlock wiring between chillers, pumps, cooling towers, fans and air handling units and other miscellaneous mechanical equipment.	DDC	DDC	E	DDC
7	Duct Smoke Detectors	E	M	E	E
8	Dampers				
	a. Control Dampers	M	M	N/A	DDC
	b. Smoke Dampers and Combination Fire/Smoke Dampers	M	M	E	E
9	Airflow Stations with transmitter.	M	M	E	DDC
10	Air terminal devices (I.e., VAV and fan powered boxes).	M	M	E	DDC
11	Intelligent Devices and Control Units provided with packaged mechanical equipment such as: Large VAV and constant volume package units Boilers and Chillers.	M	M	E	NI
12	Intelligent Devices and Control Units not provided by equipment manufacturer such as: Air handling units, Heat pumps, AC units (small < 20 tons), Air terminal units (VAV boxes)	DDC	DDC	E	DDC
13	Intelligent Devices and Control Units provided with electrical systems such as: Occupancy / motion sensors, Lighting Control Panels, Switches and dimmers, Switch Multiplexing Control Units, Door Entry Control Units.	E	E	E	DDC
14	Gateways for proprietary non-BACnet equipment	M	M	E	DDC
15	Communications network devices such as Routers, Bridges and Repeaters.	DDC	DDC	DDC	DDC
Abbreviations					
DDC		DDC Contractor (controls contractor)			
M		Mechanical Contractor			
E		Electrical Contractor			
N/A		Not Applicable			

Notes:

1. Magnetic motor starters (special duty type) shall be set in place under electrical division except when part of factory wired equipment, in which case they shall be set in place under mechanical division.
2. Where a remote motor disconnect is required in addition to the one provided integral to a Variable Frequency Drive (VFD), controls contractor shall provide the necessary control interlock between the disconnects.

SECTION 23 30 00 - AIR DISTRIBUTION

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes: Provide ductwork and appurtenances required for a complete air transmission and distribution system for the heating, ventilating, and air conditioning systems indicated on Drawings and as specified.

B. Related Requirements:

1. Division 01: General Requirements.
2. Section 09 9000: Painting and Coating.
3. Section 23 0500: Common Work Results for HVAC.
4. Section 23 0800: HVAC Systems Commissioning.
5. Section 23 0513: Basic HVAC Materials and Methods.
6. Section 23 0548: HVAC Sound, Vibration and Seismic Control.
7. Section 23 0700: HVAC Insulation.
8. Section 23 0900: HVAC Instrumentation and Controls.
9. Section 23 0923: Environmental Control and Energy Management Systems.
10. Section 23 3813: Kitchen Ventilation System.
11. Section 23 8000: Heating, Ventilating and Air Conditioning Equipment.

1.02 SUBMITTALS

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

B. Manufacturer's Data:

1. Complete list of items to be furnished and installed under this Section. Material lists that do not require performance data shall include manufacturer names, types and model numbers.
2. Manufacturer's specifications and other data required to demonstrate compliance with specified requirements.
3. Literature shall include descriptions of equipment, types, models, sizes, capacity tables or curves marked to indicate performance characteristics, electrical requirements, options selected, space requirements, including allowances for servicing, and other data. Data shall include name and address of nearest service

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and maintenance organization that regularly stocks repair parts. Listings of items that function as parts of an integrated system shall be furnished at one time.

4. Submit complete acoustical test reports showing that proposed products have been tested in accordance with latest editions of relevant ASHRAE and AHRI Standards (ANSI/ASHRAE Standard 70 for air inlets and outlets; ANSI/ASHRAE Standard 130 and AHRI 880 for terminal units) and will be suitable for operation in Project spaces with specified maximum noise criteria (NC) requirements. The results of all testing shall be certified by an independent testing agency and submitted to the Architect for approval. The submittal shall include a complete description of the test conditions, methods and procedures.
5. Submittals shall include a tabulation of proposed products, identification of Project spaces where proposed products are to be installed, maximum allowable NC for all Project spaces, and product NC (at specific design air volume) for all Project spaces.
6. Shop Drawings: Shop Drawings indicating methods of installation of equipment and materials, sizes and gages of ducts, and details of supports. Items to be covered shall include but not be limited to following:
 - a. Layout of ductwork and equipment drawn to scale to establish that equipment will fit into allotted spaces with clearance for installation and maintenance. Indicate proposed details for attachment, anchoring to, and hanging from structural framing of building. Indicate vibration isolation units, foundations, supports, and openings for passage of pipes and ducts.
 - b. Drawings indicating locations and sizes of sleeves and prepared openings for pipes and ducts.
 - c. Typical details of supports for equipment and ductwork.

1.03 QUALITY ASSURANCE

- A. Installer's and Manufacturer's Qualifications: Comply with provisions stated under Section 23 0500: Common Work Results for HVAC.
- B. Sound power level measurements and Manufacturers' NC value calculations shall be conducted in complete accordance with the latest version of ANSI/ASHRAE Standards 70 and 130 and AHRI 880.

1.04 PRODUCT HANDLING

- A. Protection, Replacements, Delivery and Storage: Comply with provisions stated in Section 23 0500: Common Work Results for HVAC.

1.05 COORDINATION

- A. Coordinate activities in accordance with provisions of Section 23 0500: Common Work Results for HVAC.

PART 2 – PRODUCTS

- A. Unless otherwise noted, provisions, including amendments thereto, of the HVAC Duct Construction Standards of Sheet Metal and Air Conditioning Contractor's National Association (SMACNA) and the California Mechanical Code (CMC), are hereby made part of this Section.
- B. Rectangular, round and flat oval ducts shall be manufactured and installed in accordance with requirements of the HVAC Duct Construction Standards – Metal and Flexible of SMACNA.
- C. Sheet metal ducts shall be fabricated from galvanized steel, aluminum or stainless steel.
- D. Galvanized steel ducts shall be fabricated of galvanized steel sheet, lock forming grade, conforming to ASTM A653 and A924.
- E. Galvanized steel ducts gage thickness and permissible joints and seams of concealed ductwork shall conform to requirements in HVAC Duct Construction Standards – Metal and Flexible of SMACNA and the CMC unless noted otherwise on the drawings. The more stringent requirements shall prevail. Galvanized steel ducts gage thickness and permissible joints and seams of exposed ductwork shall conform to requirements in Tables 2 and 3, Minimum Metal Gages, of this Section. When more stringent requirements are noted on the drawings the most stringent requirement shall prevail.
- F. Button punch snap-lock seams, using Lockformer or equal, shall be permitted only in concealed areas using 20 and 22 gage galvanized steel ducts with screws added at the ends. Button punch snap-lock is not permitted for aluminum or duct lighter than 22 gage.
- G. Ducts shall be reinforced in accordance with SMACNA standards: Cross-broken Duct: Duct sizes 19 inches wide and larger which have more than 10 square feet of unbraced panel shall be beaded or cross-broken. This requirement is applicable to 20 gage or less thickness and 3 inches w.g. or less pressure. For details, refer to SMACNA manual.
- H. Round and Oval Galvanized Steel and Aluminum Ducts:
1. Round Spiral Ducts and Fittings: Fabricated from galvanized sheet steel shall be machine-formed spiral pipe with sealed spiral locking joints. Fittings shall be furnished with continuous corrosion-resistant welds. Provide gages of ducts and fittings recommended by manufacturer.
 2. Details of seams and transverse joints for round duct and fittings shall conform to SMACNA standards.
 3. Flat oval ducts shall be provided as indicated on the Drawings. Reference standard details in SMACNA manual.
 4. Minimum duct wall thickness for concealed flat oval duct construction shall conform to requirements in HVAC Duct Construction Standards – Metal and Flexible of SMACNA and the CMC. The more stringent requirements shall prevail. Gage thickness and permissible joints and seams of exposed ductwork shall conform to requirements in Table 1, of this Section.
 5. These provisions apply for ducts furnished for indoor comfort heating, ventilating and air conditioning service only.

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I. Flexible Ducts

1. Flexible duct shall be non-metallic, insulated for conditioned air supply and return. The flexible ducts shall be factory fabricated with exterior reinforced laminated vapor barrier, 1 ½-inch thick fiber glass insulation (K = 0.25 at 75 degrees F), encapsulated zinc-coated spring steel wire helix and impervious, smooth, non-perforated interior vinyl liner and factory fabricated steel connection collars. For the composite assembly, including insulation and vapor barrier, comply with NFPA Standard 90A or 90B and tested in accordance with UL Standard, UL 181. Non-insulated metallic ducts shall be provided for exhaust only.
2. Methods of installations, standards for joining and attaching, and supporting flexible duct shall conform to applicable provisions of SMACNA manual.
3. Specifications herein shall not supersede installation requirements by flexible duct manufacturer if those are more stringent.

J. Aluminum Ducts:

1. Material for aluminum duct shall be of 3003-H14 alloy aluminum sheets, with such designation embossed or stenciled on each sheet. Minimum tensile strength shall be 19,000 psi.
2. Aluminum duct gage thickness and permissible joint and seams shall conform to Table 1, Construction Details for Rectangular ducts, in this Section.
3. Aluminum ductwork shall be furnished to transport moisture-laden air from shower rooms, shower drying rooms, dishwashers and discharge ducts from evaporative condenser and cooling towers.
4. Unless otherwise noted, follow construction details for steel construction standards as indicated for unreinforced duct, reinforced duct, or cross-broken duct.
5. Button punch snap-lock seams on aluminum ducts are not permitted.

K. Stainless Steel Duct:

1. Materials for stainless steel duct shall be stainless steel conforming to ASTM A167 and A480.
2. Stainless steel ducts shall be provided as required and indicated on the Drawings.
3. Fume hood exhaust shall be stainless steel.
4. Kitchen exhaust duct system shall be stainless steel Type 304.
5. Stainless steel ducts shall be constructed with welded joints except for connections to equipment which shall be flanged joints with gaskets.
6. Entire stainless steel duct systems shall comply with current CMC requirements for product conveying ducts except where the requirements of this Section are more stringent.

L. Fittings and Other Construction Details: Details of fittings such as elbows, turning vanes, branch take-off and connections, duct access doors, connections for grilles, registers and

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ceiling diffusers, flexible connector at fan, etcetera, shall conform to applicable provisions of this Section or SMACNA manual.

- M. Duct Seam and Joint Sealant: Provide sealant or tape for metal ducts at duct joints which are defined as transverse joints between duct sections including girth joints, branch and sub-branch intersections, duct collar tap-ins, fitting subsections, louver and air terminal connections, access doors and frames, and abutments to building structure. Also provide the same at duct seams which are defined as longitudinal joint between duct sections. Spiral lock seams in factory fabricated round or oval ducts are excluded.
1. Sealant for low-pressure ducts shall be: Design Polymerics DP1010 or DP1020, Childers CP-145A/CP-146 Chil-Flex, Foster's 32-19 Duct-Fas, Miracle-Kingco Glenkote Seal-Flex, Ductmate Industries PROseal or FIBERseal, or equal.
 2. Provide sealing material for medium-pressure ducts as described in the SMACNA manual for those pressures.
 3. Sealant materials shall comply with the flame spread and smoke developed rating of current CMC when tested in accordance with ASTM E84.
 4. Sealant for exposed to weather ducts shall pass the Weather Resistance Test per ASTM G154 at 2000 hours QUV.
- N. Restrictions:
1. Zinc-coated steel duct shall not be installed for ductwork transporting moisture-laden air. Flexible duct may only be furnished where specifically indicated on Drawings. Aluminum ducts shall not be installed for internal pressures above 2 inches of water.
 2. Fiberglass duct is not permitted as a substitute for sheet metal duct.

2.02 ACOUSTICAL DUCT AND PLENUM LINERS

- A. Duct liners shall conform to requirements of Section 23 0700: HVAC Insulation.

2.03 DAMPERS

- A. Manually Operated Volume Control Dampers:
1. VD-1, Rectangular: Multi-blade type, opposed blade operation, 16 gage galvanized steel blades; center pivoted on 3/8 inch diameter steel trunnions; interlocking edges; dampers shall be in own angle frame, full duct size as indicated on Drawings; frame of minimum 16 gage steel channel construction. Provide with damper operator and axles positively locked to blade. Ruskin MD35, Pottorff MD-42, Greenheck MBD-15 or equal.
 2. VD-2, Round: Frame shall be constructed of not less than 20 gage galvanized steel, blades of not less than 20 gage galvanized steel channel construction with factory neoprene seals, 1/2 inch diameter axle shafts and locking hand quadrant. Ruskin MDRS25, Greenheck MBDR-50, or equal.
 3. VD-3, Oval: Frame shall be constructed of not less than 14 gage galvanized steel channels with factory blade seals of not less than 12 gage galvanized steel with not

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less than ½ inch diameter axle shafts. Provide Ruskin standard construction for frame, blade and axle size, thickness and material variation. Provide adjustable locking hand quadrant. Ruskin CDO25, or equal.

B. Motorized Volume Control Dampers:

1. MVD-1, Rectangular: Multi-blade type opposed blade operation, 16 gage minimum steel channel frame construction; 16 gage galvanized steel blades center pivoted on ½ inch diameter steel trunnions. Interlocking edges. Dampers shall be in own angle frame. Full duct size as indicated on the Drawings. Provide with matching two position motorized actuator with linkages, 24VAC by Belimo, Honeywell, Invensys, or equal. Ruskin CD35, Pottorff CD-42, Greenheck VCD Series, or equal.
2. MVD-2, Round: Butterfly type constructed with minimum 20 gage galvanized steel frame with steel angle reinforcement on above 20-inch diameter. Blade shall be 14 gage minimum thickness. Neoprene seal to ensure air tightness in closed position. Furnish with matching two position motorized actuator with linkage 24 VAC by Belimo, Honeywell, Invensys, or equal. Ruskin CDRS25, American Warming and Ventilating (AMV) VC-25, Air Balance, Inc. AC530, or equal.
3. Electronic Damper Actuators: Belimo, Honeywell, Invensys, or equal.
 - a. Sized for torque required for damper seal at load conditions.
 - b. Coupling: V-bolt dual nut clamp with a V-shaped toothed cradle. Aluminum clamps or set screws are not acceptable.
 - c. Overload Protection: Microprocessor or an electronic based motor controller providing burnout protection if stalled before full rotation is reached. Actuator shall be electronically cut off at full open to eliminate noise generation with the holding noise level to be inaudible.
 - d. Power Requirements: As indicated on Drawings.
 - e. Actuator Timing: Shall meet 15 seconds.
 - f. Temperature Rating: Actuator shall have a UL 555S listing by damper manufacturer for 350 F.
 - g. Auxiliary Switches: Provide for signaling, fan control, and position indications.

C. Automatic Fire Dampers:

1. FD, Fire Dampers: Shall conform to requirements of and be listed by State of California Fire Marshal and NFPA 90A. Dampers shall provide airflow resistance not to exceed 0.05 inch water gage static pressure at 900 fpm or 0.25 inch water gage at 2,000 fpm. Dampers shall be installed in required steel sleeve at each penetration of a rated partition.
 - a. Vertical-mounted fire dampers: Fire damper shall be curtain type with blades removed from the air stream to allow for maximum free area. Dampers will be provided in factory sleeves as tested and listed by manufacturer. Dampers shall be rated for 1 ½ hours for installation in one or 2-hour partitions. Provide UL listed fusible links of adequate size and

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temperature rating. Dampers will be installed according to the manufacturer's recommended installation instructions provided with units. Provide suitable access for inspection and servicing of each damper. Pottorff VFD-10/VFD-10D Series, Ruskin IBD/DIBD Series, Greenheck FD/DFD Series, or equal.

- b. Ceiling fire dampers: Ceiling fire dampers shall be butterfly type with ceramic material to minimize heat radiation. Dampers shall be rated for one hour and shall be furnished as a part of an integral sleeve ceiling box that will accept air distribution, have a UL listed and pre-mounted hanger tabs. Dampers shall be installed according to the manufacturers recommended installation instructions. Pottorff CFD-15 Series, Ruskin CFD Series, Greenheck CRD-1 Series/CRD-2, or equal.
- c. Combination fire and smoke dampers: Combination fire and smoke dampers shall be louver bladed type. Units shall be tested and listed under UL 555 and UL 555S. Rating 1 ½ hours for installation in one or 2-hour partitions. The seals shall be non-degradable steel to steel. Leakage shall not exceed 15 cfm/sq. ft. at one inch w.g. and shall be tested at 850 degrees F. Dampers shall be capable of being remotely controlled and reset for pressurization and smoke evacuation. Fire-releasing device shall be UL 33 listed melting fusible links. Dampers shall be provided in sleeves with pre-mounted non-stall motor actuators and dual-position indicators for remote annunciation, if required. The complete assembly shall be factory cycled and tested prior to shipment. Provide suitable access for inspection and servicing of each damper. Pottorff FSD-141 with non-stall motor, Ruskin FSD37 or FSD60 with electric fuse link Model EFL 200, with electric non-stall motor, Greenheck FSD Series, with non-stall motor, or equal.

2. Electronic Damper Actuators: Refer to Sub-paragraph 2.04.B.3.

- D. Relief Dampers: Parallel multi-blade, counter balanced type with adjustable counter weights. Constructed of 20 gage galvanized sheet steel or extruded aluminum with solid stops all around. Bearings shall be dust proof, ball bearings. Damper shall open on a positive pressure of 0.01 inch within space and close to a backdraft. Interlocking edges shall prevent dust infiltration when closed. Air Balance, Inc., Pottorff, Ruskin, Metal Form Manufacturing Co. Inc., or equal.
- E. Duct Access Panels: Provide factory fabricated access panels in ducts where required for servicing fire or smoke dampers, and at other locations as specified in this Section. Units shall consist of removable panel, gasketed and pressure sealed by controlled spring tension locks. Construct unit, including interior parts, of same material as duct. Units shall be constructed to be suitable for installation in systems of up to 5 inches water gage static pressure.

2.04 AIR DISTRIBUTION DEVICES

A. General:

1. Grilles, registers, diffusers and appurtenances shall conform to requirements specified herein and shall be of type and sizes as specified and indicated on Drawings. Performance shall be in accordance with ANSI/ASHRAE Standard 70 including airflow velocity, pressure, temperature, and sound measurements.

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2. Sponge neoprene, rubber, vinyl or felt border gaskets shall be provided for surface-mounted registers, grilles or diffusers.
 3. The noise generating characteristics of all specified grilles, registers, and diffusers shall be tested to, and comply with, all requirements of this specification. Representative samples shall be subjected to tests in accordance with applicable standards and procedures in order to demonstrate such compliance. A special test for this project is not required if the manufacturer has previous certified test results that can be made applicable to this project. Maximum Sound Levels of diffusers, grilles and registers shall be as follows:

Administrative office area:	NC 30
Classrooms:	NC 20
Libraries and other noise sensitive areas:	NC 25
Gymnasiums, cafeterias, lockers areas:	NC 30.
 4. Provide suitable frame types to match the ceiling types as specified or indicated on the Architectural Drawings.
 5. Ceiling diffusers shall be provided with equalizing grids.
 6. Ceiling mounted grilles, registers and diffusers shall be provided with a factory applied, baked enamel, dull finish, bone white to match acoustical ceiling tile.
 7. Grilles or registers mounted on painted walls or other surfaces shall be furnished with a baked prime coat and finish painted in accordance with Section 09 9000: Painting and Coating.
 8. Do not provide opposed blade dampers at diffusers and registers to balance the airflow, as they tend to create noise. Provide a manual volume damper at each branch take-off and also at branch duct to each diffuser and register upstream of the flexible duct connections. Air throw patterns shall be as indicated on the drawings.
 9. Diffusers, registers and grilles indicated or scheduled on the drawings to comply with special requirements shall take precedence over the standard items specified.
- B. Ceiling Diffusers - Round, Square, Rectangular:
1. CD-1 For non-classroom areas of less than 10 feet ceiling height only. Units shall be square or rectangular modular core type as indicated on the drawings. Anemostat QC Series, Krueger Model 1240, Price SMCD Series, or equal.
 2. CD-2 For typical classrooms. Units shall be square plaque type. Anemostat PG Series, Krueger Model PLQ, Price SPD Series, or equal. The horizontal air discharge pattern shall be 360-degree radial type with factory installed blank-offs for three way, two way corner, two way opposite, or one way discharge pattern.
 3. CD-3 For non-classroom areas of higher than 10 feet ceiling height. Units shall be square or rectangular louver faced type. Anemostat D Series, Krueger Model SH, Price SMD/AMD Series, or equal.
 4. CD-4: Units shall be round, adjustable pattern, and surface-mounted type. Anemostat C-27, Krueger RM Series, Price RCDE Series, or equal.

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5. CD-5: Units shall be adjustable linear slot type. Anemostat SLAD Series, Krueger Model 1900, Price AS Series, or equal.
- C. Grilles - Return, Exhaust, Ceiling, Square, Rectangular:
1. GR-1 Acoustical Tile on Plaster Ceiling: Return and exhaust grilles shall be single deflection type with horizontal fixed face bars set at straight or 45 degree angle, ½ inch spacing and flush and flanged for surface mounting. Anemostat S3HD Series, Krueger Model S80/S85, Price 500/600 Series, or equal.
 2. GR-2 Prefabricated Acoustical Tile Ceiling with Inverted Exposed T-Bars: Return and exhaust grilles shall be with single deflection horizontal fixed face bars, set at straight or 45 degree angle, ½ inch spacing and flush, lay-in panel type with nominal overall dimension of 24-inch by 24-inch. Anemostat Type SAC3L Series, Krueger Model S80/S85, Price 500/600 Series, or equal.
- D. Registers, Supply, Return, Wall:
1. WR-1: Sidewall supply register shall be double deflecting type with loose key-operated opposed blade volume control. Anemostat S2 Series, Krueger Model 80/880, Price 500/600 Series, or equal.
 2. WR-2: Sidewall return register shall be single deflecting type with horizontal fixed face bars set at 45 degree angle flush and flanged for surface mounting and complete with loose key-operated opposed blade volume control. Anemostat S3 Series, Krueger Model S80/S85, Price 500/600 Series, or equal.

2.05 SOUND ATTENUATING EQUIPMENT - DUCT SILENCERS

- A. Provide factory fabricated duct silencers of tubular or rectangular type, for high or low velocity service, with arrangements, sizes and capacities as indicated on Drawings. Construct silencers of galvanized steel with casing seams sealed or welded to be airtight at a pressure differential of 8 inches water gage between inside and outside of unit, and stiffen or brace as required to prevent structural failure or deformation at same condition, or audible vibration during normal operation. Filler material shall comply with the following:
- | | |
|--|---|
| Fire Safety Standards: | NFPA 90A and 90B |
| Temperature: | ASTM C411 |
| Air velocity: | ASTM C1071, UL 181 |
| Fire Hazard Classification: | ASTM E84, UL 723-Class 1, NFPA 255 |
| Corrosion Resistance: | ASTM C739, C665 |
| Fungi Resistance: | ASTM G21 |
| Water Vapor Sorption: | ASTM C1104, less than 1 percent by weight |
| Formaldehyde, Phenoloc Resins or other Volatile Organic compounds: | 0 percent. |
- B. Select and provide silencers from acoustical and aerodynamic rating tables based on actual test readings or interpolated values of such readings obtained from tests made by recognized independent laboratories. Tests shall be in accordance with ASTM E477.
- C. Select and provide silencers for air pressure drops not exceeding those indicated on Drawings, and of types, sizes and models for which noise reduction values, dynamic insertion loss, in decibels reference 10 to 12 watts, are not less than indicated on Drawings.

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2.06 ZONE TEMPERATURE CONTROL DEVICES

Specifications

(Not Used)

2.07 SMOKE DETECTORS

- A. Refer to Section 28 3100: Fire Detection and Alarm.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Examine areas and conditions under which Work of this Section will be performed. Correct conditions detrimental to proper and timely completion of Work. Do not proceed until unsatisfactory conditions have been corrected.

3.02 DUCTWORK

- A. Construct ductwork according to details of fabrication and methods of support, as indicated in the SMACNA manuals and CMC, unless specified or indicated otherwise in this Section or on Drawings. In event of conflict, the most stringent requirement shall be provided.
- B. Unless otherwise required, construct ducts to conform accurately to dimensions indicated and to be straight and smooth on inside, with joints neatly finished.
- C. Duct dimensions indicated are net inside dimensions. If the indicated duct is to be furnished with an acoustic lining, add twice the thickness of the acoustic liner in both the duct width and height dimensions to provide the gross sheet metal duct dimensions.
- D. Where aluminum is welded, provide a minimum thickness of 16 gage, and use gas inert tungsten process of welding.
- E. Anchor ducts to building structural slab, framing and roof decking and detail method of anchoring and fastening if not indicated on Drawings. Supports shall be seismically constructed.
- F. Construct and install ducts to be completely free from vibration under operating conditions.
- G. Indicate on layout drawing, required for suspended ductwork, location of supports, loads imposed on each fastening or anchor, typical details for anchorage, and details for special anchorage for supports attached to metal roof decking.
- H. Attach supports only to building structural framing members and concrete slabs.
- I. Where supports are required between structural framing members, detail and install suitable intermediate metal framing.
- J. Ducts transporting air-conditioned or heated supply air shall be insulated in accordance with requirements of Section 23 0700: HVAC Insulation.
 - 1. Ducts exposed to weather shall be furnished with exterior insulation with weather jacket or interior lining as indicated on Table 2, Section 23 0700: HVAC Insulation.

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- K. Ferrous angles and structural members and joining collars specified for construction and support of ductwork and plenums shall be primed with one heavy coat of required asphaltic aluminum paint before installation or fabrication. Metal surfaces shall be thoroughly cleaned before installation of paint. Galvanizing may be provided instead of painting. Installed duct hanger rods concealed in furred ceilings and walls are not required to be primed or painted.
- L. Broken places in galvanized coating shall be acid washed and then completely soldered over or painted with galvanizing paint.

3.03 DUCT CONSTRUCTION

- A. Minimum ductwork gages, joints, reinforcing, and bracing of concealed ductwork shall conform to SMACNA and CMC. Exposed ductwork shall conform to the following tables in addition to SMACNA and CMC. The most stringent standards shall prevail. Hoods, plenums, and castings shall not be lighter than the duct gage listed in Table 2 for corresponding dimensions. Additional bracing shall be provided to prevent objectionable panel vibration.
- B. Provide longitudinal seams of the grooved snap lock and standing, sealed and taped, or sealed spiral or continuously welded. For exhaust duct, taping may be omitted.

TABLE 1 - SHEET METAL THICKNESS FOR CIRCULAR DUCTS AND FLAT-OVAL (FOR STATIC PRESSURES LISTED)

Gage Thickness			
2-inch Water Column	Diameter of Duct	Horizontal Girth	
Maximum S.P.	Maximum	Maximum	Joints
<u>Round / Oval</u>	<u>Diameter Support</u>	<u>Distance</u>	
26 / 24	Up to 9 inch	10-foot	2-inch slip
26 / 24	9 to 14-inch	8-foot	4-inch
24 / 22	14 to 23 inch	8-foot	4-inch
22 / 20	23 to 37-inch	8-foot	4-inch
20 / 18	37 to- 51-inch	6-foot	1 ¼-inch by 1 1/8-inch flange

- C. Construction Details for Rectangular Sheet Metal Ducts for Low-Pressure Systems - Velocities not Exceeding 2,000 Feet Per Minute:
 1. For pressures in excess of 2 inches water column, duct wall thickness shall be 2 gages heavier than set forth in this table.
 2. Duct specifications shown below are applicable when ducts larger than 18 inches are cross-broken. Where cross breaking is not provided, duct wall thickness shall be 2 gages heavier on ducts 19 inches to 60 inches wide unless longitudinal standing seams are furnished.

TABLE 2 - MINIMUM METAL GAGES - UNREINFORCED RECTANGULAR DUCT (2" W.G. OR LESS)

Minimum Gage Thickness <u>Steel / Aluminum</u>	Max. Side, Gross <u>Dimensions</u>	Duct Permissible Girth Joints	Horizontal Support Maximum <u>Distance</u>

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26 / 24	Up to 10-inch	Drive-slip, plain S-slip, or 1 inch government lock	10-foot
24 / 22	11 to 12-inch	Drive-slip, plain S-slip, or 1 inch government lock	10-foot
22 / 20	13 to 14-inch	Drive-slip, plain S-slip, or 1 inch government lock	10-foot
20 / 18	15 to 18-inch	Drive-slip, plain S-slip, or 1 inch government lock	10-foot
18 / NA	19 to 20-inch	Drive-slip, plain S-slip, or 1 inch government lock	10-foot
16 / NA	21 to 24-inch	Drive-slip, plain S-slip, or 1 inch government lock	10-foot

**TABLE 3 - MINIMUM METAL GAGES - REINFORCED RECTANGULAR DUCT
(2" W.G. OR LESS)**

Reinforcement Ratings To Comply with SMACNA Standards				
Minimum Thickness	Gage Steel / Aluminum	Max. Side, Gross Dimensions	Duct Permissible Girth Joints	Reinforcement Spacing Max. Distance
26 / 24		Up to 14-inch	Drive-slip, plain S-slip, or 1 inch government lock with B rated reinforcement	6'
24 / 22		13 to 18-inch	Drive-slip, plain S-slip, with C rated reinforcement	8'
		19 to 30-inch	Standing S/D -slip, 1 inch bar slip, or 1 inch government lock with E rated reinforcement	5'
22 / 20		31 to 36-inch	1 inch bar slip, reinforced bar slip, or 1 inch government lock with F rated reinforcement	5'
		37 to 48-inch	1 5/8-inch standing S or 1 inch government lock with G rated reinforcement	4'
20 / 18		49 to 54-inch	1 5/8-inch standing S or 1 inch government lock with H rated reinforcement or G rated tie rods	4'
18 / NA		55 to 84-inch	1 5/8-inch standing S or 1 inch government lock with I rated reinforcement or G rated tie rods	4'
		85 to 108-inch	2 ½-inch standing seam with K rated reinforcement or H rated tie rods	4'

* Button punch snap-lock seams, using Lockformer or equal, shall be permitted only in non-accessible areas using 20 and 22 gage galvanized steel ducts with screws added at the ends. Button punch snap-lock is not permitted for aluminum or duct lighter than 22 gage.

- D. Ferrous angles and structural members and joining collars specified for the construction and support of ductwork and plenums shall be primed with one heavy coat of asphalt aluminum paint before installation or fabrication. The metal surface shall be thoroughly cleaned before application of the paint. Galvanizing may be provided instead of painting. Installed duct hanger rods concealed in furred ceilings and walls is not required to be primed or painted.
- E. Broken places in galvanized coating shall be acid washed and then completely soldered over or painted with galvanizing paint.
- F. S-type or drive-slip type girths or longitudinal seams shall not be furnished for ductwork installed outdoors or mounted on roofs.
- G. Broken places in galvanized coating shall be acid washed and then completely soldered over or painted with galvanizing paint.

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3.04 DUCTS AND PLENUMS WITH LINERS

- A. Ducts and plenums lined with acoustical insulation shall be as indicated on Drawings.
- B. Duct dimensions indicated on Drawings are net. Add thickness of acoustic liners to obtain gross sheet metal duct dimensions.
- C. For duct liner specifications and installation, refer to Section 23 0700: HVAC Insulation.

3.05 DUCT ELBOWS AND TURNING VANES

- A. Duct elbows, including supply, exhaust, and return, shall be provided with a centerline radius of 1.5 times duct width parallel to radius whenever possible; centerline radius shall not be less than width of duct parallel to radius.
- B. Where space does not permit above radius, or where square elbows are indicated on Drawings, turning vanes shall be installed whether indicated on Drawings or not.
- C. Turning vanes shall be thick double-wall vane type, Ductmate Industries PROrail, or equal. Duro Dyne vane rail system duct turns may be furnished, provided they are of thick double wall type and Shop Drawings are submitted and reviewed by the Architect. Duct turning vanes shall be of same material as ductwork and shall be rigidly fastened in ductwork.

3.06 DUCT JOINTS AND SEAMS

- A. Conditioned air supply ducts shall be furnished with joints and seams sealed, taped or welded for air tightness, except spiral seam factory machine formed duct components. Spiral seam is exempted. Joints between slip-fit components may be assembled with all seams and joint connections fastened with screws and taped.
- B. Other ducts shall be furnished with joints and seams sealed by using sealant, taping, soldering, or welding. Ducts for grease hood exhaust shall be furnished with grease-tight welding or brazing on external surface for joints and seams. Fiberglass ducts shall be provided with a thermally activated closure system, Johns Manville Fortifiber Therm-Lock with Automatic Bond Indicator dots, or equal.
- C. S-slip or drive-slip type girths or longitudinal seams are not permitted on exterior or exposed rooftop mounted ductwork.
- D. Caulking, taping, or other joint or seam treatment shall be provided in accordance with recognized standards.
- E. Seams around fan, coil housing and plenums shall be sealed with gaskets or sealing compound to provide an airtight assembly.
- F. Stainless steel ductwork connected to range hoods and fume hoods shall be provided with grease-tight, gas tight welded seams, and shall be constructed and installed so that grease or other material cannot become pocketed in any portion thereof, and system shall slope downward toward hood not less than 1/4 inch per lineal foot. Gasketed flanged joints with sealing compound shall be used only at fan and fume hood connections.
- G. Alternative duct connectors such as Ductmate Industries, Mez Industries, or equal may be used if the following conditions are met:

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Specifications

1. One of the specifically listed connectors is submitted and approved by the Architect and OAR.
2. The correct size connector, application, and gage of material conform to SMACNA Standards.
3. The connector is installed per manufacturer's specifications.

3.07 DUCT TRANSITION

- A. Slopes in sides of transition pieces shall be no greater than 1 to 5. Abrupt changes or offsets in duct system are not permitted, except when reviewed by the Architect.

3.08 DUCT TEST HOLES

- A. Holes in ducts and plenums shall be provided for pilot or static tubes for obtaining air measurements to balance or check air systems. Holes shall be covered with neoprene gasketed sheet metal cover or plugged with a fitted neoprene plug chained to duct.

3.09 SOUND ATTENUATING EQUIPMENT

- A. Install sound attenuators where required and indicated on Drawings. Refer to manufacturer's instructions for required installation.

3.10 FLEXIBLE CONNECTIONS

- A. At points where sheet metal connections are installed to fans or air handling units, or where ducts of dissimilar metals are connected, a flexible connection of commercial grade, Duro Dyne Durolon, Ventfabrics Ventglas, Ductmate Industries Proflex, or equal, non-combustible material shall be installed and securely fastened by zinc-coated steel clinch-type bands or a flange type connection. Inlet and outlet openings shall be axially in-line, maximum deviation of centerline shall be less than 5 percent of diameter or shortest dimension of a rectangular inlet of fan or air handling unit, with system at rest. Duct end of connection shall be seismically restrained if more than 4 feet from last support.

3.11 AIR TERMINAL DEVICES

- A. General: Install supply devices after ducts, plenums, and casings have been cleaned and blown free of small particles, as specified. Devices shall be aligned to be parallel to ceiling construction or walls and ceiling surfaces, and shall be pulled tightly to compress gaskets and to fit neatly against surfaces.
- B. Diffusers: Support surface mounted ceiling diffusers from angles or channels resting on and fastened to ceiling construction. Do not support from ducts. Install lay-in diffusers on T-bar ceilings with hanger wires from each corner and not supported by ceiling structure. Provide sheet metal adaptor box above each diffuser to allow space for volume controller with round collars for connection to round ducts where indicated on Drawings. Fasten duct-mounted diffusers to duct collars.
- C. Registers and Grilles:

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Specifications

1. Install wall supply registers at least 6 inches below ceiling, unless otherwise indicated. Locate return and exhaust registers 6 inches below ceiling unless otherwise indicated.
2. Support ceiling diffuser type inlets, registers, and grilles as required above for ceiling diffusers.
3. Fasten wall mounted and duct mounted registers and grilles to flanges of duct collars.

3.12 DAMPERS

- A. Manually operated dampers, gravity dampers, fire dampers, and motor operated dampers shall be furnished and installed as specified and indicated. Upon completion of installation, dampers shall be checked, lubricated, and adjusted so that they operate freely, without binding. Dampers shall be of standard commercial manufacture, complete with damper frame. Where painting is required, they shall be shop finished unless otherwise noted.
1. Provide and install manual volume dampers per SMACNA standards to allow balancing per AABC, NEBB or TABB Procedures and Standards whether indicated on the drawings or not.
 2. Balancing dampers shall be installed in main supply ducts from fan discharge plenums, where two or more ducts are connected to each plenum, although such balancing dampers may not be indicated. Each zone shall be provided with a manual volume damper. Sheet metal screws shall be installed through handles and into ducts to lock damper in place after test and balance.
 3. Each supply, return, and exhaust branch shall be provided with manual volume dampers.
 4. Do not provide opposed blade dampers at air inlets and outlets.
 5. Each supply, return, and exhaust inlet or outlet shall be provided with a manual volume damper. This damper shall be a minimum of 5 feet upstream of the air outlet and inlets. An acoustic flexible duct should be provided between the outlet and inlet and the damper for concealed ducts.
 6. Dampers installed in accessible locations shall be provided with locking and indicating quadrants. Ventfabrics Ventlok, Duro Dyne, Young Regulator Co., or equal.
 7. Dampers installed in ductwork in furred ceiling spaces or in roof spaces with less than 30 inches of clearance below beams, joists, or other construction, and where access panels are not provided shall be furnished with damper rods extended below ceiling and terminated with a concealed damper regulation. Ventfabrics Ventlok, Young Regulator Co., Duro Dyne, or equal.
 8. Dampers not identified as splitter, extractor, or butterfly dampers shall be of multi-louver type arranged for opposed blade operation. Damper shall be same dimension as adjoining duct and be tight closing. Blades shall not be greater than 9 inches. Dampers shall be not less than 18 gage steel.

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Specifications

9. Motor operated dampers shall be furnished by temperature control manufacturer as part of temperature control equipment and shall conform to requirements of Section 23 0900: HVAC Instrumentation and Controls.
10. Dampers shall be provided with accessible operating mechanisms. Where operators are exposed in finished portions of building, operators shall be chromium-plated with exposed edges rounded. Splitter dampers are not permitted unless specified and reviewed by the Architect.
11. Dampers shall not be installed in combustion air ducts.
12. Access panels shall be installed for access at each damper's operating mechanism.

3.13 FIRE AND SMOKE DAMPERS

- A. Fire dampers or combination fire and smoke dampers shall be installed and accessible at duct penetrations of rated walls and partitions and as required by State Fire Marshal and NFPA 90A, 92A, 92B, and 101.
- B. Fire dampers shall be sized, and adjoining duct enlarged, to assure full size air passage of connecting ductwork.
- C. Install smoke dampers as indicated on Drawings and as required in ducts penetrating smoke isolation separations.
- D. Fire dampers or combination fire and smoke dampers shall be electrically actuated, power open-fail close type, UL 555 and UL 555S classified for 1-1/2 hours.
- E. Provide a service disconnect switch for each and every combination smoke and fire damper.

3.14 SMOKE DETECTORS

- A. Smoke detectors shall be installed in accordance with requirements of the California Mechanical Code.
- B. Smoke detectors shall be installed in systems of over 2000 CFM capacity to detect presence of smoke and automatically shut down air handling units or fans unless it has been verified with the electrical installer that Exception 1 to CMC 609.0: Automatic Shutoffs, regarding automatic shut down of systems with total coverage smoke detection systems is applied.
- C. Smoke detectors shall be installed in supply system downstream of filters.

3.15 BACKDRAFT DAMPERS

- A. Backdraft dampers shall be installed at locations indicated in accordance with the State of California Building Energy Efficiency Standards, Title 24, CCR.

3.16 DUCT SLEEVES AND PREPARED OPENINGS

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Specifications

- A. Furnish duct sleeves for 15-inch diameter ducts or less passing through floors, walls, ceilings, or roof and install during construction of the floor, wall, ceiling, or roof. Install round ducts larger than 15 inches diameter and square and rectangular ducts passing through floors, walls, ceilings or roof through prepared openings. Provide duct sleeves and prepared openings for duct mains and duct branches.
- B. Provide one inch clearance between duct and sleeve or between insulation and sleeves for insulated ducts, except at grilles, registers and diffusers.
- C. Provide prepared openings for round ducts larger than 15 inches in diameter and for square and rectangular ducts with one inch clearance between duct and openings or between insulation and opening for insulated ducts, except at grilles, registers and diffusers.
- D. Provide closure collar of galvanized sheet metal not less than 4 inches wide unless otherwise indicated on Drawings on each side of walls or floors where sleeves or prepared openings are provided except where grilles or diffusers are installed. Install collar tight against surface. Fit sharp edges of collar installed around insulated duct to preclude tearing or puncturing insulation covering vapor barrier. Fabricate collars from round ducts in steel. Provide not less than 4 nails to attach collar where openings are 12 inches in diameter or less and not less than 8 nails where openings are 20 inches in diameter or less.
- E. Pack space between sleeve or opening and duct or duct insulation with commercial grade packing yarn.

3.17 FLEXIBLE DUCT RUNOUTS

- A. Runouts from branches, risers or mains to air terminal units and outlets may be pre-insulated, factory fabricated flexible ducts complying with NFPA 90A. Flexible ductwork shall not exceed 7 feet in length. When required to suspend flexible ducts, furnish hangers of type recommended by manufacturers of pre-insulated flexible duct and install at intervals recommended. Method of attachment to other components of air distribution system for a vapor-tight joint shall be in accordance with printed instructions of flexible duct manufacturer. Bend radius shall be 1-1/2 times diameter of duct, measured from centerline. Bends greater than 90-degree angle are not permitted. Non-metallic flexible duct shall be permitted only in T-bar suspended ceilings.

3.18 DUCT HANGERS AND SUPPORTS

- A. Exposed or easily accessible ductwork: Single horizontal ducts shall be suspended from heavy steel hanger straps securely fastened to overhead structural members. Ducts shall be supported by a hanger strap passing around and fastened to duct with not less than two Parker No. 10 screws set approximately 2 inches in from each edge, to form a supporting stirrup attached to overhead supports. Rectangular ducts shall be provided with two hanger straps, one located on each side of duct. Round ducts may be installed from a single hanger strap unless conditions require that duct be held tight against ceiling, in which case two hanger straps may be brought down each side of duct, oriented at right angles to axis of duct and securely fastened to duct standing leg seam or angle iron stiffener with a minimum of two bolts, measuring 1/4 inch, for each side of duct. Hanger straps shall be galvanized with a minimum size of 1 1/8-inch by 14 gage. Angles of galvanized steel of 1 1/8-inch by 1 1/8-inch by 16 gage (14 gage for ducts 60 inches or greater) may be furnished instead of straps.
- B. Non-accessible ductwork: Non exposed and hidden from sight during regular school operations ductwork, rigid round, rectangular, and flat oval metal ducts, shall be installed with support systems conforming to SMACNA Standards.

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Specifications

- C. Where ducts are installed one above the other, they shall be individually supported on a trapeze of steel angles with 3/8 inch supporting steel rods securely fastened to overhead construction. A minimum distance of 3 inches shall be maintained between ducts wherever possible, but in no event shall distance be less than 2 inches. Minimum sizes of steel angles shall be 1 ½-inch by 1 ½-inch by 1/8 inch for duct sizes through 60 inches in greatest dimension, 2-inch by 2-inch by 1/8 inch for duct sizes 61 inches through 84 inches, 2-inch by 2-inch by 3/16 inch for duct sizes 85 inches through 96 inches, and 2-inch by 2-inch by 1/4 inch for duct sizes over 97 inches.
- D. Ducts 30 inches square area and greater and ducts 20 feet long and longer shall be seismically restrained. Refer to Section 23 0548: HVAC Sound, Vibration and Seismic Control.
- E. Hangers shall not be supported by, or fastened to, non-structural members including blocking. Toggle or Molly type bolts are not permitted.
- F. Vertical ducts shall be supported with suitable angles on each side of each duct located at each floor and at intervals not to exceed 8 feet. Angles shall be sized and installed according to SMACNA Standards for required span so that they will be rigid, without bending or sagging.
- G. Roof-mounted ductwork shall be installed a minimum 12 inches above roof and shall be supported by galvanized welded pipe, one on each side, fastened to roof structure, flashed and sealed to roof membrane. Install supports at each turn, unit connections, and each penetration, and space at maximum 6 feet off-center in general. Pitch pockets are not allowed.

3.19 ACCESS PLATES AND DOORS

- A. Access plates and doors shall be furnished and installed where stops, valves, fire dampers, fusible links, coils, damper operating mechanism, control equipment, lubrication fittings, air filters, air handling equipment and similar items normally requiring adjustment or servicing are installed in concealed spaces.
- B. Access plates and doors shall be located to permit convenient access to equipment sized to permit removal of equipment for servicing. Access plates shall be no less than 12-inch by 12-inch in clear opening. Proper servicing of equipment requires adequate access for maintenance personnel. Access doors shall not be less than 24-inches by 24-inch, unless otherwise detailed. Two or more valves shall not be located in same access area unless sufficient clearance is provided for operation, servicing and removal of each valve.
- C. Openings in ducts or plenums whose longer dimension does not exceed 12 inches may be covered by a plate of same material as duct, gasketed and fastened to duct or plenum with sheet metal screws.
- D. Access plates in floors shall not be less than 8-inch by 8-inch and shall be carborundum surface brass with cast brass frames anchored into concrete. Access plates in tile walls shall be chromium plated brass and polished. Serrated plates furnished as part of a clean-out assembly are permitted in floors instead of a separate plate.
- E. Access plates and doors in walls and ceilings of finished rooms and in locations normally accessible to students shall be furnished with continuous piano hinges, unless otherwise specified, and a special flush type spring-loaded latch requiring an Allen wrench to operate. Access devices shall be installed after plastering in plaster ground openings.

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Specifications

- F. Access panels or doors penetrating one-hour fire resistive ceilings shall meet code requirements for such openings.
 - G. Access panels shall be fire-rated; Milcor, or equal. Access doors shall be as required for installation in openings penetrating one-hour fire resistive ceilings. Access doors shall be furnished with a flush, key-operated cylinder lock, furnished with two keys each, instead of Allen headlock for non-rated ceilings.
 - H. Access panels that are part of an integrated ceiling are specified in Section 09 8433: Cementitious Wood Fiber Acoustical Units. Identification markers shall be affixed to adjacent supports, under this portion of Work, to indicate location and type of mechanical device to be serviced.
 - I. Access panels installed in ducts or plenums located in heater or equipment rooms containing gas-fired equipment shall be furnished with heavy-duty spring closing hinges and refrigerator door type catches unless otherwise required. When these panels are intended for maintenance personnel access, catches shall be operable from both interior and exterior.
 - J. Other access panels, except those specified above, shall be furnished with suitable hinges and one or more sash fasteners.
 - K. Panels located in ducts and plenums shall be installed with gaskets made of synthetic rubber, felt, or similar material to provide an airtight installation. Panels shall be constructed and reinforced to prevent vibration.
 - L. Label the words "FIRE DAMPERS" on panels over fire dampers and words "DO NOT OPEN - HEATER IS OPERATING" on panels located in heater or equipment rooms. Letters shall be approximately 3 inches high, if space is available.
 - M. Furnish a key to operate latch access plates, one for each access plate, but not to exceed five keys for any one Project.
 - N. Access plates and panels shall be furnished with manufacturer's name or trade mark and model number cast or stamped thereon, or upon a label permanently affixed thereon.
 - O. Provide duct through roof flashing as detailed in the SMACNA standards or as indicated on Drawings.
 - P. Refer to SMACNA for access plate and door construction.
- 3.20 PRESSURE TESTING
- A. Test all supply, return and exhaust ducts, plenums and casings at static pressure indicated for system to insure substantially airtight ducts per current industry standards before covering with insulation or concealing in masonry. Substantially airtight shall be construed to mean that no air leakage is noticeable through senses of feeling or hearing at duct joints. Test ductwork for leaks at 1 ½ times operating pressure but at a minimum of 2 inches of water.
- 3.21 CLEANUP
- A. Remove rubbish, debris and waste materials and legally dispose off the Project site.

- A. Protect the Work of this Section until Substantial Completion.

END OF SECTION

SECTION 23 80 00 - HEATING, VENTILATING AND AIR CONDITIONING EQUIPMENT

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes: Air conditioning and air handling equipment including but not limited to:
 - 1. Variable Refrigerant Flow Systems.
 - 2. Fans.
- B. Related Requirements:
 - 1. Division 01: General Requirements.
 - 2. Section 07 6000: Flashing and Sheet Metal.
 - 3. Section 22 1000: Plumbing.
 - 4. Section 23 0500: Common Work Results for HVAC.
 - 5. Section 23 0513: Basic HVAC Materials and Methods.
 - 6. Section 23 0548: HVAC Sound, Vibration and Seismic Control.
 - 7. Section 23 0900: HVAC Instrumentation and Controls.
 - 8. Section 23 0923: Environmental Control and Energy Management System.
 - 9. Section 23 3000: Air Distribution.

1.02 DESIGN REQUIREMENTS

- A. Work of this Section is based on HVAC equipment units indicated as Basis of Design in Part 2 of this Section. Products from different HVAC equipment manufacturers listed are never identical, although equivalent in capacity, performance and quality. In the cases where dimensions, weight, configuration and utility requirements differ from the products used as a basis of design, the Contractor, at no additional cost to the Owner, shall coordinate and submit, for Architect review, revisions to the design.

1.03 SUBMITTALS

- A. Provide in accordance with Division 01 and Section 23 0500: Common Work Results for HVAC.
- B. For products listed that are not the basis of design, submit the following in addition to above requirements:
 - 1. Title 24 Calculations: Replace HVAC unit values in calculation files provided by the Architect and submit for review.

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1.04 QUALITY ASSURANCE

Specifications

- A. Provide submittals in accordance with Section 23 0500: Common Work Results for HVAC.

1.05 PROJECT RECORD DOCUMENTS

- A. Provide Owner instructions on equipment operation and maintenance procedures, as indicated in Section 23 0500: Common Work Results for HVAC.

1.06 WARRANTY

- A. Compressors shall be provided with manufacturer's five year warranty, (replacement only).
- B. Manufacturer shall warrant parts, except heat exchangers, for a period of five years.
- C. Heat exchangers shall be provided with manufacturer's ten year warranty, (replacement only).

PART 2 – PRODUCTS

2.01 EQUIPMENT

- A. Capacities of air conditioning equipment indicated on Drawings are net capacities actually required. Standard catalog ratings shall be adjusted to actual Project site environmental conditions.

2.02 VARIABLE REFRIGERANT FLOW SYSTEMS

- A. The HVAC equipment basis of design is LG Multi-V variable refrigerant volume. All bidders shall furnish the minimum system standards as defined by the base bid model numbers, model families or as otherwise specified herein. In any event the contractor shall be responsible for all specified items and intents of this document without further compensation.
- B. AIR-COOLED, COMPRESSOR-CONDENSER UNIT, HEAT RECOVERY
 - 1. General:
 - a. The air-conditioning system shall use R410A refrigerant.
 - b. Each system shall consist of one, two or three air source outdoor unit frame.
 - c. Dual and triple frame configurations shall be field piped together using manufacturer's designed and supplied Y-branch kit in conjunction with field provided interconnecting pipe to form a common refrigerant circuit.
 - d. Refrigerant circuit configuration for Heat Recovery System

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Specifications

- i. The refrigerant circuit shall be constructed using field provided copper piped together with manufacturer supplied Heat Recovery unit(s) ,Y- branches or Header fittings, connected to (ducted, non-ducted or combination thereof) single/multiple indoor units to effectively and efficiently control the simultaneous heating and cooling operation of the VRF system.
- ii. Each refrigerant pipe, y-branch, header kit, elbows and isolation ball valves shall be individually insulated with no air gaps. All joints shall be glued and sealed.
- e. Factory installed microprocessor controls in the outdoor unit(s), HR unit(s), and indoor unit(s) shall perform functions to efficiently operate the VRF system and communicate in a daisy chain configuration between each other. Communications and cabling shall conform to RS485 standard.
- f. The system shall be designed to accept connection up to 58 indoor units depending on the outdoor unit model selected.
- g. The outdoor unit shall have a fusible plug.
- h. The fusible plug shall have a threaded connector.
- i. The unit shall be shipped from the factory fully assembled including internal refrigerant piping, compressor, contacts, relay(s), power and communications wiring necessary.
- j. Each refrigeration circuit shall have the following components:
 - i. Refrigerant strainer(s)
 - ii. Check valve(s)
 - iii. Oil separator
 - iv. Accumulator
 - v. 4-way reversing valve
 - vi. Vapor injection valve
 - vii. Variable path valve
 - viii. Oil balancing valve for Hi-POR (Available for 12 & 14 ton only)
 - ix. Oil Level sensor
 - x. Electronic expansion valve(s)
 - xi. Sub-cooler
 - xii. High and low side Schrader valve service ports with caps.

2. Unit Cabinet:

- a. Outdoor unit cabinet shall be made of 20 gauge galvanized steel with an enamel finish.
- b. Outdoor unit cabinet finish shall be tested in accordance with ASTM B-117 salt spray test procedure for a minimum of 1000 hours.
- c. The front panels of the outdoor units shall be removable type for access to internal components.
- d. A smaller service access panel, not larger than 6.25"x 6.67" and secured by a maximum of (2) screws shall be provided to access the following:
- e. Service tool connection
 - i. DIP switches
 - ii. Auto addressing
 - iii. Error codes
- f. The cabinet shall have piping knockouts to allow refrigerant piping to be connected at the front or through the bottom of the unit.

3. Fan:

- a. Each 6 ton cabinet shall be equipped with one direct drive variable speed propeller fan with Brushless Digitally Controlled (BLDC) motor with a vertical air discharge.
- b. Each 8 to 14 ton cabinet shall be equipped with two direct drive variable speed propeller fan(s) with BLDC motor(s) with a vertical air discharge.
- c. The fan(s) blades shall be made of Acrylonitrile Butadiene Styrene (ABS) material.
- d. The fan(s) motor shall be equipped with permanently lubricated bearings.
- e. The fan motor shall be variable speed with a maximum operating speed of 1050 RPM.
- f. The fan shall have a raised guard to help prevent contact with moving parts.
- g. The cabinet shall have option to change the discharge air direction from vertical to horizontal using optional factory provided air guides.
- h. The cabinet shall have DIP switch setting to raise external static pressure up to 0.32 in-wg.

4. Condenser Coil:
 - a. The outdoor unit shall have a factory built coil comprised of aluminum fins mechanically bonded on copper tubing.
 - b. The copper tubes shall have inner grooves.
 - c. The aluminum fins shall have factory applied corrosion resistant GoldFin™ material.
 - d. Hydrophilic Coil coating shall be tested in accordance with ASTM B-117 salt spray test procedure for a minimum of 1000 hours
 - e. The outdoor unit coil shall be tested to a pressure of 551 psig.
 - f. The coil for each cabinet shall have 14 Fins per Inch (FPI).
 - g. All the outdoor units shall have a 3 rows heat exchanger.
 - h. The cabinet shall have a coil guard.
5. Compressor:
 - a. Each 6, 8, 10 ton cabinet shall be equipped with one hermetically sealed, inverter driven, High Side Shell (HSS) scroll compressor.
 - b. The 12 and 14 ton cabinet shall be equipped with two hermetically sealed, inverter driven, HSS controlled scroll compressors.
 - c. Each inverter driven, HSS scroll compressor shall be capable of operating in a frequency range from 15 Hz to 150 Hz with control in 0.5 Hz increments.
 - d. The compressor(s) shall be equipped with a 60 Watt crankcase heater.
 - e. The compressor shall use a factory charge of Polyvinyl Ether (PVE) oil.
 - f. The compressor bearing(s) shall have Teflon™ coating.
 - g. The compressor(s) shall be protected with:
 - i. High Pressure switch
 - ii. Over-current /under current protection
 - iii. Phase failure
 - iv. Phase reversal
 - h. Standard, non-inverter driven compressors shall not be permitted
6. Oil Management

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Specifications

- a. The system shall have Hi-POR (High Pressure Oil Return) to ensure a consistent film of oil on all moving compressor parts at low speed. Oil is returned to compressor through a separate oil injection pipe.
- b. Oil return system shall maintain high side pressure return to the compressor
- c. The system shall be provided with a centrifugal oil separator designed to extract oil from the oil/refrigerant gas stream leaving the compressor and return the extracted oil to the compressor oil sump.
- d. The system shall have an oil level sensor in the compressor to provide direct oil level sensing.
- e. The system shall only initiate an oil return cycle if the oil level is too low.
- f. Timed oil return operations or non-oil level sensing systems shall not be permitted.

7. Refrigerant Management

- a. System shall have advanced refrigerant control functions that optimize operating efficiency at all ambient operating conditions. Advanced refrigerant control functions shall include:
- b. Accumulator shall be equipped with controls that vary the amount of refrigerant charge being circulated based on operating mode.
- c. Outdoor unit coil shall be equipped with controls that maximizes heat transfer. Controls shall vary the coil circuiting between parallel and series configurations and be able to change flow direction in response to multiple refrigerant monitoring parameters and operating conditions.
- d. Compressors shall be equipped with an intermediary port that introduces additional refrigerant to the compression chamber based on multiple refrigerant system monitoring parameters. This feature increases heating capacity at low ambient conditions.
- e. System shall have advanced refrigerant control functions that optimize operating efficiency at all ambient operating conditions. Advanced refrigerant control functions shall include:

8. Sound Levels

- a. Each cabinet shall be rated with a sound level not to exceed 59.5 dB(A) when tested in an anechoic chamber under ISO3745 standard.

9. Sensors

- a. Each single cabinet shall have
 - i. Suction temperature sensor

- ii. Discharge temperature sensor
- iii. High Pressure sensor
- iv. Low Pressure sensor
- v. Outdoor temperature sensor
- vi. Outdoor unit heat exchanger temperature sensor

C. HEAT RECOVERY UNIT (HRU) FOR HEAT RECOVERY SYSTEM

1. General

- a. HR unit shall be designed and manufactured by the same manufacturer of VRF indoor unit(s) and outdoor unit(s).
- b. HR unit casing shall be made with galvanized steel.
- c. HR unit shall require 208-230V/1-phase/60Hz power supply.
- d. HR Unit shall be an intermediate refrigerant control device between the air source outdoor unit and the indoor units to control the systems simultaneous cooling and heating operation.
- e. HR unit shall be engineered to work with a three pipe VRF system comprising of
 - i. High Pressure Vapor Pipe
 - ii. Low Pressure Vapor Pipe
 - iii. Liquid Pipe
- f. HR unit shall be designed to be piped in series or parallel.
- g. HR unit shall have 2, 3 or 4 ports.
- h. Each port shall be capable of operating in cooling or heating independently regardless of the operating mode of any other port on the HR unit or in the system.
- i. Each port shall be capable of connecting from 1 to 8 indoor units to a maximum nominal capacity of 54MBh.
- j. Maximum nominal capacity per HR unit shall not exceed 192MBh.
- k. Indoor units greater than 54MBh nominal capacity shall be twinned using a reverse Y-branch.
- l. HR unit shall be internally piped, wired, assembled and run tested at the factory.

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Specifications

- m. HR unit shall be designed for installation in a conditioned environment.
 - n. HR unit shall have a liquid bypass valve.
 - o. HR unit shall have (2) two-position solenoid valves per port.
 - p. HR unit shall have a balancing valve to control the pressure between the high pressure and low pressure pipe during mode switching.
 - q. HR unit shall have an electronic expansion valve for subcooling.
 - r. HR unit shall not require a condensate drain.
 - s. HR unit shall be internally insulated.
 - t. All field refrigerant lines between outdoor unit and HR unit and from HR unit to indoor unit shall be field insulated.
 - u. The HR unit shall not exceed a net weight of 49 lbs.
 - v. The system shall be designed to accommodate 16 HR units connected to Heat Recovery units piped in single series string.
 - w. A single series pipe string of 1 to 16 HR units shall be capable of serving indoor units with a total nominal capacity of 192 MBH per HR unit.
2. Piping Capabilities
- a. The elevation difference between indoor units on heat pump systems shall be 131 feet.
 - b. The elevation differences for heat recovery systems shall be:
 - i. Heat recovery unit (HRU) to connected indoor unit shall be 49 feet
 - ii. HRU to HRU shall be 49 feet
 - iii. Indoor unit to indoor unit connected to same HRU shall be 49 feet
 - iv. Indoor unit to indoor unit connected to separate parallel HRU's shall be 131 feet.
 - c. The acceptable elevation difference between two series connected HR units shall be 16 feet.
3. Controls
- a. HR unit(s) shall have factory installed unit mounted control boards and integral microprocessor to communicate with other devices in the VRF system.

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Specifications

- b. HR unit shall communicate with the air source unit via the air source/indoor unit 2-conductor shielded communications cable terminated using a daisy chain configuration.
 - c. The VRF manufacturer shall provide published documentation that specifically allows the installation of field provided isolation valves on all pipes connected to the Heat Recovery unit to allow the servicing of HR units refrigerant circuit or the replacement of HR unit without evacuating the balance of the piping system.
- D. BAS INTERFACE GATEWAY
1. Provide BTL certified BACnet Gateway allowing complete open protocol, 2 way communication between VRF system and various brands of BAS over BACnet/IP.
 2. An embedded web server shall be incorporated to facilitate troubleshooting and remote diagnostics or serve as an alternative method for manual system control whenever the BAS is offline.
 3. Interface shall be capable of controlling and monitoring up to 256 indoor units with the following functions:
 - a. Unit Run/stop
 - b. Zone Controller Permit/Prohibit
 - c. Operation Mode Cool/Dry/Fan/Auto/Heat
 - d. Fan Speed Low/Medium/High/Auto
 - e. Temperature Set point with upper and lower limits
 - f. Room Temperature
 - g. Alarms
 - h. Module shall require 120V power.
- E. EVAPORATOR-FAN UNIT (Configuration as indicated on plans)
1. General
 - a. Unit shall be factory assembled, wired, piped and run tested.
 - b. Unit shall be designed to be installed for indoor application.
 - c. Unit shall be designed to mount fully concealed above the finished ceiling, exposed suspended from overhead structure, integrated with the ceiling as an in ceiling cassette, surface mounted on wall or floor mounted as indicated on plans.

- d. Unit shall be capable to be installed with heat pump or heat recovery or cooling VRF system.
2. Casing/Panel
- a. Unit case shall be manufactured using galvanized steel plate.
 - b. The cold surfaces of the unit shall be covered internally with a coated polystyrene insulating material.
 - c. The cold surfaces of the unit shall be covered externally with sheet insulation made of Ethylene Propylene Diene Monomer (M-Class) (EPDM)
 - d. The external insulation shall be plenum rated and conform to ASTM Standard D-1418.
 - e. Unit shall be provided with hanger brackets designed to support the unit weight on a minimum of four corners.
 - f. Hanger brackets shall have pre-punched holes designed to accept field supplied, all thread rod hangers.
3. Cabinet Assembly
- a. Unit shall be equipped with factory installed temperature thermistors for
 - i. Return air
 - ii. Refrigerant entering coil.
 - iii. Refrigerant leaving coil.
 - b. Unit shall have a factory assembled, piped and wired electronic expansion valve (EEV) for refrigerant control.
 - c. Unit shall have a built-in control panel to communicate with other indoor units and to the outdoor unit.
 - d. Unit shall have the following functions as standard
 - i. Self-diagnostic function
 - ii. Auto restart function
 - iii. Auto changeover function (Heat Recovery system only)
 - iv. Auto operation function
 - v. Child lock function
 - vi. Forced operation

- vii. Dual thermistor control
 - viii. Sleep mode
 - ix. External static pressure (ESP) control
4. Fan Assembly
- a. The unit shall have direct driven Sirocco fans.
 - b. The fan shall be made of high strength ABS GP-2200 polymeric resin.
 - c. The fan motor shall be Brushless Digitally controlled (BLDC) with permanently lubricated and sealed ball bearings.
 - d. The fan/motor assembly shall be mounted on vibration attenuating rubber grommets.
 - e. The fan speed shall be controlled using microprocessor based direct digitally controlled algorithm.
 - f. In cooling mode, the indoor fan shall have the following settings: Low, Med, High and Auto.
 - g. In heating mode, the indoor fan shall have the following settings: Low, Med, High and Auto.
 - h. The Auto fan setting shall adjust the fan speed to most effectively achieve the set-point.
 - i. Each of the settings can be field adjusted from the factory setting (RPM/ESP).
5. Filter Assembly
- a. Rack for return filter of MERV 13 efficiency filter
6. Coil Assembly
- a. Unit shall have a factory built coil comprised of aluminum fins mechanically bonded on copper tubing.
 - b. Unit shall have minimum of 2 rows of coils.
 - c. Unit shall have a factory supplied condensate drain pan below the coil.
 - d. Horizontal unit shall be installed and wired condensate drain pump capable of providing minimum 27.5 inch lift from bottom surface of the unit.
 - e. Vertical unit shall be designed for gravity drain.
 - f. Unit drain pan shall be provided with a secondary drain port/plug allowing pan to be drained for service.
 - g. The drain pump shall have a safety switch to shut off the unit if condensate rises too high in the drain pan.
 - h. Unit shall have provision of 45° flare refrigerant pipe connections
 - i. The coil shall be factory pressure tested at a minimum of 551 psig.
 - j. All refrigerant piping from outdoor unit or Heat Recovery (HR) unit to indoor unit shall be field insulated.

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7. Microprocessor Control

- a. The unit shall have a factory installed microprocessor controller capable of performing functions necessary to operate the system.
- b. The unit shall be able to communicate with other indoor units and the outdoor unit using a field supplied minimum of 18 AWG, 2 core, stranded and shielded communication cable.
- c. The unit controls shall operate the indoor unit using one of the five operating modes:
 - i. Auto changeover (Heat Recovery System only)
 - ii. Heating
 - iii. Cooling
 - iv. Dry
 - v. Fan only

8. Electrical

- a. The unit electrical power shall be 208-230/1/60 (V/Ph/Hz)
- b. The unit shall be capable of operating within voltage limits of +/- 10% of the rated voltage.

9. Controls

- a. Unit shall use controls provided by the manufacturer to perform all functions necessary to operate the system effectively and efficiently and communicate with the outdoor unit over an RS485 daisy chain.

F. KEY GENERAL SPECIFICATIONS ALTERNATE SUPPLIER CHECKLIST

Submit proof of compliance with the following or proof that the current project conditions exclude compliance.

1. System includes software based selection output for performance, piping, wiring, etc.
2. System includes complete engineering data including capacity and piping connections, piping and wiring diagrams, sound levels, etc.
3. Capability for connecting up to (58) indoor units.
4. System includes smart oil control sensor for managed oil recovery timing.
5. Outdoor unit has variable pass heat exchanger and controls flow direction to maximum heat transfer at all operating conditions.
6. System accumulator shall have controls that vary refrigerant amount being circulated.
7. System is capable of 738 Equivalent Feet of piping from Outdoor unit to indoor unit.
8. System is capable of 3,280ft of total "one way" piping.

9. System can allow up to 295ft from the first branch point.
10. System can have a vertical separation of 360ft between outdoor and indoor units.
11. System can allow up to 131ft elevation difference between indoor units.
12. Condensing units have a fan/fan motor External Static Pressure up to 0.32" WG.
13. System includes a self-diagnostic, auto-check function to detect malfunctions.

2.03 ROOF MOUNTED POWER EXHAUST VENTILATORS

- A. RMEV-1
(Not Used)
- B. RMEV-2:
(Not Used)
- C. RMEV-3:
(Not Used)
- D. RMEV-4:
 1. Manufacturer: Fan shall be model LDP as manufactured by Greenheck, Loren Cook Company, Twin City, or equal.
 2. Spun aluminum, roof mounted, direct driven, louvered penthouse type ventilator, with components as indicated and specified. Sizes, performances, and accessories shall be as indicated on equipment schedules on Drawings. Also, provide accessories for proper operation and balancing of fans in accordance with design intent and sequence of operation.
 3. Certification: Fan shall be manufactured at an ISO 9001 certified facility. Fan shall be listed by Underwriters Laboratories Inc. (UL 705) and ETL listed for Canada. Fan shall bear AMCA Certified Ratings Seals for Fan Sound and Air Performance.
 4. Housing: Louvered penthouse shall be constructed of aluminum, with a hinge for access to motor. Hood shall be a heavy extruded aluminum with mitered and welded corners and leak resistant.
 5. Wheel: Wheel shall be centrifugal backward inclined, constructed of 100 percent aluminum. The wheel cone and fan inlet will be matched and shall have precise running tolerances for maximum performance and operating efficiency. Wheel shall overlap the spun venture for maximum performance. Wheel shall be balanced in accordance with AMCA Standard 204, Balance Quality and Vibration Levels for Fans.

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6. Motor: Motor shall be open drip proof type with permanently lubricated bearings, built-in thermal overload protection and disconnect plug. Motor shall be a DC electronic commutation type motor (ECM) specifically designed for fan applications. AC induction type motors are not acceptable. Motors are permanently lubricated, heavy duty ball bearing type to match with the fan load and pre-wired to the specific voltages and phase. Internal motor circuitry to convert AC power supplied to the fan to DC power to operate the motor. Motor shall be speed controllable down to 20% of full speed (80% turndown). Speed shall be controlled by either a potentiometer dial mounted at the motor or by a 0-10 VDC signal. Motor shall be a minimum of 85% efficient at all speeds.

2.04 CEILING CABINET FANS

A. CCF-1:

1. Manufacturer: Fan shall be CSP 100-3600 Series as manufactured by Greenheck, Loren Cook Company, Twin City or equal.
2. Provide ceiling, wall, or inline mounted, direct driven, centrifugal exhaust fans of sizes, capacities and configurations indicated on drawings, complete with accessories for installation of fans. Also, provide accessories for proper operation and balancing of fans in accordance with design intent and sequence of operation.
3. Certification: Fan shall be manufactured at an ISO 9001 certified facility. Fan shall be listed by Underwriters Laboratories (UL 705) and ETL listed for Canada. Fan shall bear AMCA Certified Ratings Seal for Sound and Air Performance.
4. Housing: The fan housing shall be minimum 20 gage galvanized steel and acoustically insulated. Blower and motor assembly shall be mounted to a minimum 14 gage reinforcing channel and shall be easily removable from housing. Motor shall be mounted on vibration isolators. Unit shall be supplied with integral wiring box and disconnect receptacle shall be standard. Discharge position shall be convertible from right angle to straight through by moving interchangeable panels. The outlet duct collar shall include a reinforced aluminum damper with continuous aluminum hinge rod and brass bushings. To accommodate different ceiling thickness, an adjustable prepunched mounting bracket shall be provided. A powder painted white steel grille shall be provided as standard. Unit shall be shipped in ISTA Transit Tested Certified packaging.
5. Wheel: Wheel shall be centrifugal forward curved type, constructed of galvanized steel. Wheel shall be balanced in accordance with AMCA Standard 204, Balance Quality and Vibration Levels for Fans.
6. Motor: Motor shall be open drip proof type with permanently lubricated bearings, built-in thermal overload protection and disconnect plug. Motor shall be furnished at specified voltage.

B. CCF-2:

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1. Manufacturer: Fan shall be SQ Series as manufactured by Greenheck, Loren Cook Company, Twin City or equal.
2. Provide inline mounted, direct driven, centrifugal exhaust fans of sizes, capacities and configurations indicated on drawings, complete with accessories for installation of fans. Also, provide accessories for proper operation and balancing of fans in accordance with design intent and sequence of operation.
3. Certification: Fan shall be manufactured at an ISO 9001 certified facility. Fan shall be listed by Underwriters Laboratories (UL 705) and ETL listed for Canada. Fan shall bear AMCA Certified Ratings Seal for Sound and Air Performance.
4. Housing: The fan housing shall be minimum 20 gage galvanized steel and acoustically insulated. Blower and motor assembly shall be mounted to a minimum 14 gage reinforcing channel and shall be easily removable from housing. Motor shall be mounted on vibration isolators. Unit shall be supplied with integral wiring box and disconnect receptacle shall be standard. Discharge position shall be convertible from right angle to straight through by moving interchangeable panels. The outlet duct collar shall include a reinforced aluminum damper with continuous aluminum hinge rod and brass bushings. To accommodate different mounting positions, an adjustable pre-punched mounting bracket shall be provided. Unit shall be shipped in ISTA Transit Tested Certified packaging.
5. Wheel: Wheel shall be non-overloading, centrifugal backward inclined type, constructed of aluminum. Wheel shall be balanced in accordance with AMCA Standard 204, Balance Quality and Vibration Levels for Fans.
6. Motor: Motor shall be open drip proof type with permanently lubricated bearings, built-in thermal overload protection and disconnect plug. Motor shall be a DC electronic commutation type motor (ECM) specifically designed for fan applications. AC induction type motors are not acceptable. Motors are permanently lubricated, heavy duty ball bearing type to match with the fan load and pre-wired to the specific voltages and phase. Internal motor circuitry to convert AC power supplied to the fan to DC power to operate the motor. Motor shall be speed controllable down to 20% of full speed (80% turndown). Speed shall be controlled by either a potentiometer dial mounted at the motor or by a 0-10 VDC signal. Motor shall be a minimum of 85% efficient at all speeds.

2.05 GRAVITY EXHAUST/INTAKE VENTILATORS

A. GEIV-1:

1. Manufacturer: Unit shall be model PR or TR as manufactured by Loren Cook Company, Greenheck GRS Series, Twin City, or equal.
2. Spun aluminum, roof mounted gravity ventilators of sizes, capacities and configurations indicated on drawings, complete with accessories for installation of ventilators. Also, provide accessories for proper operation

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of ventilators per code and in accordance with design intent and
sequence of operation.

3. Certification: Fan shall be manufactured at an ISO 9001 certified facility.
4. Housing: The unit shall be of bolted and welded construction utilizing corrosion resistant fasteners. The spun aluminum structural components shall be constructed of minimum 16 gage marine alloy aluminum, bolted to a rigid aluminum support structure. The aluminum base shall have continuously welded curb cap corners for maximum leak protection. The spun aluminum baffle shall have a rolled bead for added strength. Birdscreen constructed of 1/2" mesh shall be mounted across air opening. Unit shall bear an engraved aluminum nameplate and shall be shipped in ISTA Transit Tested Certified packaging.
5. Provide gravity type back-draft or relief dampers at relief or exhaust ventilators (with counterweights if required). Gravity relief dampers shall fully open at 0.01" static pressure.
6. Intake ventilators shall be provided with normally closed, motorized dampers that are interlocked with fan to open upon fan activation unless fan is provided with such a damper.

2.06 FILTERS

- A. Air filters shall be of pleated, high capacity, disposable type of efficiencies indicated on drawings. Each filter shall consist of a non-woven cotton fabric media, media support grid, and enclosing frame. Filter shall be UL 900 listed, Class 2.
- B. Filter media shall provide an average efficiency as specified on drawings per ASHRAE Standard 52.2.
- C. Initial resistance of air filters shall not exceed following limits for each efficiency level at face velocities indicated. Lower resistance requirements, if indicated on drawings shall have precedence.

30 percent (MERV 8)	0.27 inch water gage at 500 feet per minute
75 percent (MERV 11)	0.28 inch water gage at 500 feet per minute
85 percent (MERV 13)	0.30 inch water gage at 500 feet per minute
95 percent (MERV 14)	0.38 inch water gage at 500 feet per minute
- D. Media support shall be a welded wire grid or a rigid frame with an effective open area of not less than 96 percent.
 1. Media support shall be bonded to filter media to eliminate possibility of media oscillation and media pull-away.
 2. Media support grid shall be formed in such a manner that it effectively forms a radial pleat design, providing total use of filter media.
- E. Enclosing frame shall be bonded to air entering and air exit side of each pleat, to ensure pleat stability. Inside periphery of enclosing frame shall be bonded to filter pack, thus eliminating possibility of air bypass.

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F. Holding frames shall be factory fabricated of 16 gage galvanized steel, or equivalent and shall be furnished with gaskets and spring type positive sealing fasteners. Fasteners shall be capable of being attached or removed without use of tools.

G. Manufacturers: Camfil Farr, Koch, or AAF.

2.14 LOUVERS, AIR CONDITIONING (use in conjunction with relief damper)

A. Standard steel louvers shall be furnished complete with frames, blades, finish and construction details per Drawings and manufacturer's recommendations.

B. Louvers shall be furnished with horizontal blades, 2 inches deep for air through wall installation in conjunction with gravity relief damper for backdraft protection that will open at 0.01 inch wc room static pressure as indicated on Drawings. Blades shall be 16-gage steel, spaced at 1 7/8-inch at 30 degrees angle, and with baked epoxy coating. Panel size shall be as indicated but not less than 24 inches width by 18 inches in height.

PART 3 – EXECUTION

3.01 GENERAL

A. Examine areas under which Work of this Section will be performed. Correct conditions detrimental to proper and timely completion of Work. Do not proceed until unsatisfactory conditions have been corrected.

3.02 EQUIPMENT FOUNDATIONS

A. Provide foundations (housekeeping pads, level platforms or curbs) for mechanical equipment whether indicated on drawings or not. Equipment foundations shall be of sufficient size and weight, and of proper design to preclude shifting of equipment under operating conditions, or under abnormal conditions imposed upon equipment.

B. Provide foundations (housekeeping pads, level platforms or curbs) for mechanical equipment whether indicated on drawings or not. Foundations shall meet requirements of equipment manufacturer and, when required by Architect, obtain from equipment manufacturer, approval of foundation design and construction, for equipment to be installed. Equipment vibration shall be maintained within design limits, and shall be dampened and isolated. Isolators shall be bolted to a structural member so as to be readily removable.

3.03 EQUIPMENT DESIGN AND INSTALLATION

A. Uniformity: Unless otherwise specified, equipment of same type or classification shall be product of same manufacturer.

B. Application: Only provide equipment as reviewed by Architect.

C. Equipment Installation: Equipment installation shall be in strict accordance with these Specifications, and installation instructions of manufacturers. Equipment installed on concrete foundations shall be grouted before piping is installed. Piping shall be installed in such a manner as not to place a strain on equipment. Flanged joints shall be

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adequately extended before installation. Piping shall be graded, anchored, guided and supported, without low pockets.

1. Install equipment in a neat and skillful manner, properly aligned, leveled, and adjusted for satisfactory operation.
2. Install so connecting and disconnecting of piping and accessories can be readily accomplished, parts are readily accessible for inspection, service and repair. Space shall be provided to readily remove filters, coils, compressors and fan wheels. Access doors shall be hinged with cam lock door handles.
3. Provide flexible connections for duct, pipe and conduit connections at moving equipment.

3.04 ROOF-TOP EQUIPMENT MOUNTING

- A. Downflow Packaged Units: Install unit on a prefabricated mounting frame or curb secured directly to roof. Follow manufacturers recommended installation manuals. Submit Shop Drawings for review by Architect.
- B. Horizontal Flow Packaged Units: Install unit on platform or prefabricated mounting frame or curb secured directly to roof designed to suit roof conditions and requirements of provided unit. Submit Shop Drawings for review by Architect.

3.05 NOISE AND VIBRATION

- A. Operation of Equipment: Mechanical equipment and piping systems shall operate without exceeding specified noise and/or vibration levels.
- B. Corrective Measures: If specified noise and/or vibration levels are exceeded, provide necessary changes to reduce noise and/or vibration levels to within specified levels.

3.06 FIELD TESTS AND INSPECTION

- A. General: Perform field inspections, field tests, and trial operations as specified in Section 23 0500: Common Work Results for HVAC. Provide labor, equipment and incidentals required for testing. The Project Inspector will witness field tests and trial operations as specified in Section 23 0500: Common Work Results for HVAC.
- B. Equipment and Material: Equipment and material certified as being successfully tested by manufacturer, in accordance with referenced Specifications and standards, will not require re-testing before installation. Equipment and materials not tested at place of manufacture will be tested before or after installation, as applicable or necessary, to determine compliance with reference Specifications and standards.
- C. Start-Up and Operational Test: System shall be started up and initially operated with components operating. During this test, various strainers or filters shall be periodically cleaned until no further accumulation of foreign material occurs. Adjust safety and automatic control instruments as required to provide proper operation and control sequence. Refer to Section 23 0500: Common Work Results for HVAC.

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- D. Extent of Field Tests: After installation and before completion, Work of this Section shall be subjected to required field tests, including those specified here and in Section 23 0500: Common Work Results for HVAC.
- E. Operation and Maintenance Data: Provide required operation and maintenance data as specified in Section 23 0500: Common Work Results for HVAC.

3.07 REFRIGERANT PIPING

- A. Unless otherwise indicated, main liquid and suction lines from condensing unit to evaporator coil shall be of sizes specified by manufacturer.
- B. Refrigeration piping shall be refrigeration grade copper tubing, type L hard-drawn. In instances where refrigeration lines are installed in an inaccessible location and must be snaked through conduit or a trench, that portion of tubing required to complete connections through conduit or trench may be soft drawn. Maintain entire system clean and dry during installation. Pipe shall be sealed until installed.
- C. Refrigeration piping, both hard and soft-drawn, shall be straight and free from kinks, restrictions and horizontal runs shall be sloped towards compressor one inch to 10 feet wherever possible. Vapor line oil traps shall be installed on bottom of vertical risers and inverted oil trap shall be installed on top of vertical risers.
- D. Joints shall be installed with Sil-Fos 15, Silvaloy 15, or equal, high melting point solder.
- E. Flare nuts required on suction lines shall be of short forged or frost-proof type. Other fittings shall be standard sweat-soldered type. Ells and return bends shall be long radius type. Install leak lock material.
- F. Refrigeration Piping: Joints shall be silver brazed and leak tested. Field fabricated lines shall be thoroughly flushed and cleaned before connection. Bleed nitrogen through lines during silver brazing, and cap and seal lines when not completed and connected to equipment.
- G. Sleeve penetrations of floors, walls and ceiling to allow for free motion of piping. Provide 24 gage galvanized iron pipe and chrome-plated escutcheon plates. Pack annular space between pipe and sleeve with incombustible material such as fiberglass and seal each end with mastic to provide a waterproof seal.
- H. Install insulated couplings at points of connection between dissimilar metals for cathodic protection. Insulate copper tubing from ferrous materials and hangers with 2-inch thickness of 3-inch wide strip, 10 mil polyvinyl tape wrapped around pipe.
- I. Support piping by iron hangers and supports. Hydra-Zorb cushion clamps, LSP Products Group Acousto Clamp, or equal, on non-insulated piping, and Klo-Shure coupling clamp on insulated piping, or equal.
- J. Provide saddles to protect pipe insulation.
- K. Provide connections of copper and brass pipe and tubing with Harris Products Group Safety-Silv 56, Lucas-Milhaupt, Inc., or equal, complying with ANSI/AWS A5.8 and NSF 51.

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- L. Insulate refrigerant suction lines.
 - M. On split heat pump systems, insulate both vapor and liquid lines. For insulation materials, refer to Section 23 0700: HVAC Insulation.
- 3.08 CLEANUP
- A. Remove rubbish, debris and waste materials and legally dispose of off Project site.
- 3.09 PROTECTION
- A. Protect Work of this Section until Substantial Completion.

END OF SECTION

SECTION 260100

BASIC MATERIALS AND METHODS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Addenda, Alternates, Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specifications collectively apply to work of this Section.

1.02 WORK INCLUDED

- A. The specifications and drawings are intended to cover a complete installation of systems. The omission of expressed reference to any item of labor or material for the proper execution of the work in accordance with present practice of the trade shall not relieve the Contractor from providing such additional labor and materials.
- B. All labor, materials, appliances, tools, equipment, facilities, transportation and services necessary for and incidental to performing all operations in connection with furnishing, delivery and installation of electrical system, complete, as shown on the drawings and/or specified herein. Work includes but is not necessarily limited to the following:
 - 1. Conduits for all wiring systems, unless otherwise specifically noted.
 - 2. All electrical wiring and connections to equipment furnished under other sections of Specifications.
 - 3. All electrical wiring and connections to Owner furnished equipment.
 - 4. All wiring and conduit for Air Conditioning and Heating and Ventilating systems, and electrical equipment in Plumbing Section of work.
 - 5. Pull wires in conduit runs indicated as conduit only (CO).
 - 6. Lighting panelboards.
 - 7. Building electrical wiring, conduits, outlet boxes, junction boxes, convenience outlets, switches, plates and all miscellaneous items of electrical equipment, apparatus and material specified and/or shown on Drawings.
 - 8. Disconnect switches, magnetic motor starters and manual motor starters.
 - 9. All required grounds.
 - 10. All anchors, chases, sleeves and supports for electrical equipment.
 - 11. Excavation necessary for execution and completion of electrical work.
 - 12. Required backing, supports and blocking for lighting fixtures.
 - 13. Relocation of Fire Alarm Devices.
 - 14. Relocation of Intrusion Alarm / CCTV devices.
 - 15. Relocation of Speakers.
 - 16. Relocation of Clock Outlets.
 - 17. Computer Network Wiring System.
 - 18. Tests of entire system.
 - 19. Lighting fixtures complete with lamps and required accessories.
 - 20. Guarantees.
 - 21. Temporary power for building construction.
 - 22. Temporary lighting during construction.

23. Complete connections to all motors, apparatus, electrically operated devices, etc., as shown on Drawings.
24. Circuits, switches, starters and connections for all exhaust fans, blowers and heaters.
25. Flashing of conduits through roof.
26. Shop Drawings.
27. Include an allowance of \$250.00 for the material cost of any lighting fixture where an outlet is shown on drawings without a fixture type designation.
28. In these specifications, Fire Alarm, Clock and Class Change Signal, PA/Intercom, Television, Intrusion Alarm, etc. are referred to as Auxiliary Systems or Signal Systems.

1.03 GUARANTEE

- A. In addition to guarantee required in Division 01 or specifically specified elsewhere, all materials and equipment provided and installed under this Division of Specifications shall be guaranteed by Contractor in writing for a period of one year from date of acceptance of work by Owner. Should any trouble develop during this period due to defective materials or faulty workmanship, the Contractor shall furnish all necessary labor and materials to correct the trouble without costs to Owner.
- B. Guarantee complete and perfect operation of entire system and that all apparatus will perform in accordance with detailed drawings and Specifications.
- C. Guarantee that all equipment will be supported in such a way as to be free from objectionable vibration and noise.
- D. Guarantee that all licenses and royalties for use of any patented feature of system will be paid before acceptance of system.

1.04 GENERAL REQUIREMENTS

- A. Codes: Construct project in accordance with following codes and regulations.
 1. 2016 California Electrical Code, Title 24 C.C.R.
 2. 2016 California Mechanical Code, Title 24 C.C.R.
 3. 2016 California Plumbing Code, Title 24 C.C.R.
 4. 2016 California Energy Code, Title 24 C.C.R.
 5. 2016 California Historical Building Code, Title 24 C.C.R.
 6. 2016 California Fire Code, Title 24 C.C.R.
 7. 2016 California Existing Building Code, Title 24 C.C.R.
 8. 2016 California Green Building Standards Code (CALGreen Code), Title 24 C.C.R.
 9. 2016 California Referenced Standards Code, Title 24 C.C.R.
 10. Local codes and ordinances.
 11. Division of State Architect.

Keep a copy of applicable code available at Site while performing work of this Section. Nothing in these Drawings and Specifications to be construed as authority to violate codes and ordinances. Conflict with applicable regulations to be resolved at Contractor's expense before installation.

- B. Permits, Fees and Inspections: Obtain and pay for all necessary permits and fees required by any constituted authority having jurisdiction including utilities. Arrange and pay for all required inspections or examinations and deliver certificates of inspection to Architect.
- C. Record Drawings:
1. Provide record drawings for work of this Section.
 2. Keep up-to-date a complete "As-Built" record set of blueline prints corrected daily and showing every change from original Drawings and Specifications and exact "As-Built" locations, sizes, and kinds of equipment.
 3. Prints for this purpose may be obtained from Architect at cost of printing. Keep this set of Drawings on job and use only as a record set.
 4. Drawings to serve as work progress sheets. Make neat and legible notations in red ink thereon daily as work proceeds, showing work as actually installed. Drawings to be available at all times for inspection, and kept at a location designated by Architect.
 5. On completion of work, obtain one set of prints from Architect at cost of printing, and note neatly in scale all changes on record set. Deliver complete set of prints together with one set of blueline prints to Architect together with Contractor's name, address and phone number. Incorrect, non-legible or non-reproducible drawings will not be accepted.
- D. Selection and Ordering of Equipment and Materials: Within two weeks after award of Contract, arrange for purchase and delivery of all light fixtures, equipment and materials required in ample quantities and at proper time. Inform Architect immediately of any inability to obtain suitable delivery of any equipment or material. Send copy of letter verifying date of purchases to Architect.
- E. Shop Drawings and Material Lists:
1. Submit material lists and shop drawings as called for in Division 01, and as supplemented by this Division, and with sufficient promptness to ensure that overall work of project will not be delayed.
 2. Submit six copies of a list of materials and equipment manufacturers that Contractor intends to use.
 3. Provide shop drawings for following:
 - a. Panelboards.
 - b. Lighting fixtures, lamps and necessary accessories.
 - c. Time switches.
 - d. Contactors.
 - e. Wall dimmers.
 4. Do not fabricate work until reviewed shop drawings for work have been received from Architect. Work fabricated or erected in advance of reviewed shop drawings will be at risk of Contractor.
 5. Architect's or Engineer's review of shop drawings does not relieve Contractor of responsibility for errors including details, dimensions, or materials, as well as conformance with requirements of Drawings and Specifications.
 6. Shop drawings will be checked by Architect and Engineer for conformance to design as a convenience to Contractor. Dimensions will not be checked. Should interferences become evident, notify Architect immediately so that matter may be resolved prior to proceeding with fabrication.

7. No reimbursement based on a claim that work was placed in accordance with dimensions shown on a reviewed shop drawing will be allowed for removing or replacing work already in place.
8. Make available a copy of every reviewed shop drawing at Project Site.
9. Submit shop drawings in coherent groups; e.g., all lighting fixtures at one time.
10. Submit actual samples of specified equipment or material to Architect for review when requested.

F. Substitution and Approval of Material:

1. Base all bids and proposals only upon materials, construction and equipment named or described in specification and/or shown on drawing. Should a Contractor wish to use other equipment than that specified, he shall submit proposed substitution by fully describing equipment he prefers to use and by listing credit or additional cost to his bid as a separate item should substitution be acceptable.
2. All equipment and materials proposed for substitution shall be similar in design and equal in quality and function to those specified herein or on drawings. Contractor (not sales vendor) shall demonstrate his proposed substitution and shall specifically note all differences between item specified and proposed substitution. Actual samples and test data, certified by an independent testing laboratory, shall be submitted when requested.
3. Each substitution will be given consideration, but without any obligation expressed or implied on part of Architect to change named requirements of specification. Only one substitution for each item of equipment will be permitted. Contractor assumes sole responsibility for performance and space requirements for substitute equipment. Decision of Architect shall be final as to whether or not substitution is acceptable.

G. Terminology:

1. Term "provide" used on Drawings and elsewhere in the Specifications shall be considered to mean "furnish and install".
2. Term "UL" means Underwriters Laboratories Inc.

H. Workmanship: See supplementary Conditions, Architect is sole judge of whether execution is in a workmanlike manner.

I. Safety Conditions: Be responsible in preventing energized switches, circuit breakers or circuits from being turned to "On" position during construction period. Be responsible for damages to personnel and/or property resulting from contact with energized circuits, switches, circuit breakers, busses or other electrical apparatus. Construct all electrical work with electrical system de-energized in area. At no time permit work on equipment or apparatus with energized circuits.

J. Verification of Dimensions: All scaled and figured dimensions are approximate and are given for estimating purposes only. Before proceeding with work carefully check and verify all dimensions and sizes and assume all responsibility for fitting of materials and equipment to other parts of equipment and to structure. Where apparatus and equipment have been indicated on drawings, dimensions have been taken from typical equipment of class indicated. Carefully check drawings and see that equipment will fit into spaces provided.

- K. Locations:
1. Locations of conduits, outlets, apparatus and equipment indicated on drawings are approximate only and shall be changed to meet architectural and structural conditions as required.
 2. Install conduit and equipment in a manner and in locations avoiding all obstructions, preserving headroom, keeping openings and passageways clear and readily accessible for maintenance and repairs. Make changes in locations of conduit or equipment which may be necessary to accomplish this. Drawings are essentially diagrammatic to extent that many offsets, bends, special fittings and exact locations are not indicated. Examine all drawings prepared by manufacturers, suppliers and installers of all equipment including air conditioning and plumbing fixture shelving, for requirements and locations of equipment and outlets.
 3. Should any structural interferences prevent installation of outlets, setting of cabinets for lighting panelboards, running of conduits, or installation of other electrical equipment at locations shown on Drawings, necessary minor deviations therefore as determined by Engineer may be permitted. In event changes in indicated locations or arrangements are necessary due to developed conditions in building's construction or rearrangement of furnishings or equipment, Owner shall be permitted to move any junction box or utility outlet a distance of 10' and such changes shall be made without extra cost providing change is ordered before work is installed. Submit an estimate of cost or credit for other changes and proceed only upon written authority of Architect.
 4. Be cautioned that diagrams showing electrical connections are diagrammatic only and must not be used for obtaining lineal runs of wiring or conduit. Wiring diagrams do not necessarily show exact physical arrangement of equipment.
 5. Locations of outlets, lighting fixtures, cabinets, panelboards, apparatus, motors, mechanical equipment, etc., shown on Electrical Drawings is only approximate. Do not scale them from Electrical Drawings.
 6. Verify locations of outlets, lighting fixtures, equipment etc., with Architectural Drawings of interior and exterior details and finish, and coordinate location of electrical work with mechanical and other equipment.
 7. Locate lighting fixtures as per reflected ceiling plans prepared by Architect.
- L. These Specifications and attendant Drawings are intended to cover a complete and operable electrical system. Follow Drawings and Specifications and execute all work according to true intent and meaning. Should any error or omission exist in either or both of these Drawings and Specifications, or conflict one with another, have same explained and adjusted by Engineer before submitting bid price for electrical work; otherwise at own expense, supply proper materials and labor to completely install same, make good any damage to or defect in work of results obtained therefore caused by such error, omission or conflict. Most restrictive, greater quantity or size, better quality or other superior condition of all representations shall prevail. It is intended that outlets be located symmetrical with Architectural elements notwithstanding fact that locations indicated on Drawings may be distorted for clarity.
- M. Omission of expressed reference in Drawings or Specifications to any item of labor or material necessary for proper execution of work in accordance with present good

practice of trade will not relieve Contractor from providing such additional labor and materials.

- N. Job Visits by Engineer: Periodic visits to job by Engineer is for express purpose of verifying compliance by Contractor with contract documents. Such visits by Engineer shall not be construed as construction supervision. Neither shall such visits be construed to make Engineer responsible for providing a safe place for performance of work by Contractor or Contractor's employees or safety of supplies of Contractor or his subcontractors.
- O. Cooperation with Others: Organize work that will harmonize with work of all trades so that all work may proceed as expeditiously as possible. Be responsible for correct placement of work and connection of work to all related trades.
- P. Protection of Finish: Provide adequate means for protecting all finished parts of materials and equipment against damage from any cause during progress of work and until acceptance by Architect. Cover all material and equipment in storage and during construction in such a manner that no finished surfaces will be damaged, marred or splattered with paint. Keep moving parts perfectly clean and dry. No paint spraying will be permitted in building. Replace or refinish damaged material or equipment including face plates or panels without additional costs to Owner.
- Q. Cleaning Equipment and Premises: Thoroughly clean all parts of materials, equipment and exposed parts such as receptacles and panelboards, of cement, plaster and other materials. Remove all oil and grease spots with a non-flammable cleaning solvent. Brush exposed metal work with steel brushes to remove rust and other spots and leave smooth and clean. During progress of work, carefully clean up and leave premises and all portions of building free from debris. At completion of work, remove all waste materials and debris resulting, leaving everything in a complete and satisfactory condition.
- R. Cutting and Patching: Include all cutting and patching in bid. Do not cut any structural members without first having received written permission from Architect. Cutting of round openings which can be done by use of a rotary drill shall be done by Contractor requiring same. Cutting and patching finish work shall be performed by workmen of the respective trade.
- S. Conditions at Site: Visit Job Site and become familiar with all existing conditions within scope of work and include in Bid Proposal allowance for these conditions. Verify exact locations of services prior to construction. Notify all other Contractors of these utility locations.
- T. Documents: Read all relevant documents, become familiar with job, scope of work, type of general construction, Architectural, Structural, Mechanical and Electrical Drawings and Specifications. Also become familiar with purpose for which these Drawings have been prepared and become cognizant of all details involved.
- U. Acceptance: Before work will be accepted, demonstrate to Owner and Architect that entire installation is complete and in proper operating condition and Contract has been fully and properly executed. Following items shall be prepared and submitted to Architect:
 - 1. Two copies of all test results required under this Division.

2. Two copies of local and/or state code enforcing authorities final inspection certificates.
 3. Copies of as-built record drawings as required.
 4. Notify Architect in writing when installation is complete and that a final inspection of this work can be performed. In event defects or deficiencies are found during this final inspection they shall be corrected to satisfaction of Architect before final acceptance can be issued.
 5. Two Maintenance and Operating Manuals as required.
- V. Field Inspections: Provide proper facilities for access of Owner or Owner's representative to conveniently examine and inspect all portions of work covered in this Contract at any and all reasonable hours.
- W. Completing Work: At completion of work, remove all waste materials and debris resulting from work, leaving everything in a complete and satisfactory condition.
- X. Electrical Superintendent: Include services of a qualified electrical foreman capable of interpreting intent of Drawings and Specifications, to study Plans, Specifications and references, and coordinate all requirements with other trades, authorized to make decisions and issue instructions; be constantly in charge of work and available at job site at all times and at final inspection. Instruct Owner's representative for proper operation and recommend maintenance of all systems.
- Y. Maintenance and Operating Manuals:
1. Before completion and acceptance of work, furnish Owner with two complete sets of operating and maintenance instruction manuals. Bind each set in durable hardboard binder and index.
 2. Compile data for manuals upon approval of material list and sketches so as not to delay final approval of work installed. Operating manuals to contain all pertinent data relating to electrical installation such as fixture cuts, manufacturer's approval, shop drawings, sketches, wiring diagrams and equipment operating instructions.
 3. Instruct Owner's operating personnel with electrical operating procedures before work is considered complete.
- Z. Extra Work or Costs to This Contractor Due to Other Contractors or Trades: Adjusted between this Contractor and offending Contractor at no extra cost to Owner. Notify Architect before such extra work is done.
- AA. Tests:
1. Upon completion of work and adjustment of all equipment, all systems shall be tested under direction of Owner's representative to demonstrate that all equipment furnished and installed and/or connected under provision of these Specifications shall function electrically in manner required. All tests shall be completed prior to final inspection of project.
 2. All systems shall test free from short circuits and grounds and shall be free from mechanical and electrical defects. All circuits shall be tested for proper neutral connection.
 3. All instrumentation and personnel required for testing shall be furnished by Contractor.

BB. Noise Control:

1. Perform electrical work to a manner in minimize transmission of noise and preserve acoustical properties of building structure.
2. Where equipment is mounted on vibration isolators, use flexible connections to reduce transmission of noise.
3. Where conduits pass through sleeves in interior walls, floors, or ceilings, completely fill space between each conduit and its sleeve to provide an airtight seal.
4. Use glass fiber material, "Duxseal" compound, for acoustic seals.

CC. Seismic Bracing Standards: All pipes, cable trays, conduits, etc. shall be supported and braced in accordance with SMACNA "Seismic Restraint Manual, Guidelines for Mechanical Systems", including Appendix B, "Additional Requirements for OSHPD" and "Addendum no. 1, September 2000". Comply with CBC, where requirements are more stringent than SMACNA, including, but not limited to the following:

1. Pipes and conduit shall be braced to resist the forces prescribed in California Building Code.
2. Where possible, pipes, conduit and their connections shall be constructed of ductile materials (copper, ductile iron, steel or aluminum and brazed, welded, or screwed connections.) Pipes, conduits and their connections, constructed of nonductile materials (e.g., cast iron, no-hub pipe and plastic), shall have the brace spacing reduced to one-half of the spacing allowed for ductile material in accordance with California Building Code or SMACNA Seismic Restraint Manual.
3. Seismic restraints may be omitted for the following conditions:
 - a. All piping suspended by individual hangers 12 inches or less in length from the top of the pipe to the bottom of the structural support for the hanger.
 - b. All electrical conduit less than 2.5 inches trade size.
4. For rigidly supported, electrical conduit, or cable trays, the product of $C_{al}l_p$ need not to exceed 1.2 for any value of l_p .
5. All Trapeze assemblies supporting, cable trays and conduit shall be braced to resist the forces and relative displacements per ASCE 7 Chapter 13, considering the total weight of the elements on the trapeze.
6. Conduit supported by a trapeze where none of these elements would individually be braced need not be braced if connection to the pipe/conduit of directional changes do not restrict movement of the trapeze. If this flexibility is not provided, bracing will be required when the aggregate weight of the pipes and conduit exceed 10 pounds/foot. The weight shall be determined assuming all pipes and conduits are filled with water.

DD. Bracing Standards Application: Comply with bracing standards by evaluating the complete installation of all utilities and equipment, and providing a comprehensive solution based on Contractor's layout, coordination with other trades, and with the structural design and all other provisions for incorporating systems into the buildings. Show bracing products and layout in shop drawing submittals. The following criteria apply to the bracing of all systems:

1. The design parameters for determining the Total Design Lateral Force shall be as designated on the structural drawing.
2. Seismic Hazard Levels (SHL) shall be as designated on structural drawings.

3. Contractor shall submit documentation for each condition, which is not specifically covered in the SMACNA manual, including piping configurations and conditions, structural systems, structural connection methods, and other issues regarding the application of the standards.
 4. Provide expansion anchors, sized per SMACNA guidelines, for use in concrete.
 5. For connections to structural steel, wood framing, etc. provide bolted or welded connections, sized per SMACNA guidelines.
 6. Seismic bracing components consisting of structural shapes.
 7. Seismic bracing cable shall be galvanized steel, conforming to ASTM A603, zinc-coated with minimum 0.4 ounces/sf, pre-stretched, 7 x 19 strand, sized per SMACNA guidelines.
- EE. In hard ceiling space where access to j-boxes, detectors, etc is required, provide ceiling access panel, fire-rated typical.

END OF SECTION

SECTION 260160

ELECTRICAL DEMOLITION FOR REMODELING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Addenda, Alternates, Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specifications collectively apply to work of this Section.

1.02 DESCRIPTION

- A. Work includes but is not limited to the following:
 - 1. Electrical demolition.

PART 2 - PRODUCTS

2.01 MATERIALS AND EQUIPMENT

- A. Materials and equipment for patching and extending work: As specified in individual Sections.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify that abandoned wiring and equipment serve only abandoned facilities.
- B. Drawings are based on field observation and existing record documents. Report discrepancies to Architect/Engineer before disturbing existing installation.
- C. Beginning of demolition means installer accepts existing conditions.

3.02 DEMOLITION

- A. Provide all necessary electrical demolition. See Architectural drawings for extent of wall removal and other demolition. Remove existing electrical devices in walls to be demolished. Re-route and reconnect as required, any active circuits feeding through these walls in order to keep upstream and downstream circuits active. Remove exposed conduit, wiring, devices, etc. as required.
- B. Where new lighting is shown in an area with existing lighting, demolish existing lights, associated conduits, wires, devices, etc. Dispose of existing ballasts with PCB in accordance with all regulations of all governing agencies having jurisdiction.
- C. Where mechanical equipment is to be demolished as shown on mechanical drawings, demolish disconnect switches, conduits, wires and associated electrical equipment.

- D. Dispose of all demolished equipment and devices. Equipment with salvage value shall be disposed of per District's instructions.
- E. When underground conduits are indicated to be removed or intercepted, assume that all existing underground conduits are concrete encased and provide all work to remove encasement as necessary.

END OF SECTION

SECTION 26 05 00
ELECTRICAL GENERAL PROVISIONS

PART 1 - GENERAL

1.1 SCOPE

1.1.1 Work Included: All labor, materials, appliances, tools, equipment, facilities, transportation and services necessary for and incidental to performing all operations in connection with furnishing, delivery and installation of the work of this Section, complete, as shown on the Drawings and/or specified herein. Work includes, but is not necessarily limited to, the following:

.1 Examine all other sections for work related to those other sections and required to be included as work under this section.

.2 General provisions and requirements for electrical work.

1.2 SUBMITTALS

1.2.1 General

.1 Review of Contractors submittals are for general conformance with the design concept of the Project and general compliance with the information given in the contract documents. Any action shown is subject to the requirements of the Plans and Specifications. Contractor is responsible for quantities; dimensions which shall be confirmed and correlated at the job site; fabrication processes and techniques of construction; coordination of work with that of all other trades and satisfactory performance of their work.

.2 The Contractor shall review each submittal in detail for compliance with the requirements of the Contract Documents prior to submittal to the Architect. The Contractor shall "Ink Stamp" and sign each item of the submittal with a statement "CERTIFYING THE SUBMITTAL HAS BEEN REVIEWED BY THE CONTRACTOR AND COMPLIES WITH ALL THE REQUIREMENTS OF THE CONTRACT DOCUMENTS".

.3 Where the Construction Documents indicate specific Manufacturer(s) for any given product, it shall be considered a substitution if the Contractor proposes to use any Manufacturer other than those specifically named. The Contractor shall clearly and specifically identify each individual proposed substitution or proposed deviation from the requirements of the Contract Documents with a statement "THIS ITEM IS A SUBSTITUTION".

1.2.2 Material Lists and Shop Drawings:

.1 Submit material list, Equipment Manufacturers, and Shop Drawings for approval within 35 days of award of Contract. Give name of Manufacturer and where applicable, brand name, type and/or catalog number of each item. Listing of more than one Manufacturer for any one item of equipment, or listing items "as specified", without both make and model or type designation, is not acceptable. The right is reserved to require submission of samples of any material whether or not particularly mentioned herein.

.2 Shop Drawings shall be submitted in completed bound groups of materials (i.e., all lighting fixtures or all switchgear, etc.). Shop Drawing shall be prepared by Factory Authorized Representatives. Departure from the above procedure will result in resubmittals and delays.

.3 Submittals which are intended to be reviewed as substitution or departure from the Contract Documents must be specifically noted as such or the requirements of the Contract Documents will prevail regardless of the acceptance of the submittal.

.4 Shop Drawings shall include dimensioned plans, elevations, details, wiring diagrams and descriptive literature of components parts where applicable.

.5 The Contractor shall verify dimensions of equipment and be satisfied as to fit and that they comply with all Code requirements relating to clear working space about electrical equipment prior to submitting Shop Drawings for approval.

.6 Shop Drawings shall include the Manufacturer's projected days for shipment from the factory of completed equipment, after the equipment is released for production by the Contractor. It shall be the responsibility of the Contractor to insure that all material and equipment is ordered and installed in time to provide an orderly progression of the work, and to allow full occupancy and full operation of the facility at the scheduled completion date. The Contractor shall notify the Architect of any changes in delivery which would affect the Project completion date.

1.2.3 The Contractor shall be responsible for incidental, direct and indirect costs resulting from the substitution of specified Contract Materials or Work.

1.2.4 Maintenance and Operating Manuals

.1 The Contractor shall furnish three copies of typewritten maintenance and operating manuals for all electrical equipment, fire alarm equipment, sound system equipment, etc., to the District and instruct District's Personnel in correct operation of all equipment at completion of Project.

.2 Maintenance and operating manuals shall be bound in three-ring, hard-cover, plastic binders and shall be delivered to the District with letter of transmittal, carbon copy to the Architect.

1.2.5 Portable or Detachable Parts: The Contractor shall retain in his possession, and shall be responsible for all portable and detachable parts or portions of the installation such as fuses, keys, locks, adapters, locking clips, and inserts until final completion of contract work. These parts shall then be delivered to the District or his Authorized Representative and an itemized receipt obtained, with copies of receipt sent to the Architect.

1.2.6 Record Drawings

.1 Provide and maintain in good order at the job site a complete set of Electrical Contract prints. Changes to the Contract to be clearly recorded on this set of prints. No pay request by the Contractor will be granted without verification that the jobsite prints are up-to-date and current with the Project Construction. At the end of the Project, the Contractor shall transfer all changes to one set of transparencies to be delivered unfolded to the Architect. Transparency Drawings shall be prepared in an organized and clearly legible fashion by persons skilled in drafting techniques.

.2 The actual location and elevation of all buried lines, boxes, monuments, vaults, stub outs and other provisions for future connections shall be referenced to the building lines or other clearly established base lines and to approved bench marks. All measurements shall be witnessed by the Job Inspector who shall make his own record of the dimensions. Before the Inspector signs the Record Drawings, he shall check his own dimensions against those on the Drawings. If any necessary dimensions are omitted from the Record Drawings, the Contractor shall, at his own expense, do all excavation required to expose the buried work and to establish the correct locations.

.3 The Contractor shall keep the "Record" prints up to date and current with all work performed.

.4 A mandrel shall be pulled through each conduit upon completion of the duct bank. All mandrelling must be done in the presence of the Job Inspector.

1.3 GENERAL SUMMARY OF ELECTRICAL WORK

1.3.1 The Specifications and Drawings are intended to cover a complete installation of systems. The omission of expressed reference to any item of labor or material for the proper execution of the work in accordance with present practice of the trade shall not relieve the Contractor from providing such additional labor and materials.

1.3.2 Refer to the Drawings and shop Drawings of other trades for additional details which affect the proper installation of this work. Diagrams and symbols showing electrical connections are diagrammatic only. Wiring diagrams do not necessarily show the exact physical arrangement of the equipment.

1.3.3 Before submitting a bid, the Contractor shall familiarize himself with all features of the Drawings and existing site which may affect the execution of the work. No extra payment will be allowed for failure to obtain this information.

1.3.4 If there are omissions or conflicts between the Drawings and Specifications, clarify these points with the Architect before submitting bid.

1.4 LOCATIONS OF EQUIPMENT

1.4.1 The Drawings indicate diagrammatically the desired locations or arrangements of conduit runs, outlets, equipment, etc., and are to be followed as closely as possible. Proper judgment must be exercised in executing the work so as to secure the best possible installation in the available space and to overcome local difficulties due to space limitations or interference of structure conditions encountered.

1.4.2 Where outlets are placed on a wall, locate symmetrically with respect to each other and other features or finishes on the wall.

1.4.3 In the event changes in the indicated locations or arrangements are necessary, due to developed conditions in the building construction or rearrangement of furnishings or equipment, such changes made without cost, providing the change is ordered before the conduit runs, etc., and work directly connected to same is installed and no extra materials are required.

1.4.4 Lighting fixtures in mechanical spaces are shown in their approximate location only. Do not install light outlets or fixtures until mechanical piping and duct work is installed, and then install lights in a location to provide best lighting.

1.4.5 The locations of existing utilities, building, equipment and conduit shown on the Drawings is approximate. Verify exact locations and routing of existing systems in the field. Include all costs in Contract price for adjustment required to accommodate existing conditions.

1.4.6 Coordinate and cooperate in every way with other trades in order to avoid interference and assure a satisfactory job.

1.5 AIR CONDITIONING, HEATING, PLUMBING EQUIPMENT WIRING

Provide electrical work, materials, and control components required for proper operation of the air conditioning, heating, and plumbing systems.

1.6 QUALITY ASSURANCE

1.6.1 Work and materials in full accordance with the latest Rules and Regulations of the California Code of Regulations Title 24, Part 3 "California Electrical Codes", Title 8 "Division of Industrial Safety", the National Life Safety Code, and other applicable Federal and State Laws and Regulations, California Building and Fire code.

1.6.2 All material and equipment shall be new and shall be delivered to the site in unbroken packages. All material and equipment shall be listed and labeled by Underwriters Laboratories or other recognized testing laboratories, where such listings are available. Comply with all installation requirements and restrictions pertaining to such listings.

1.6.3 Work and material shown on the Drawings and in the Specifications are new and included in the Contract unless specifically indicated as existing or N.I.C. (Not in Contract).

1.6.4 Keep a copy of all applicable Codes available at the job site at all times while performing work under this Section. Nothing in Plans or Specifications shall be construed to permit work not conforming to the most stringent of Codes.

1.7 CLEANING EQUIPMENT, MATERIALS, AND PREMISES

All parts of the equipment shall be thoroughly cleaned of dirt, rust, cement, plaster, etc., and all cracks and corners scraped out clean. Surfaces to be painted shall be carefully cleaned of grease and oil spots and left smooth, clean, and in proper condition to receive paint finish.

1.8 JOB CONDITIONS - PROTECTION

Protect all work, materials and equipment from damage from any cause whatever and provide adequate and proper storage facilities during the progress of the work. All electrical equipment shall be stored in a weather-tight structure. Provide for the safety and good condition of all the work until final acceptance of the work by the District and replace all damaged or defective work, materials, and equipment before requesting final acceptance.

1.9 CUTTING AND PATCHING

Perform cutting and patching of the construction work which may be required for the proper installation of the electrical work. Patching shall be of the same material, thickness, workmanship and finish as existing and accurately match surrounding work to the satisfaction of the Architect. Cutting of structural members shall not be done without notifying the Architect and obtaining DSA approval.

1.10 IDENTIFICATION

1.10.1 Panelboards, terminal cabinets, circuit breakers, disconnect switches, starters, relays, time switches, contactors, pushbutton control stations, and other apparatus used for the operation or control of feeders, circuits, appliances, or equipment shall be properly identified by means of descriptive nameplates or tags permanently attached to the apparatus and wiring.

1.10.2 Nameplates shall be engraved laminated phenolic. Shop Drawings with dimensions and format shall be submitted to the Architect before installation. Attachment to equipment shall be with escutcheon pins, rivets, self-tapping screws or machine screws. Self-adhering or adhesive backed nameplates shall not be used.

1.10.3 Plates: All cover and device plates shall be furnished with engraved or etched designations under any one of the following conditions:

- .1 Three gang or larger gang switches.
- .2 Keyed and/or locking switches.
- .3 Pilot light switches.
- .4 Switches in locations from which the equipment or circuits controlled cannot be readily seen.
- .5 Manual motor starting switches.
- .6 Switches which serve other than lighting loads.
- .7 Where so indicated on the Drawings.
- .8 As required on all control circuit switches, such as heater controls, etc.
- .9 Where receptacles are other than standard duplex receptacles to indicate voltage and phase.

1.10.4 Provide black-on-white laminated plastic nameplates engraved in minimum ¼-inch high letters to correspond with the designations on the Drawings. Provide other or additional information on nameplates where indicated.

1.10.5 For equipment containing or operating on circuits of more than 240 volts nominal, provide red-on-white laminated warning signs engraved in ½-inch high letters to read: "CAUTION - 480 (or as applicable) VOLTS AUTHORIZED PERSONNEL ONLY".

1.10.6 Wire and Cable Identification

.1 Provide identification on individual wire and cable including sign systems, fire alarm, electrical power systems (each individual phase, neutral and ground), empty conduit pull ropes, and control circuit.

.2 Identification shall be provided at each termination location, splice location, pullbox, junction box and equipment enclosure.

a. Individual wire and cable larger than #6 AWG or 0.25 inch diameter shall be provided with polypropylene identification tag holders, with yellow polypropylene tags interchangeable black alphanumeric characters. Character height 0.25 inch or TECH Products - "EVERLAST" Series. Attach identification tags with plastic "tie" wraps, minimum of two for each tag. As manufactured by Almetek Industries - "EZTAG" Series.

b. Individual wire and cable #6 AWG and smaller or smaller than 0.25 inch diameter, shall be provided with water and oil resistant, flexible, pressure sensitive machine embossed plastic tags that wrap a minimum of 360 degrees around the wire/cable diameter. The entire tag shall then be covered with a clear flexible waterproof plastic cover wrapped a minimum of 540 degrees around the wire/cable diameter and completely covering the identification.

c. Each identification tag location shall indicate the following information: circuit number, circuit phase, source termination and destination termination equipment name (or outlet number as applicable).

3. Install identification after installation/pulling of wire/cable is complete, to prevent loss or damage to the identification.

1.10.7 Cardholders and cards shall be provided for circuit identification in panelboards. Cardholders shall consist of a metal frame retaining a clear plastic cover permanently attached to the inside of panel

door. List of circuits shall be typewritten on card. Circuit description shall include name or number of circuit, area, and connected load.

1.10.8 Junction and pull boxes shall have covers marked with circuit numbers according to panel schedule. Data shall be lettered in a conspicuous manner with a color contrasting to finish.

1.11 TESTING

1.11.1 The Contractor shall obtain an independent NETA certified Testing Laboratory that will provide all instrumentation and tests on the electrical system and equipment as hereinafter described and further directed by the Architect. The test shall be performed after the completion of all electrical systems. All tests shall be recorded and documented and submitted to the Architect for review.

1.11.2 The Testing Laboratory shall meet Federal OSHA criteria for accreditation of Testing Laboratories Title 29 Part 1907. Membership in the National Electrical Testing Association shall constitute proof of meeting aid criteria, for testing of electrical system.

.1 Test for Phase to Ground Condition:

- a. Open new feeder breaker serving this project.
- b. Isolate the system neutral from ground.
- c. Close all new submain disconnects.
- d. Close all new branch feeder circuit breakers.
- e. Measure the resistance of each phase to ground. A properly calibrated "megger" type test instrument to be used. The test voltage shall be 500 volts.
- f. Record all readings after 1-minute duration and document into a complete report.

.2 Isolating Grounds: In the event that low resistance grounds are found in the system, they shall be isolated and located by testing each circuit individually as outlined above. Make proper corrections to restore the resistance values to an acceptable value.

1.11.3 Method of obtaining ground resistance shall be in accordance with the latest edition of the James G. Biddle (Plymouth Meeting, Pennsylvania) manual published on this subject.

1 Perform "fall-of-potential" tests on each new grounding electrode of system per IEEE Standard No. 81, Section 8.2.1.5. When suitable locations for test rods are not available, a low resistance dead earth or reference ground will be utilized.

.2 Perform the two-point method test per IEEE Standard No. 81, Section 8.2.1.1, to determine the ground resistance at each ground bus in distribution boards and distribution panels and transformer neutrals.

1.11.4 All instrumentation and personnel required for testing shall be furnished by the Contractor.

1.11.5 The testing, calibrating and setting of all circuit breakers, device protection relays, and adjustable settings shall be by an independent Testing Laboratory. Set as recommended by the respective Manufacturer and coordination study so as to be coordinated with other protection devices within the electrical design. Four bound and tabulated copies of the test and settings shall be sent to the Architect.

1.11.6 Ampere and voltage measurements:

.1 Take and record ampere and line voltage measurements under full load on all new panel feeders, and air conditioning feeders provided in the Contract. Record measurements at the equipment tested and submit to the Architect for review.

.2 Ampere voltage readings shall be:

- a. Phase A-B, A-C, and B-C.
- b. Phase A-Neutral, B-Neutral, and C-Neutral.

.3 The ampere and voltage readings shall be not less than 20 minutes duration for each test. Record and submit the measured minimum, maximum and 20 minute average for each ampere and voltage value and test location. Voltage and ampere measurements shall occur at the connected load end of each respective feeder, not at the source of supply end of each feeder.

.4 Test equipment shall be accurate within plus or minus 1-percent.

1.12 SERIES RATED EQUIPMENT

Circuit protective devices identified as "Series Rated" or "Current Limiting" (i.e., CLCB - Current Limiting Circuit Breaker; CLF - Current Limiting Fuse; etc.) shall be series rated and tested (UL 489 and CSA5) by the Manufacturer with all equipment and circuit protective devices installed down stream of the identified series rated or current limiting devices. Provide nameplates on all equipment located down stream, including the CLCB and CLF devices, to comply with N.E.C. paragraphs 110-22 and 240-83 "CAUTION SERIES RATED SYSTEM - NEW DEVICE INSTALLATIONS AND REPLACEMENTS SHALL BE THE SAME MANUFACTURER AND MODELS."

1.13 SPARE FUSES

Provide three spare fuses for each size and type to match the installed fuses where the fuses are provided as part of the Contract.

1.14 WALL MOUNTED ELECTRICAL EQUIPMENT

1.14.1 Provide multiple horizontal sections of metal "C" channels for support and attaching wall mounted equipment to walls. Channels shall provide "turned lips" at longitudinal edges to hold "lock-in" fasteners and shall comply with ANSI-1008 and ASTM-A569 latest revision. The channels shall be steel hot dip zinc galvanized. As manufactured by Unistrut or Kindorf. Coordinate with details on DSA approved Drawings.

1.14.2 The "C" channels shall be positioned horizontally within 3-inches of the top and bottom of each, equipment section cabinet and located behind each equipment vertical section. Provide additional intermediate "C" channels at not less than 36-inches on center between the "top" and "bottom" "C" channel positions, located behind each equipment vertical section.

1.14.3 The "C" channels shall be of sufficient length to provide connection to not less than two vertical structural wall framing elements separated by not less than 16 inches; but in no case shall the "C" channel length be less than the width of the respective Equipment Section.

1.14.4 Attach the "C" channels to the wall structural elements after the wall, finish surface, installation (including painting) is complete.

1.14.5 Attach the “C” channels with fasteners to the building wall framing structural elements as follows: welded to steel framing; bolted to wood framing; cast in place concrete inserts for masonry and concrete construction; drilled “afterset” expansion anchors for existing masonry and concrete construction.

1.14.6 Attach the equipment to the “C” channels with threaded and bolted fasteners to “prelocate” and lock into the channel “turned lips” and channel walls.

1.15 ELECTRICAL WORK CLOSEOUT

1.15.1 Prepare the following items and submit to the Architect before final acceptance.

- .1 Two copies of all test results as required under this Section.
- .2 Two copies of Local and/or State Code Enforcing Authorities’ Final Inspection Certificates.
- .3 Copies of As-Built Record Drawings as required under the General Conditions, pertinent Division One Sections, and Electrical General Provisions.
- .4 Two copies of all receipts transferring portable or detachable parts to the District when requested.
- .5 Notify the Architect in writing when installation is complete and that a final inspection of this work can be performed. In the event any defect or deficiencies are found during this final inspection they shall be corrected to the satisfaction of the Architect before final acceptance can be issued.

1.15.2 The Contractor shall complete the following work before any electrical equipment is energized:

- .1 All equipment shall be permanently anchored.
- .2 All bus connections shall be tightened per Manufacturer’s instructions and witnessed by the DSA Inspector.
- .3 All ground connections shall be completed and identified. Perform and successfully complete all required megger and ground resistance tests.
- .4 All feeders shall be connected and identified.
- .5 The interiors of all electrical enclosures including busbars and wiring terminals shall be cleaned of all loose material and debris, paint, plaster, cleaners or other abrasive's overspray removed and equipment vacuumed clean. The DSA Inspector shall observe all interiors before covers are installed.
- .6 All dry wall work and painting shall be completed within the Electrical Rooms.
- .7 All doors to electrical equipment rooms shall be provided with locks in order to restrict access to energized equipment.
- .8 Electrical rooms shall not be used as a Storage Room after power is energized.
- .9 The coordination study shall be complete, circuit breakers ground relays set, tested, and calibrated accordingly.

END OF SECTION

SECTION 260519

WIRE AND CABLE-RATED 600 VOLT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Addenda, Alternates, Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specifications collectively apply to work of this Section.

1.02 DESCRIPTION

- A. Work includes but is not limited to the following:

- 1. Building wire.
- 2. Ground Conductors.
- 3. Wiring connections and terminations.
- 4. Conductor Identification.

- B. Related Work:

- 1. Section 260100 - Basic Materials and Methods.
- 2. Section 260526 - Grounding.
- 3. Section 260533 - Conduit.
- 4. Section 260553 - Electrical Identification.

PART 2 - PRODUCTS

2.01 BUILDING WIRE

- A. Wires shall be single conductor type THHN or THWN insulated with polyvinyl chloride and covered with a protective sheath of nylon, rated at 600 volts. Wires may be operated at 90 degrees C. maximum continuous conductor temperature in dry locations, and 75 degrees C. in wet locations and shall be listed by UL Standard 83 for thermoplastic insulated wires, listed by Underwriters Laboratories (UL) for installation in accordance with Article 310 of the California Electrical Code (CEC). Conductors shall be solid copper for 12 AWG and smaller conductors, and stranded copper for 10 AWG and larger conductors. Conductors shall be insulated with PVC and sheathed with nylon. Wires shall be identified by surface markings indicating manufacturer's identification, conductor size and metal, voltage rating, UL symbol, type designations and optional rating. Indentations for lettering are not permitted. Wires shall be tested in accordance with the requirements of UL standard for types THWN, or THHN.
- B. Conductors shall be solid Class B or stranded Class C, annealed uncoated copper in accordance with UL standards, or another Nationally Recognized Testing Laboratory (NRTL).
- C. Control Circuits: Copper, stranded conductor 600 volt insulation, THWN/THHN.

- D. Minimum branch circuit wiring: No. 12 AWG copper, 600 volt insulation.
- E. Minimum wire size except for control wiring: No. 14 AWG copper, 600 volt insulation.
- F. Wiring for fluorescent lighting fixtures mounted end-to-End: Type "THHN".

2.02 GROUND CONDUCTORS

- A. Equipment ground: Insulated conductor green in color.
- B. Isolated circuit ground: Insulated conductor green in color.
- C. Ground Wires: Bare copper or with green colored insulation.

2.03 CONDUCTOR ARRANGEMENT AND IDENTIFICATION

- A. Ties: T & B "Ty-rap" or 3M Company.
- B. Lacing: Nylon twine.
- C. Markers: Adhesive type, Brady.

2.04 CONDUCTORS

- A. All Wire: New and delivered to job site in unbroken packages.
- B. Each package shall bear Underwriter's and Manufacturer's labels and seals indicating date of manufacture and maximum allowable voltage.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Wires shall not be installed until debris and moisture is removed from conduits, boxes, and cabinets. Wires stored at site shall be protected from physical damage until they are installed and walls are completed.
- B. Wire-pulling compounds furnished as lubricants for installation of conductors in raceways shall be compounds approved and listed by UL, NRTL, or equal. Oil, grease, graphite, or similar substances are not permitted. Pulling of 2 AWG or larger conductors shall be performed with a cable pull machine. Any runs shorter than 50 feet are exempt. When pulling conductors, do not exceed manufacturer's recommended values
- C. At outlets for light, power, and signal equipment, pigtail splices with 8-inch circuit conductor leads for connection to fixtures, equipment, and devices.
- D. Pressure cable connectors, pre-insulated 3M Scotchlok, Hubbell Power, O-Z/Gedney or equal, Y, R or B spring-loaded twist-on type, may be furnished in splicing number 8 AWG or smaller wires for wiring systems; except public address and telephone systems.

- E. Joints, splices, taps, and connections to switchboard neutral, bonding or grounding conductors, conductors to ground busses, and transformer connections for wires 6 gage and larger shall be performed with high-pressure cable connectors approved for installation with copper conductors. Connectors shall be insulated with heavy wall heat shrink WCSM, or cold-applied roll-on sleeve RVS. Insulation level shall be a minimum of 600V and joints, splices, and taps shall be qualified to ANSI C 119.1, UL, NRTL, or equal listed mechanical pressure connections.
- F. Connections to any bussing and high-press cable connectors shall be securely bolted together with corrosion-resistant plated carbon steel, minimum grade five machine screws secured with constant pressure-type locking devices.
- G. Connection of any bonding or grounding conductors shall be securely bolted together with corrosion-resistant plated carbon steel, minimum grade five machine screws secured with constant pressure-type locking devices.
- H. Wire switchboards, panel cabinets, pull boxes, and other cabinets except public address, shall be neatly grouped and tied in bundles with nylon ties at 10-inch intervals. In switchboards, panels and terminal blocks, wires shall be fanned out to terminals. If bundles are longer than 24 inches, a maximum of nine current carrying conductors may be bundled together.
- I. Install conductor lengths with a minimum length within the wiring space. Conductors must be long enough to reach the terminal location in a manner that avoids strain on the connecting lug.
- J. Maintain the conductor required bending radius.
- K. Neutral conductors larger than 6 gage, which are not color identified throughout their entire length, shall be taped, painted white or natural gray, or taped white where they appear in switchboards, cabinet, gutters or pull boxes. Neutral conductors 6 gage and smaller shall be white color identified throughout their entire length.
- L. Fire alarm and clock wiring shall be continuous from terminal cabinets or from equipment to each device. Splices are not permitted between devices and/or terminal cabinets at junction and pull boxes. Wiring shall be terminated at terminal blocks or devices only.
- M. Wiring systems shall be free from short circuits and grounds, other than required grounds. The contractor shall be responsible for the testing of feeder and branch circuit conductor's insulation resistance. The insulation of the conductors shall be tested prior to connections to any panelboards, switchboards, variable frequency drives, lighting control systems, ballasts, and wiring devices such as but not limited to GFI receptacles, TVSS receptacles, or equipment. Insulation testing of panelboards and switchboards shall be independently performed from the insulation testing of any conductors as specified in other sections of this specification.
 - 1. Utilize the services of an approved independent testing laboratory to perform megger time-resistance insulation testing of feeder conductors. Tests must be conducted with wires disconnected at both ends.

- a. Provide calibration program records to assure the testing instrument to be within rated accuracy. The test equipment accuracy shall be in accord with the requirements stated by the National Institute of Standards and Technology (NIST).
- b. Test equipment shall be provided with a label stating the date of last calibration. As a minimum the equipment shall have been calibrated within the past 12 months.
- c. Test reports shall include the following:
 - 1) Identification of the testing organization.
 - 2) Equipment identification.
 - 3) Ambient conditions.
 - 4) Identification of the testing technician.
 - 5) Summary of project.
 - 6) Description of equipment being tested.
 - 7) Description of tests.
 - 8) Test results.
 - 9) Analysis, interpretation and recommendations.

3.02 COLOR CODES

A. General Wiring:

- 1. Color code conductor insulation as follows:

SYSTEM VOLTAGE		
Conductor	208Y/120	480Y/277
Phase A	Black	Brown
Phase B	Red	Orange
Phase C	Blue	Yellow
Neutral	White	Natural Gray

Neutrals shall be colored-distinguished if circuits of two voltage systems are used in the same raceway.

- 2. For phase and neutral conductors 6 gage or larger, permanent plastic-colored tape may be furnished to mark conductor end instead of coded insulation. Tape shall cover not less than 2 inches of conductor insulation within enclosure.

B. Signal Systems: Wires for signal systems shall be color-coded. Except where otherwise specified, color-coding shall be as follows:

SYSTEM	COLOR CODE
Clocks	Pink, Gray and Orange
Fire Alarm Horns	Pink (+) and Gray (-)
Fire Alarm Strobes	Orange (+) and Blue (-)
Un-Interruptible 24 Volt Power (Annunciator, Water Flow, and Audible Device)	Yellow (+) and White (-) Note: A single white wire may be common to both
Interruptible 24 Volt Power (4 wire smoke detectors, duct detectors)	Brown (+) and White (-) Note: A single white wire may be common to both
Switch-Leg Sprinkler Bell (Between water flow and	Violet (+) and White (-)

audible device)	
Door Holding Magnets (Non Power Limited)	Black (+) and White (-)

3.03 FEEDER IDENTIFICATION

- A. Feeder wires and cables shall be identified at each point the conduit run is broken by a cabinet, box, gutter, etc. Where terminal ends are available, identification shall be by means of heat shrink wire markers, which provide terminal strain relief. Markers shall be by Tyco Electronics, Panduit, Brady Perma-Sleeve, or equal. Identification in other areas shall be by means of wrap-around tape markers from Tyco Electronics, Panduit, Brady Perma-Code or equal. Markers shall include feeder designation, size, and description.

3.04 TAPE AND SPLICE KITS

- A. Splices, joints, and connectors joining conductors in dry and wet locations shall be covered with insulation equivalent to that provided on conductors. Free ends of conductors connected to energized sources shall be taped. Voids in irregular connectors shall be filled with insulating compound before taping. Thermoplastic insulating tape approved by UL, NRTL, or equal for installation as sole insulation of splices shall be furnished and shall be installed according to manufacturer's printed specifications.

3.05 PROTECTION

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

3.06 CLEANUP

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

END OF SECTION

SECTION 260526

GROUNDING

PART 1 - GENERAL

1.01 Provide required grounding.

1.02 SYSTEM DESCRIPTION

- A. All metallic objects on the premises that enclose electrical conductors or that are likely to be energized by electrical currents shall be effectively grounded.
- B. All metal equipment parts such as enclosures, raceways, and equipment grounding conductors and all earth grounding electrodes shall be solidly joined together into a continuous electrically conductive system.
- C. All metallic systems shall be solidly interconnected to the electrical system as provided by the service entrance and for each grounded separately derived system that is installed.
- D. A separately derived A.C. source shall be grounded to the equipment grounding conductor and to a separate made electrode.
- E. Electrical continuity to ground metal raceways and enclosures, isolated from equipment ground by use of non-metallic conduit or fittings, shall be provided by a green insulated grounding conductor of approved size within each raceway connected to isolated metallic raceways, or enclosures at each end. Each flexible conduit shall be provided with a green insulated grounding conductor of approved size. In addition to using metallic conduits as ground, provide a ground wire sized per code in every conduit.
- F. Cold water or other utility piping systems shall not be used as the only source of grounding electrodes. Grounding electrodes shall be "made electrodes" specified as follows:
 - 1. Grounding electrodes as specified in Part 2 of this Specification.
 - 2. Concrete enclosed electrode, which is made up of at least 20'-0" of #4 AWG, minimum size, copper conductor, encased by at least 2" of concrete, located within or near bottom of a concrete foundation, or footing, which is in direct contact with earth. Footing rebar must be connected to copper wire using approved connections. An external electrode as specified in Article 2.01, Paragraph B of this Specification Section must be installed and connected to foundation or footing rebar.
- G. Non-current-carrying metal parts of high voltage equipment enclosure, signal and power conduits, switchboard and panelboard enclosures, motor frames, equipment cabinets, and metal frames of buildings shall be permanently and effectively grounded.

- H. Metallic or semi-conducting shields, and lead sheaths of cables operating at high voltage, shall be permanently and effectively grounded at each splice and termination.
- I. Neutral of service conductors shall be grounded as follows:
 - 1. Neutral shall be grounded at only one point within school site for that particular service. Preferable location of grounding point shall be at service switchboard, or main switch.
 - 2. Equipment and conduit grounding conductors shall be bonded to that grounding point.
 - 3. If other buildings on campus are served from a switchboard or panelboard in another building, power supply is classified as a feeder and not as a service.
 - 4. Equipment grounding conductor is carried from switchboard to each individual building. At building, grounding conductor is bonded with power equipment enclosures, metal frames of building, etc., to "made electrode" for that building.
 - 5. Neutral of feeder shall not be grounded.
- J. If there is a distribution transformer at a building, secondary neutral conductor shall be grounded to "made electrode" serving building.
- K. Within every building, main switchboard or panel, shall be bonded to a 1" or larger cold water line with a 1" conduit with one #6 wire. Metallic piping systems (gas, fire sprinkler, etc.) shall be bonded to cold water line with 3/4" conduit with one #8 wire.

PART 2 - PRODUCTS

2.01 YARD BOXES

- A. Yard boxes shall be precast concrete and shall be approximately 14" wide, 19" long, and 12" deep (outside dimensions), or larger, if necessary, to obtain required clearances. Boxes shall be equipped with bolt-down, checkered, cast iron covers and a cast iron frame cast into box. Yard boxes shall be Brooks 36 or approved equal.

2.02 ELECTRODES

- A. "Made" electrodes shall be approved copper-clad steel ground rods, minimum 3/4" diameter, 10'-0" long.

2.03 GROUND ENHANCEMENT MATERIAL

- A. Ground enhancement material as manufactured by Erico Electrical Products shall be used packed inside a 3" diameter hole around ground rod. Manufacturer's installation instructions must be followed for each ground rod installation.

PART 3 - EXECUTION

3.01 ELECTRICAL DEVICES

- A. Grounding electrodes shall be located in nearest usable planting area, where not otherwise indicated on Drawings, and each electrode shall terminate within a concrete yard box installed flush with finish grade. In planting areas, concrete yard box shall be 2" above planting surfaces.
- B. If concrete enclosed electrode is used, grounding wire shall terminate to a suitable copper plate with grounding lugs.
- C. Grounding rods shall be driven to a depth of not less than 8'-0". A permanent ground enhancement material as manufactured by Erico Electrical Products shall be used at each ground rod to improve grounding effectiveness. The manufacturer's guidelines shall be used for each installation.
- D. Grounding electrodes shall have a resistance to ground of not more than 5 ohms.
- E. When using grounding rods, if resistance to ground exceeds 5 ohms, 2 or more rods connected in parallel shall be provided to meet grounding resistance requirement.
- F. Ground rods shall be separated from one another by not less than 10'-0"
- G. Parallel grounding rods shall be connected together with approved fittings and approved grounding conductors in galvanized rigid steel conduit, buried not less than 12" below finish grade.
- H. Electrical Contractor shall include in his bid, cost of services of an approved independent testing laboratory, to test grounding resistance of all made electrodes, ground rods, and bonding of building steel, water pipes, gas pipes and other utility piping. Tests to be performed are as follows:
 - 1. Visually and mechanically examine ground system connections for completeness and adequacy.
 - 2. Perform "fall of potential" tests on each ground rod or ground electrode where suitable locations are available per IEEE Standard No. 81, Section 8.2.1.2. Where suitable locations are not available, measurements will be referenced to a known dead earth or reference ground.
 - 3. Perform the two point method test per IEEE No. 81, Section 8.2.1.1 to determine ground resistance between ground rod and building steel, and utility piping - such as water, gas and panelboard grounds. Metal railings at building entrances and at handicapped ramps shall also be tested.
 - 4. Test shall be conducted in presence of the District Electrical Inspector.
- I. Three copies of test results shall be submitted to the District Electrical Inspector. Test results shall be submitted on an official form from the independent testing laboratory showing project location, test engineer, test conditions, test equipment data, ground system layout or diagram, and final test results.

END OF SECTION

SECTION 260533

CONDUIT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Addenda, Alternates, Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specifications collectively apply to work of this Section.

1.02 DESCRIPTION

- A. Work includes but is not limited to the following:
 - 1. Rigid metal conduit and fittings.
 - 2. Intermediate metal conduit and fittings.
 - 3. Electrical metallic tubing and fittings.
 - 4. Flexible metal conduit and fittings.
 - 5. Liquidtight flexible metal conduit and fittings.
 - 6. Non-metallic conduit and fittings.

PART 2: PRODUCTS

2.01 RIGID STEEL CONDUIT AND FITTINGS

- A. Rigid Steel Conduit: Hot dipped galvanized inside and out, galvanized threads, mild steel, zinc coated, inside and outside protective coating. Standard lengths: 10'-0".
- B. Bushings: Threaded insulated metallic type except sizes 1" and smaller may be non-metallic type. Setscrew bushings are not acceptable.
- C. Couplings, elbows, bends and other fittings: Same material and finish as rigid steel conduit. All shall be threaded type.

2.02 RIGID ALUMINUM CONDUIT AND FITTINGS

- A. Conduit: Extruded from 6063-T24 alloy of maximum 1/10% copper content and containing lubricating inside liners; rigid threaded type.
- B. Bushings: Insulated metallic except that sizes 1" and smaller may be non-metallic.

2.03 INTERMEDIATE METAL CONDUIT (IMC) AND FITTINGS

- A. Conduit: Galvanized steel, zinc coated, protective coating inside and out.
- B. Fittings and Conduit Bodies: Use fittings and conduit bodies specified above for rigid steel conduit.

- C. Conduit: May be used in lieu of rigid steel conduit where permitted by code, except in concrete, underground, runs longer than 100 feet for all power feeders with conduit greater than 2 inches.

2.04 ELECTRICAL METALLIC TUBING (EMT) AND FITTINGS

- A. Conduit: Hot dipped galvanized or sherardized inside and out, zinc coated with protective enamel coating inside. Provide bushings at ends of conduits.
- B. Connectors: Steel, insulated, bused tap-on or wrench tightened compression type. (Couplings similar) Indentor or screw type not acceptable.
- C. Conduit: May be used in lieu of rigid steel conduit where permitted by code, except exposed, in concrete and for runs more than 100' for all power feeders with conduit greater than 2 inches.

2.05 FLEXIBLE METAL CONDUIT AND FITTINGS

- A. Conduit: Steel single strip, hot dipped galvanized on all 4 sides prior to fabrication. Flexible aluminum conduit will not be allowed.
- B. Connectors: Die cast with ridges that thread into conduit. (Binding screw type connectors are not acceptable.)
- C. Conduit: May be used in lieu of rigid steel conduit where specifically indicated; at connections to vibrating equipment; at drops to light fixtures from J-boxes; at locations judged by Architect impractical to use rigid conduit. Maximum length for any application shall be 6 feet.

2.06 LIQUIDTIGHT FLEXIBLE CONDUIT AND FITTINGS

- A. Conduit: Steel, single strip, hot dipped galvanized on 4 sides prior to fabrication.
- B. Connectors: Insulated, special Appleton "STN" Series.
- C. Jacket: Liquidtight, polyvinyl chloride plastic.
- D. Conduit: Use for final connection to motor terminal boxes and transformers. Use at exterior locations, damp locations, wet locations and for flex connections in kitchen, restrooms and similar areas.

2.07 PLASTIC CONDUIT AND FITTINGS

- A. Conduit: Extruded, virgin polyvinyl chloride compound, Schedule 40, heavy wall, in 10'-0" lengths with couplings.
- B. Fittings: Non-threaded type couplings.
- C. Conduit: May be used underground only. Vertical elbows and risers of all sizes shall be rigid steel with 20 mil bonded PVC coating.

2.08 CONDUIT SUPPORTS

- A. Conduit Clamps, Straps, and Supports: Steel or malleable iron. Clamps: Unistrut Nos. P111 thru P1124, Kindorf No. C105. Straps: One or two hole as required.
- B. Conduit hangers, racks and trapezes: Steel, threaded rods, channel iron "U" shaped racks equal to "Unistrut".
- C. Individual conduit hangers: Steel, threaded rods with malleable iron split rings.
- D. Hanger rods: 3/8" minimum diameter for 2" and smaller conduit, factory made. 1/2" minimum for 2-1/2" and larger conduit.
- E. Wire supports: 12 gauge zinc coated iron tie wire, or 16 gauge galvanized double annealed steel tie wire.

2.09 CONDUIT ROOF JACKS AND FLASHING

- A. Roof Jacks:
 - 1. For Single Conduits Through Roof: Stonemen Stormtite Series #1100-4; seamless 4 pound lead flashing assembly, 8" skirt, steel reinforced varipitch boot; caulk type cast iron counterflashing sleeve, with vandalproof set screws, and Perma-seal waterproofing compound.
 - 2. Sleeves for Conduits: Sleeves shall be adjustable type, of 26 gage galvanized iron, Adjust-to Crete Co. Adjust-to-Crete, or Jet Line Products Inc. Jet-Line, or equal.
 - 3. Where conduit enters a building through a concrete foundation below grade, or ground water level, or where it is necessary to seal around a conduit where it passes through a concrete floor or wall, provide O-Z/Gedney Type FSK Thru Wall and Floor Seal, or equal.

2.10 CONDUIT PULLING CORDS

- A. Pull Wire: No. 12 galvanized iron or nylon pull wire rated 250 pounds tensile strength.

2.11 CONDUIT FITTINGS, ELLS AND BUSHINGS

- A. Special conduit fittings: Crouse-Hinds "Condulets" or Appleton "Unilets".
- B. Ells: Same quality, same finish and same make as conduit.
- C. Bushings: Thomas & Betts or approved equal.
- D. Seismic separations and expansion joints: OZ type "AX" complete with bonding strap and clamps. At exterior locations use OZ type "EX".

2.12 CONDUIT SEALS AND SEALING COMPOUND

- A. Vertical seals: Crouse Hinds type "EYD" or Appleton type "SF".

- B. Horizontal Seals: Crouse Hinds type "EYS" or Appleton type "ESU".
- C. Sealing compound: Crouse Hinds "CHICO" or Appleton "APELCO".
- D. Fireproofing Compound: Dow Corning No. 3-6548 RTV or equal by 3M Company or Nelson.

2.13 UNDERGROUND SPACERS FOR PVC CONDUIT

- A. Spacers: PVC, interlocking type, intermediate and base styles.
- B. Sizes: For 2" to 4" conduit.
- C. Manufacturer: Carlon or approved equal.

2.14 SPECIAL UNDERGROUND COUPLINGS FOR PVC CONDUIT

- A. Expansion couplings: PVC type to expand up to 4".
- B. Couplings: Socket type for joining PVC conduit.
- C. Adapters: Socket type at one end for PVC conduit and threaded female type at other end for metallic connection.

2.15 PLASTIC CONDUIT CEMENT

- A. Solvent weld cement: Fast drying, brush-on type.

2.16 MC CABLE

- A. Metal Clad (MC) cable system is not allowed.

PART 3: EXECUTION

3.01 CONDUIT SIZING, ARRANGEMENT, AND SUPPORT

- A. Arrange conduit to maintain headroom and present a neat appearance.
- B. Unless indicated otherwise, conceal conduit within or behind finished walls and ceiling.
- C. Route exposed conduit and conduit above accessible ceilings parallel and perpendicular to walls and adjacent piping.
- D. Maintain minimum 6 inch clearance between conduit and piping. Maintain 12 inch clearance between conduit and heat sources such as flues, steam pipes, and heating appliances.

- E. Arrange conduit supports to prevent distortion of alignment by wire pulling operations. Fasten conduit using galvanized straps, lay-in adjustable hangers, clevis hangers, or bolted split stamped galvanized hangers.
- F. Group conduit in parallel runs where practical and use conduit rack constructed of steel channel with conduit straps or clamps. Provide space for 25 percent additional conduit.
- G. Do not fasten conduit with wire or perforated pipe straps. Remove all wire used for temporary conduit support during construction, before conductors are pulled.
- H. Do not support conduit from any equipment subject to vibration. Support from structural members only.
- I. Structural Considerations for Conduit Routing:
 - 1. Where conduits are to pass through or will interfere with any Structural member, or where notching, boring or cutting of the structure is necessary, or where special openings are required through walls, floors, footings, or other buildings elements, to accommodate the electrical work, such work shall conform to State Building Code.
 - 2. Where conduits are terminated in groups at panelboards, switchboards and signal cabinets, etc., provide templates or spacers to hold conduits in proper position and to preserve alignment. Conduits terminating at signal cabinets shall enter cabinets in following approved locations only: Conduits entering top, side, and bottom of cabinets shall be aligned in a single row, centered 2" from rear of cabinet; conduits entering back of cabinet shall be aligned in a single row centered 2" from top of cabinet. Conduits shall not be spaced closer than 3" on centers.
 - 3. 1" and smaller conduits above metal lath ceilings shall be tied to ceiling channels. 1-1/4" conduits above metal lath ceilings shall be rigidly suspended with pipe hangers or pipe racks or shall be secured to superstructure with factory made pipe straps. Conduits in metal lath or steel stud partitions, shall be tied to furring channels or studs. In ceiling spaces and in partitions, tie wires shall be spaced not more than 5'-0" apart, shall hold conduit tight against channels and studs at point of tie and shall not bear any of weight of conduit. Tie wire shall be #16 gage galvanized double annealed steel tie wire.
 - 4. Where auxiliary supports, saddles, brackets,, etc., are required to meet special conditions they shall be made rigid and secure before conduit is attached thereto.
 - 5. Conduit in ceiling spaces, in stud walls and under floors shall be supported with factory made pipe straps or shall be suspended with pipe hangers or pipe racks. Pipe straps shall be attached to and shall hold conduit tight at point of support against ceiling and floor joists, rafters, and wall studs, or 2" x 4" headers fitted between joists or wall studs.
 - 6. Conduits installed on exposed steel trusses and rafters shall be fastened with factory made conduit straps or clamps which shall hold conduit tight against supporting member at point of support.
 - 7. Conduits under buildings shall be strapped with factory made conduit straps to underside of concrete floor or joists, or wood floor joists, or shall be

suspended with pipe hangers or pipe racks. Conduits under building shall not rest on ground but shall be suspended from building or shall be buried below surface of ground. 1" and larger conduits under buildings shall be suspended with conduit hangers or racks.

8. Pipe hangers for individual conduits shall be factory made, consisting of a pipe ring and threaded suspension rod. Pipe ring shall be malleable iron, split and hinged, and shall securely hold conduit, or shall be springable wrought steel. Rings shall be bolted to or interlocked with suspension rod socket. Rods shall be 3/8" for 2" conduit hangers and smaller and shall be 1/2" for 2-1/2" conduit hangers and larger.
9. Pipe racks for groups of parallel conduits and for supporting total weights not exceeding 500 pounds shall be trapezoid type and shall consist of a cross channel, Steel City Kindorf #B-900, Unistrut #P-1000 suspended with a 3/8" minimum diameter steel rod at each end. Each rod shall be fastened with nuts, top and bottom to cross channel and with a square washer on top of channel. Each conduit shall be clamped to top of cross channel with conduit clamps, Steel City Kindorf #C-105 or Unistrut Nos. P-1111 through P-1124. Conduits shall not be stacked one on top of another, but a maximum of 2 tiers may be on same rack providing an additional cross channel is installed. Where a pipe rack is to be longer than 18", or if weight it is to support exceeds 500 pounds, submit details of installation to the Architect for approval.
10. Factory-made pipe straps shall be one or 2-hole formed galvanized clamps, heavy duty type, except where otherwise specified.
11. Hangers straps, rods, or pipe supports under concrete shall be attached to inserts set at time concrete is poured. Under wood use bolts, lag bolts, or lag screws; under steel joists or trusses use beam clamps.

3.02 CONDUIT INSTALLATION

- A. Cut conduit square using a saw or pipe cutter; de-burr cut ends.
- B. Bring conduit to the shoulder of fittings and couplings and fasten securely.
- C. Use conduit hubs or sealing locknuts for fastening conduit to cast boxes, and for fastening conduit to sheet metal boxes in damp or wet locations.
- D. Install no more than equivalent of two 90-degree bends between boxes for conduits 2" diameter and larger, three for conduit under 2" diameter. Locate pull boxes as required.
- E. Use conduit bodies to make sharp changes in direction, as around beams.
- F. Use hydraulic one-shot conduit bender or factory elbows for bends in conduit larger than 2 inch size.
- G. Avoid moisture traps where possible; where unavoidable, provide junction box with drain fitting at conduit low point.
- H. Support rigid, intermediate and thin wall conduit at 8'-0" maximum on centers and 3'-0" from junction boxes.

- I. Support flexible and liquidtight flexible conduit at 4'-0" maximum on centers and 12" from junction boxes.
- J. PVC conduit: Use underground only. Encase in 3" concrete (2000 psi) envelope except under building.
- K. Provide No. 12 AWG insulated conductor or suitable pull string in empty conduit, except sleeves and nipples.
- L. Install expansion-deflection joints where conduit crosses building expansion or seismic joints.
- M. Where conduit penetrates fire-rated walls and floors, seal opening around conduit with UL listed fire barrier, "3M" calk or equal.
- N. Route conduit to roof mounted devices and equipment through roof jacks. Provide flashing/roof jacks for all new and existing conduits which penetrate roof to appropriate Roofing Section(s) for installation.
- O. Run conduit to equipment on roof concealed in attic space. Penetrate roof at equipment locations only.
- P. For conduits to roof mounted HVAC equipment, penetrate roof with roof jacks outside footprint of HVAC units. Do not penetrate roof inside HVAC units.
- Q. Do not use aluminum conduit below grade, cast in concrete or in masonry in contact with earth.
- R. Conduit underground may be rigid conduit and in these conditions shall be given two heavy coatings of a suitable primer and a single half lapped layer of protective plastic tape. Primer and tape shall be "Scotchrap" No. 50 tape. Primer and tape shall be "Scotchrap" Primer or Trantex V-10 tape and Dutch Brand Primer. Primer and tape shall be in strict accordance with manufacturer's instructions. As an alternate, conduit and fittings shall have a PVC bonded coating (40 mil thickness minimum) by Occidental Coating Company.
- S. Where conduit is installed underground, under slabs on grade, exposed to weather or in wet locations, make joints liquidtight and gastight.
- T. For underground or underslab conduit, apply a heavy coat of Pabco P & B No. 2 paint to all surfaces within 6" each side of fittings and to areas where wrenches or other tools have been applied. On exposed conduit, repair scratches and other defects with galvanizing repair stick, Enterprise Galvanizing "Galvabar".
- U. Cut threads on rigid conduit to standard taper and to a length such that all bare metal exposed by threading operation will be completely covered by couplings or fittings used. In addition, cut lengths of thread such that all joints will become secure and wrench tight just preceding point where conduit ends would butt together in couplings and where conduit ends would butt into ends or shoulders of other fittings. Securely tighten all threaded connections.

- V. Make joints in rigid conduit installed in concrete or masonry liquid-and-gas-tight, with red lead and oil, or other approved joint compound and engage not less than five threads.
- W. Keep bends and offsets in conduit runs to an absolute minimum. Replace all deformed, flattened or kinked conduit. Provide large radius factory made bends or power bend rigid metal conduit of 1-1/4" trade size or larger.
- X. Place sleeves for electrical conduit passing through walls, beams or slabs before concrete is poured (exception-floor slabs on earth). Where conduit passes through suspended floor slabs, outside of chases, sleeves shall be standard weight black steel pipe extending 1-1/2" above the finished floor level. Sleeves at other locations shall be either lightweight galvanized steel tube, or galvanized sheet steel, with a minimum thickness of 24 USSG. Clearance between conduit and sleeves shall be not less than 1/2". Sleeves through outside walls below grade shall be caulked tight. Caulk with oakum and mastic to obtain watertight joint.
- Y. Penetration Membrane: Where penetration cannot be avoided, cut and re-seal membrane at point of penetration.
- Z. Provide minimum 3/4" conduit size underground.
- AA. Run exposed conduit parallel with or at right angles to building line, beams, or ceilings. Place symmetrical bends or metal boxes at changes in direction or taps.
- BB. Stub from each panel which is flush mounted in a wall, from top of panel a minimum of 3-3/4" conduits to nearest ceiling space or other accessible locations and cap for future use. Tag to indicate panel origination.
- CC. Independently support conduit rising from floor for motor connections if over 24" above floor. Support shall not be a motor or duct work which may transmit vibrations.
- DD. Provide pull wire in all conduit runs indicated as conduit only (C.O.).
- EE. Do not run conduit closer than 12" to any hot water pipe, steam pipe, heater flue or vent.
- FF. Terminate conduit stub-ups through floor for connection to equipment of junction boxes in couplings flush with top of concrete slab floor.
- GG. Within building, bury underground conduit a minimum of 6" below bottom of slab.
- HH. Use rigid metal conduit where legally required, where exposed to weather, where located in unheated areas, or where subject to mechanical injury, here defined as exposed conduit less than 7'-6" above floor in areas accessible to anyone other than authorized operating or maintenance personnel.
- II. Where a conduit from one structure crosses to another structure, e.g., from a building to an arcade or from one arcade to another arcade, use a section of liquid-

tight flex conduit at the crossing with sufficient slack to allow the two structures to move during an earthquake without breaking the conduit. For stub up to relocatable buildings, provide liquid-tite flex from stub up to first box on back of building.

- JJ. Provide PVC deflection - expansion joint fittings where underground run passes through expansion joint or is necessary for seismic conditions.
- KK. Provide a green insulated ground wire in all flexible conduit runs regardless of length.
- LL. Wipe plastic conduit (PVC) clean before joining. Apply even coat of cement to entire area to be inserted into fitting. Let joint cure for 20 minutes minimum. Use approved solvent-weld cement specifically manufactured for purpose. Threading of PVC conduit is prohibited.
- MM. Install an equipment ground (green) insulated conductor in each non-metallic conduit.
- NN. Do not install PVC conduit above grade for any reason. Seal both ends of all PVC conduit runs at each junction box or conduit interruption with sealant. Seal steel conduit risers to panelboards, switchboards, or pullboxes from underground PVC conduit runs.
- OO. Flash and counterflash all conduit runs passing through roof.
- PP. Use electrical metallic tubing above grade in dry locations only and where not subject to mechanical injury or otherwise prohibited. Concrete and masonry in contact with earth are not considered dry locations.
- QQ. Use liquid tight flexible conduit for final connections to motors and vibrating equipment. Use flexible conduit where required for equipment servicing for connections to recessed lighting fixtures from nearby accessible junction boxes, and for concealed runs in dry locations where structural conditions prevent use of other types of conduit.
- RR. For conduits for computer cables and coax cables, use large radius bends. Do not use j-box or pull box to change direction. Install boxes at straight conduit sections only and sweep conduit to make turns. Do not use conduit fittings to change directions.
- SS. Minimum radius for conduits designated for computer LAN wiring, coax cable wiring, data wiring, fibre-optics wiring, and TV cable wiring shall be as follows:

3/4"C	-	12"
1"C	-	12"
1-1/4"C	-	18"
2"C	-	24"
2-1/2"C	-	24"
3"C	-	30"
3-1/2"C	-	30"
4"C	-	30"

5"C - 36"
6"C - 42"

- TT. Size all conduits as legally required or larger where indicated or preferred. Where portions of a conduit run are increased in size, for whatever reason, make all remaining portions in that run same size.
- UU. Mark all underground conduit stub-outs with a 6 inch square by 2 foot deep concrete block with an embedded brass nameplate indicating the origin of conduit.
- VV. Do not cut concrete, masonry or structural members except where approved by Architect.
- WW. Underground Requirements:
1. Except for branch circuit conduits and auxiliary system branch circuits within a building, all conduits installed underground shall be entirely encased in concrete (2000 psi), 3" thick on all sides with multiple conduits spaced not less than 3" apart, except where otherwise specified. Provide approved conduit spacers as required to prevent any deflection of conduits when concrete is placed and to preserve position and alignment of conduits in concrete. Conduits shall be tied to spacers. Anchors shall be installed to prevent floating of conduits during pouring of concrete. Red concrete shall be used to encase conduits of systems operating above 600 volts. To protect conduits from underground to surface wall mounted panels, terminal cabinets, etc., encase conduits in 3" high concrete curb.
 2. Assemble sections of conduit with approved fittings and stagger all joints. Cut ends of conduit shall be reamed to remove all rough edges. Joints in all conduits shall be made liquid-tight. All bends at risers shall be completely below surface where possible.
 3. Two or more conduit runs in a common trench shall be separated by at least 3" of concrete. Conduit runs installed in a common trench with other utility lines and water, gas, sew lines, shall be separated from such lines by at least 12" horizontally. Power conduits shall be separated from low voltage signal conduits by 6" of concrete.
 4. Slope underground conduits between two pull boxes towards one of the boxes to avoid water and moisture trap. For underground conduits coming out of a building, slope conduits towards the first pull boxes. Take care to install underground conduits such that water cannot travel through underground pull boxes and conduits back into a building. Prevention method shall include but not limited to installing pull boxes with draining provision where conduits enter building, sealing both ends of each conduit water tight, etc.

3.03 EXCAVATION AND BACKFILL

- A. Include all excavation and backfilling required for work under this Section.
1. Bury underground conduit at least 27 inches below finished grade to top of conduit encasement.

2. Underground branch circuit conduit, within building limits, 6" below bottom of slab unless specifically indicated otherwise in these specifications.
 3. After installation of work has been inspected and approved, backfill trenches with clean earth, moistened and layer tamped to same compaction density as specified for both building and site locations under "Earthwork".
- B. Locate existing underground pipes by use of electronic locating devices and exercise utmost care in excavation work. Contractor is responsible for satisfactory repair of any underground utility line damaged as result of his excavation.
 - C. Trenches or any other excavation required for installation of electrical work, which are outside of barricaded working area, shall be barricaded at all times with continuous portable barricades. At completion of work, remove barricades from site. Backfill trenches and excavations outside of barricaded working area immediately after approval of conduit work by Inspector.
 - D. Where asphalt concrete has been cut, backfill up to existing grade.
 - E. Do not start excavations until approval is obtained from Inspector.

END OF SECTION

SECTION 260534

BOXES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Addenda, Alternates, Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specifications collectively apply to work of this Section.

1.02 DESCRIPTION

- A. Work includes but is not limited to the following:

- 1. Wall and ceiling outlet boxes.
- 2. Floor boxes.
- 3. Pull and junction boxes.
- 4. Sealant.

- B. Related Work:

- 1. Section 260100 - Basic Materials and Methods.
- 2. Section 260533 - Conduit
- 3. Section 262726 - Wiring Devices.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS-OUTLET BOXES

- A. Raco
- B. Steel City
- C. Bowers

2.02 OUTLET BOXES

- A. Sheet Metal Outlet Boxes: One piece galvanized, pressed steel, knockout type, 4-11/16" sq. by 2-1/8" deep in all locations unless otherwise indicated or required.
- B. Cast Boxes: Aluminum, or Cast fer alloy, deep type, gasketed cover, threaded hubs.
- C. Where Wiremold type box have to be used, e.g., on existing concrete wall, provide proper box such that the total depth of a box including the device mounted on the box, will not exceed 4 inches.

2.03 ACCEPTABLE MANUFACTURERS-FLOOR BOXES

- A. Hubbell

- B. Walker Parkersburg
- C. Steel City

2.04 PULL AND JUNCTION BOXES

- A. Interior and non-weatherproof boxes shall be constructed of blue or galvanized steel with ample laps, spot welded, and shall be rigid under torsional and deflecting forces. Boxes shall have auxiliary angle iron framing where necessary to ensure rigidity. Covers shall be fastened to box with a sufficient number of brass machine screws to ensure continuous contact all around. Flush type boxes shall be drilled and tapped for cover screws at Site if boxes are not installed plumb. All surfaces of pull and junction boxes and covers shall be given one coat of metal primer, and one coat of aluminum paint.
- B. Weatherproof pull and junction boxes shall conform to foregoing for interior boxes with following modifications: Cover of flush mounting boxes shall have a weather-tight gasket cemented to and trimmed even with cover all around. Surface or semi-flush mounting pull and junction boxes shall be UL approved as rain-tight and shall be complete with threaded conduit hubs. All exposed portions of boxes shall be galvanized and finished with a prime coat and coat of baked-on gray enamel.
- C. All junction and pull-boxes shall be rigidly fastened to the structure and shall not depend on conduits for support.
- D. Cast Metal Boxes for Outdoor and Wet Location Installations: Type 4 and Type 6, flat-flanged, surface-mounted junction box, UL listed as rain-tight. Galvanized cast iron OR Cast aluminum box and cover with ground flange, neoprene gasket, and stainless steel cover screws.

2.05 ACCEPTABLE MANUFACTURERS-SEALANT

- A. Crouse Hinds "CHICO"
- B. Permacel
- C. Ductseal

2.06 ACCEPTABLE MANUFACTURERS - FIRE PROOFING SEALANT

- A. Dow Corning
- B. 3M Company
- C. Nelson

PART 3 - EXECUTION

3.01 COORDINATION OF BOX LOCATIONS

- A. Provide electrical boxes as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections, and code compliance.

- B. Electrical box locations shown on Contract Drawings are approximate unless dimensioned. Verify exact location of floor boxes and outlets in offices and work areas with Owner's representative prior to rough-in.
- C. Locate and install boxes to allow access.
- D. Locate and install to maintain headroom and to present a neat appearance.

3.02 OUTLET BOX INSTALLATION

- A. Unless otherwise noted on plan or specifically allowed by the Engineer, conceal all boxes flush in wall or in ceiling space above drop ceiling. In finished areas and where it is not possible to conceal conduits and boxes, for example, on existing concrete wall, provide Wiremold type metallic surface raceways and boxes.
- B. Do not install boxes back-to-back in walls. Provide minimum 6 inch separation, except provide minimum 24 inch separation in acoustic-rated walls.
- C. Provide knockout closures for unused openings.
- D. Support boxes independently of conduit except for cast box that is connected to two rigid metal conduits, both supported within 12 inches of box.
- E. Use multiple-gang boxes where more than one device are mounted together; do not use sectional boxes. Provide barriers to separate wiring of different voltage systems.
- F. Install boxes in walls without damaging wall insulation.
- G. Coordinate mounting heights and locations of outlets mounted above counters, benches, and backsplashes.
- H. Position outlets to locate lighting fixtures as shown on reflected ceiling plans.
- I. In inaccessible ceiling areas, position outlets and junction boxes within 6 inches of recessed lighting fixture, to be accessible through lighting fixture ceiling opening.
- J. Provide recessed outlet boxes in finished areas; secure boxes to interior wall and partition studs. Accurately position to allow for surface finish thickness. Use stamped steel stud bridges for flush outlets in hollow stud wall, and adjustable steel channel fasteners for flush ceiling outlet boxes. Install plaster rings to interface with equipment to be mounted thereon.
- K. Align wall-mounted outlet boxes for switches, thermostats, and similar devices.
- L. Provide cast outlet boxes in exterior locations and wet locations. Provide cast bell-boxes at interior locations where box is exposed to view. (do not use regular 4/s or handy box with exposed knockouts and unfinished appearances for these interior exposed applications).
- M. Where boxes are installed in fire rated ceiling or walls, be responsible for preserving integrity of fire rating as required.

- N. In fire-rated wall, use 4" square deep boxes. Do not aggregate more than 100 square inches of boxes for any 100 square feet of wall or partitions. Separate outlet boxes on opposite sides of walls or partition by a minimum horizontal distance of 24 inches. Where the separation cannot be achieved due to site condition, provide 2-hour rated fire-proof material behind boxes to maintain fire rating of walls.

3.03 PULL AND JUNCTION BOX INSTALLATION

- A. Locate pull boxes and junction boxes above accessible ceilings or in unfinished areas.
- B. Support pull and junction boxes independent of conduit.

END OF SECTION

SECTION 260553

ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Addenda, Alternates, Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specifications collectively apply to work of this Section.

1.02 DESCRIPTION

- A. Work includes but is not limited to the following:
 - 1. Nameplates.
 - 2. Wire and cable markers.
- B. Related Work:
 - 1. Section 260100 - Basic Materials and Methods.
 - 2. Section 260519 - Wire and Cable -Rated 600 Volt.
 - 3. Section 260526 - Grounding.
 - 4. Section 260533 - Conduit.
 - 5. Section 260534 - Boxes.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Nameplates: Engraved three-layer laminated plastic, white letters on a black background.
- B. Wire Markers: Cloth markers, split sleeve or tubing type.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Degrease and clean surfaces to receive nameplates.
- B. Install nameplates parallel to equipment lines.
- C. Secure nameplates to equipment fronts using screws or rivets. Secure nameplate to outside face of panelboard doors.
- D. Embossed tape will not be permitted for any application.

3.02 WIRE IDENTIFICATION

- A. Provide wire markers on each conductor in panelboard gutters, pull boxes, and at load connection. Identify with branch circuit or feeder number for power and lighting circuits, and with control wire number as indicated on schematic and interconnection diagrams or equipment manufacturer's shop drawings for control wiring.

3.03 NAMEPLATE ENGRAVING SCHEDULE

- A. Provide nameplates of minimum letter height as scheduled below.
- B. Individual Circuit Breakers, Switches, Motor Starters in Panelboards, and Distribution Sections: 1/8 inch identifying circuit and load served, including location.
- C. Individual Circuit Breakers, fused and non-fused disconnect Switches, and Motor Starters: 1/8 inch identifying load served.
- D. Exterior metal pull boxes: 1/4 inch identifying systems in boxes.
- E. Terminal Cabinets: 1/4 inch identifying systems.

3.04 MARK CONDUCTOR RUNS

- A. Apply markers after conductors installed in conduits.
- B. Apply in panelboards and in junction boxes.
- C. Mark feeders in panelboards, switchboards and distribution sections.

3.05 MARK JUNCTION BOXES

- A. Mark covers of junction boxes with non-erasable marker to indicate circuit numbers or systems contained within boxes.
- B. Mark fire alarm boxes with red marker and identifying as "FA".
- C. Paint fire alarm conduits red at intervals such that conduits can be clearly identified for fire alarm system.

END OF SECTION

SECTION 262726

WIRING DEVICES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Addenda, Alternates, Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specifications collectively apply to work of this Section.

1.02 DESCRIPTION

- A. Work includes but is not limited to the following:
 - 1. Wall Switches
 - 2. Receptacles.
 - 3. Device plates and box covers.
- B. Related Work:
 - 1. Section 260100 - Basic Materials and Methods.
 - 2. Section 260526 - Grounding.
 - 3. Section 260534 - Boxes.
 - 4. Section 260553 - Electrical Identification.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS – WALL SWITCHES

- A. Harvey Hubbell Company.
- B. Pass and Seymour.
- C. Leviton.

2.02 WALL SWITCHES

- A. Wall switches for Lighting Circuit AC general use snap switch with toggle handle, rated 20 amperes and 120/277 volts AC. Handle: White or color as selected by Architect, plastic. Decorator spec grade.

2.03 ACCEPTABLE MANUFACTURERS - RECEPTACLES

- A. Harvey Hubbell Company.
- B. Pass and Seymour.

- C. Leviton.

2.04 RECEPTACLES

- A. Convenience and Straight-blade Receptacles: NEMA Configuration 5-15R: Decorator Spec Grade, White.
- B. Convenience and Straight-Blade Receptacles: NEMA configuration 5-20R: Decorator Spec Grade, White.
- C. Convenience receptacle, isolated ground type, orange in color: Decorator Spec Grade.
- D. GFI Receptacles: Duplex convenience receptacle with integral ground fault current interrupter, NEMA 5-20R, Decorator Spec Grade, White. Unit shall comply with UL 2003 GFCI requirements including lockout action.
- E. Receptacles: Highest specification grade.
- F. Provide tamper-resistant receptacles with thermoplastic dual mechanism shutter system to help prevent insertion of foreign objects. Receptacles shall have extra heavy-duty brass, one-piece mounting strap with integral ground. Receptacles shall be white color, impact resistant nylon face and back body. For tamper-resistant receptacles rated 20 amps/125 volts, provide NEMA 5-20R, white in color. For tamper-resistant receptacles rated 15 amps/125 volts, provide NEMA 5-15R, white in color. Provide Decorator Spec Grade receptacles.

2.05 ACCEPTABLE MANUFACTURERS - WALL PLATES (Match manufacturer of Device)

- A. Harvey Hubbell Company.
- B. Pass and Seymour.
- C. Leviton.
- D. TayMac.
- E. Match manufacturer of switches and receptacles.

2.06 WALL PLATES

- A. Interior Device Plates: Sierra Electric .040 stainless steel to suit device; multi-gang where required; blank plates at junction boxes and capped outlets.
- B. Weatherproof Cover Plates: Receptacles in wet locations shall be installed with an outlet enclosure clearly marked "Suitable for Wet Locations While In Use". There must be a gasket between the enclosure and the mounting surface, and between the cover and base to assure a proper seal. The enclosure must employ stainless steel mounting hardware and enclosure shall be recessed where possible and by TayMac Corporation or equal.

- C. Highest specification grade.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install wall switches 48 inches above floor to top of wall box, "OFF" position down. Verify mounting height with Architect prior to installation.
- B. Install convenience receptacles 18 inches above floor, or as noted on drawings, grounding pole on bottom.
- C. Install specific-use receptacles at heights shown on Contract Drawings.
- D. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface-mounted outlets in non-public places.
- E. Install devices and wall plates flush and level.
- F. Provide etched plates with 3/16" high black letters for:
 - 1. Outlets where voltage is other than 120 volt.
 - 2. When switch controls device other than lighting fixture.
 - 3. When switch is located out of sight of unit being controlled.
 - 4. Lock switches.
 - 5. Where more than one switch occurs under a common plate.
- G. Install plates with all four edges in continuous contact with finished wall surfaces without use of mats or similar devices.
- H. Provide blank cover plates for all boxes as required.
- I. In Kitchen, all 15A and 20A 115V receptacles shall be GFI type.

END OF SECTION

SECTION 265100

LIGHTING FIXTURES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Addenda, Alternates, Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specifications collectively apply to work of this Section.

1.02 DESCRIPTION

- A. Work includes but is not limited to the following:

- 1. Lighting fixtures and accessories.
- 2. Lamps.
- 3. Ballasts.
- 4. Parking Lot Poles.

- B. Related Work:

- 1. Section 260100 - Basic Materials and Methods.
- 2. Section 260519 - Wire and Cable.
- 3. Section 260526 - Grounding.
- 4. Section 260529 - Supporting Devices.
- 5. Section 260533 - Conduit.
- 6. Section 260534 - Boxes.

1.03 SUBMITTALS

- A. Submit Shop Drawings.
- B. Include outline drawings, lamp and ballast data, support points, weights, and accessory information for each lighting fixture type.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS - LIGHTING FIXTURES

- A. See Lighting Fixture Schedule on drawings.

2.02 SWITCHING AND DIMMING CONTROLS

- A. General

- 1. All devices color per architect.
- 2. Observe manufacturers installation instructions with particular attention to derating requirements for multiple gang installations.
- 3. Use factory made multiple gang faceplates matching device color.

4. Daylight Controls may be integrated into luminaires Performance shall equal or exceed specification for individual devices.

B. Switches

1. Standard snap style
2. 120/277 volt, 20A
3. Listed
4. Specification grade
5. Color per architect

C. Automatic control switch

1. Automatic control switch shall be a push button wall switch capable of on/off manual operation and shall also be capable of receiving automatic control signals through interrupting power to the switch and load.
2. Control switch shall mount in a standard single gang or multi-gang wall box and shall fit behind a decorator style face plate.
3. Control switch shall use an air gap relay rated for 15 Amp ballast, tungsten, general use and shall be compatible with all electronic ballasts and HID loads.
4. The control switch when used with an occupancy sensor shall provide manual on/off control from the push button and automatic shut off based on occupancy. When occupancy is not detected and the sensor's time delay has expired, the lights shall turn off. If occupancy is detected within 15 seconds of this shut off, the switch shall turn the lights back on. Otherwise, lights will remain off until the switch is manually turned on.
5. Control switch shall be capable of 3-way, 4-way, or multi-way switching.
6. Control switch shall be The Watt Shopper AS-100 or Sentry Switch or approved equal.

D. Motion sensors

1. Provide a dual technology sensor that detects presence in the control area by detecting Doppler shifts in transmitted ultrasound and passive infrared heat changes. Detection verification of both technologies must occur in order to activate lighting systems. Upon verification, detection by either shall hold lighting on.
2. Sensor shall have a retrigger feature in which detection by either technology shall retrigger the lighting system on within 5 seconds of being switched off.
3. Sensor shall be mounted and adjusted in order to eliminate detection through open doorways and outside of controlled area. To provide small motion diction and immediate activation upon entry, coverage of both technologies must be complete and overlapping throughout the controlled area.
4. The PIR technology shall utilize a temperature compensated, dual element sensor and a multi-element Fresnel lens. The lens shall be Poly IR4 material. The lens shall cover up to 2000 square feet for walking motion when mounted at 10 feet and 1000 square feet of desktop motion.
5. Ceiling or high wall mounted. Coordinate location for best detection when used with suspended lighting.
6. Ultrasonic sensing shall be volumetric in coverage with a frequency of 40 KHz. It shall automatically adjust the detection threshold dynamically to

compensate for constantly changing levels of activity and air flow throughout controlled space.

7. Sensors shall have a time delay that is adjusted automatically or shall have a fixed time delay of 5 to 30 minutes, set by DIP switches.

E. Automatic daylighting switches

1. Provide an ON/OFF daylight controller to reduce the controlled lighting as the daylight level increases. Where two stages of reduction are specified, provide a two stage controller providing a sequence reduction. As an alternate, two single stage controllers may be provided to provide two stages of reduction as long as these two devices may be adjusted to provide the desired sequencing of the lighting reduction and maintain this sequencing when switching the lights off and again when switching the lights on.
2. Ceiling mounted or luminaire mounted. The function of the automatic daylighting switches shall not be provided by a wall switch or a device mounted at wall switch height. If the device s powered by line voltage then it must be enclosed in an enclosure rated a minimum of NEMA 1 with a tamper proof cover or locking cover.
3. Independently adjustable setpoint and deadband. Setpoint shall be adjustable from at least 10 footcandles up to 100 footcandles. Deadband shall be adjustable up to at least 100% setpoint.
4. Adjustable time delay. Lighting level must be above the off setpoint continuously for the length of the time delay before the lights will switch off. The device shall not have a length of the time delay shorter than 3 minutes. Time delay shall be adjustable to up to 20 minutes.
5. Low voltage device to be connected by low voltage wiring to a power pack. If control sequence can be met, one power pack may be used with multiple control devices.
6. Daylight switch shall provide visible indicator of the current status of the control output. Indicator shall be an LED.
7. Daylight switch to provide a test mode that temporarily bypasses the time delays. If left in test mode, the daylight switch will automatically resume normal time delays at the end of a period no longer than 60 minutes. (This item is a requirement of the 2005 Title 24 standard).

F. Automatic daylighting dimming systems

1. Provide a daylighting controller to continuously dim the fluorescent lights. Daylighting controller may be a self contained photosensor or a controller with a remote photocell. Photocell or photosensor are to be ceiling mounted or attached to a pendant fixture.
2. Photosensor to provide 0 – 10 V dimming signal to continuously dim the ballasts proprietary methods of signaling dimming ballasts shall be acceptable.
3. Daylighting controller may be open or closed loop type. Closed loop devices may not be used in applications where there are adjoining dimming zones such that the luminaires from one dimming zone can be viewed by the daylighting controls in another zone. All daylighting controllers shall provide proportional control. An open loop device may accomplish this with one adjustment. All closed loop devices shall have at least two adjustments to

provide an adjustable response. Any device which attempts to maintain a constant photocell signal shall not be acceptable.

4. All adjustments shall be adjustable from the photocell.
5. Provide an occupant adjustment or override wall switch to allow the teacher to adjust the light levels.
6. Approved sensor/control manufacturers: Wattstopper, Lutron, Leviton, Lithonia, Novitas, Douglas.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install lamps in lighting fixtures and lampholders.
- B. Support surface-mounted lighting fixtures directly from building structure. Provide additional blocking, unistruts, steel channels, etc. as required.
- C. Install recessed lighting fixtures with attached accessible junctions boxes to permit removal and access from below. Use plaster frames in plaster, gypsum wallboard or acoustic ceilings. In grid ceiling rated for light fixture support, support recessed fluorescent light fixtures directly from T-bar using approved earthquake clips and in addition, 2 No. 12 wires (slack wires), one at each diagonal end of fixture attached directly to a structural member. If two opposite ends of a fixture do not rest on ceiling main runners, provide 4 No. 12 wires (support wires) to structural member. In grid ceiling not rated for fixture support, attach fixture to grid using approved earthquake clips and in addition 4 No. 12 support wires directly to structural member.
- D. Provide safety chain between fixture and structure for recessed light fixtures. Mount hanger channels to span structural and/or T-bar ceilings.
- E. Provide required backing for all lighting fixtures.
- F. Join continuously mounted fixtures by use of chase nipples.
- G. Provide spacers where required.
- H. Mount light fixtures so that fixture labels are not visible when viewed from below.
- I. For recessed fixtures in fire rated ceiling, provide fireproofing enclosure equal to rating of ceiling.
- J. Mount Parking Lot Poles complete with luminaires and lamps on concrete base.
- K. In each pendant of a pendant mounted light fixture, provide a safety wire or cable attached to the fixture and structure at each support capable of supporting four times the supported load. Provide swivel mounts at ceiling and longitudinal sway mounts at fixtures to allow fixtures to swing freely a minimum of 45 degrees from vertical.
- L. Test motion sensors and daylighting controls.
- M. For all dimming systems, contractor is responsible for burning in all lamps for 100 hours. Lamps are to operate at full output for this period.

- N. Contractor is responsible for setting up and adjusting all control devices per the manufacturer's adjustments and resulting performance.

3.02 TESTS

- A. Immediately before turning completed job over to Owner, clean all light fixtures inside and out, including plastics and glassware, adjust and tighten all trim, replace broken or damaged parts, lamp and test fixtures for electrical and mechanical operation. Replace all inoperative lamps, ballasts and other inoperative equipment.
- B. Replace noisy ballasts immediately.
- C. **Include in bid the service of a California Registered Professional Engineer or a Professional recognized by the State of California to review and certify the final installed lighting control system as required by the California Energy Code (Title-24). The Professional shall sign the required documents, submit to the proper agency and be responsible for certifying the installed lighting control system.**

END OF SECTION

SECTION 27 10 00.1

Ethernet Cabling

II.A. **Supporting Codes and Standards Documents**

It is not possible to list all of the applicable Codes and Standards documents. A non-inclusive list of key documents is presented below as a minimum:

- ANSI/EIA/TIA-568-B: Commercial Building Telecommunications Cabling Standard
- ANSI/EIA/TIA-569-A: Commercial Building Standard for Telecom Pathways and Spaces
- ANSI/EIA/TIA-606: Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
- ANSI/EIA/TIA-607: Commercial Building Grounding/Bonding Requirements
- NFPA 70: National Electrical Code
- ISO/IEC 11801: Generic Cabling for Customer Premises
- BICSI :Telecommunications Distribution Methods Manual (TDDM)

The latest revision of each document, and other related documents, is to be considered the one in force at the time of system construction and delivery to SBCUSD. The vendor is required to comply with the applicable documents in content and intent as well.

II.A.1. If any applicable documents are in conflict, then the more stringent requirement shall apply. The Contractor is required to advise the SBCUSD Information Technology (IT) Representative of any conflict that could result in work deficiencies.

II.B. **Vendor Requirements**

Vendors bidding on SBCUSD work projects shall possess as a minimum the following qualifications:

1. A manufacturer's Certified Installer/Contractor agreement in force at the time of bid submittal and throughout the entire construction process. A current support document shall be included in the Contractor's bid response.
2. Authorization to facilitate the applicable Manufacturer's System Warranty.
3. The contractor shall ensure that at least 50% of all technicians installing a copper system have received a manufacturer's training certificate for copper systems.
4. The contractor shall ensure that 100% of the technicians installing a fiber optic system have received a manufacturer's training certificate for fiber optic systems.
5. The contractor shall have copies of the technicians' certificates available for inspection by the SBCUSD IT Representative upon request.
6. Vendor shall hold in good standing a California C-10 license. Note: a valid California C-7 license in addition is preferred by SBCUSD. Vendor must act as prime, but may utilize subcontractors. A copy of the license(s) is/are to be included in the vendor's bid response.
7. The Vendor must have completed a minimum of five projects of similar size and scope for public entities within the past three years.

II.C. **Cabling System**

All copper and fiber optic components of the cabling system are either to be of a single manufacturer, or of a manufacturer partnership under a system trade name offering a single point of contact for SBCUSD in the event of a warranty claim. The SBCUSD has chosen the Panduit TX6A 10 Gig UTP Copper Cabling solution as the baseline for all equivalents to be measured. Vendors submitting other manufacturer systems for considered must meet this system in physical and electronic performance as well as utility.

II.C.1 Copper System

- A. SBCUSD requires a high performing Category 6a system that meets the following system performance guaranteed headroom as a minimum based on worst pairs:

Electrical Value	TIA/EIA Category 6A	ISO Class EA
Insertion Loss	3%	3%
NEXT	3.5 dB	2.5 dB
PSNEXT	5 dB	4 dB
PSACR-F	10 dB	10 DB
Return Loss	3 dB	3 dB
PSACR-N	6.5 dB	6.5 dB
PSANEXT	2 dB	2 dB
PSAACR-F	10 dB	10 dB

II.C.2 Copper Cable Color Standards for Horizontal Cabling, Jack Inserts and Patch Cords

The following colors are the District Standards for the specific network devices and services listed below:

Red: To be utilized when the project to install cabling has determined that the devices and services are in support of Alarms, Security, Energy Management Systems (EMS), and Environmental monitoring. The District has standardized on the color Red for horizontal cabling and jack inserts and patch cables on both ends of the horizontal cabling must also be Red in color.

II.C.3 Cable

- A. SBCUSD requires all cabling being installed within a building to be plenum rated in all environments. Even though quite desirable, SBCUSD is not aware of a Category 6A indoor/outdoor plenum-rated cable. As a result, SBCUSD is willing to accept an indoor/outdoor CM rated cable as long as the NEC termination and pathway requirements are met. Regardless of environment, the cabling shall be of the same electrical performance as Category 6A and be warranted by the same cabling system manufacturer, as Panduit or equivalent.
- B. Installation of cabling shall be of continuous length from each termination point.
- C. No length of cable shall exceed 285 feet (tested length).
- D. The bend radius of any cable shall not exceed 4 times the diameter of the cable.
- E. Should the cable become *kinked* while being installed, the contractor shall not attempt to repair the cable, but shall remove and replace the entire run. All cable runs are potential inspection items for the SBCUSD IT Representative.
- F. The cable jacket shall be maintained as close to the point of termination as possible.
- G. The cable pairs shall not be untwisted more than 1/2" from the termination point.
- H. All cabling is to be installed in its own pathway and fully supported.
- I. Cabling shall be installed with no more than a 4-foot space between supports.
- J. Cabling can be installed in pathways such as cable tray and ladder racking, as long as the pathway is low-voltage cabling only, the pathway is appropriately bonded to the building grounding system, and the Data System cables are bundled separately from other low voltage cabling.
- K. Underground cabling can be installed inside buildings to the ultimate termination point without transition as long as the cabling is rated for such applications.

II.C.4 Terminations

- A. Jack modules shall be of insulation-displacement termination construction, and may offer mass termination of all four pairs simultaneously. In addition, a jack module must be available as part of the cabling system, and facilitate the same system performance and warranties, that can be utilized in existing workstation outlet faceplates from other manufacturers.
- B. In an effort maximize space, SBCUSD has standardized on a discrete *modular* patch panel system. The system must allow the following:
 - 1. Presentation of 48 individual module ports in a 1U (1.75") rack height.
 - 2. Presentation of 24 individual module ports in a 1U (1.75") rack height.
 - 3. Presentation of 12 individual module ports to be mounted in an 89B type wall bracket.
 - 4. Offer Category 6a connectivity.
 - 5. Offer Category 5e connectivity if required
- C. Cabling shall be dressed cleanly and fully supported via Velcro straps and cabinet/rack supports. All cabling bundles are to be loosely secured with Velcro (hook & loop) straps only. Cable ties are not to be utilized. In addition, Velcro straps must not be spaced at regular intervals but must vary between 4-6 inches at random over the length of the secured cable section.
- D. Cabling slack can be placed in the cabinet/rack area as well as the ceiling areas if fully supported by the proper pathway device. No more than 4 feet per horizontal run shall be stored.
- E. No particular order is required between workstation cabling terminations or Access Point cabling terminations.
- F. The ports are to be populated beginning with port one in sequence, leaving no open ports.
- G. It is not a requirement to fill the unused ports with blanks.

II.C.5. Patch Cords

- A. Small diameter Category 6A patch cords, as manufactured by Panduit (or approved equivalent) shall be provided by the contractor for the outlet or other device termination end as well as the patch panel termination end. The contractor may be asked to install the MDF/IDF/LDF patch cords in instances where the existing Edge switches are not being replaced, as part of the SBCUSD cabinet redressing requirement. These patch cords for the most part shall be either 8" in length or 12" in length as required with preference given to the 8" length where it can be used without strain.
- B. Small diameter Category 6A patch cords, as manufactured by Panduit (or approved equivalent), utilized for all patching shall be of appropriate length and engaged into the associated terminated jack, then coiled and left to be engaged into the device at the appropriate time.
- C. As a space saving effort, SBCUSD requires the diameter of the patch cable shall not exceed .150" as manufactured by Panduit (or approved equivalent).
- D. The connector end of the patch cord shall provide a *tangle-free latch* design as manufactured by Panduit (or approved equivalent).
- E. A Category 6A small diameter, tangle-free latch design patch cord for devices in lengths appropriate for the specific workstation shall be delivered to SBCUSD. The SBCUSD IT Representative will confirm the quantities and lengths required per site. At no time shall a patch cord exceeding 5 meters be required.

II.C.8. Cable Management

- A. As part of SBCUSD's efforts to maximize cabinet/rack space utilization, no new horizontal cable management devices shall be installed. See Cabinets/Racks Redressing Requirements.
- B. Rear cable management devices to support cables to the point of termination are to be utilized. A towel bar style bracket is acceptable as long as the cables are neatly and securely attached via Velcro straps.
- C. Vertical wire management may be utilized when appropriate.

II.C.9. Labeling

- A. All workstation outlets, Access Points, and patch panel termination ports are to be labeled with the SBCUSD standard labeling system.
- B. The standard labeling system is as follows:
 - 1. The patch panel termination location followed by the port number
 - Example: IDF-A1 to port 07 A1-07 (workstation cable)
 - Example: IDF-A1 to port 07 A1-W07 (Access Point cable)
- C. A wrap around label shall be installed at each end of the cable no more than 4 inches from the point of termination presenting the same alphanumeric scheme.

II.C.10 Warranty

- A. Installers must be Panduit/General certified and be able to provide the Certification Plus System Warranty for 25 years.
- B. Installer Requirements
 - a. Certification Plus System Warranties are only available when installed by a Panduit ONESM Partner accredited with the Deploy competency as of the date of installation. Such Partners must meet various criteria imposed by Panduit to achieve such status, including maintaining minimum levels of trained technicians and sales staff, and having a RCDD or Panduit-approved equivalent on staff.
- C. Issuing the Warranty Certificate
 - a. Once the structured cabling system has been installed, registered, and validated by Panduit, a Certification Plus System Warranty Certificate will be issued to the end user, providing the confidence and security in the newly installed Panduit structured cabling system.

IIC.11 Acceptance of Installed Cabling

- A. Cabling installer MUST provide Fluke (or equivalent) test results for each cable drop installed, showing the overall length of the horizontal cabling and the Pass/Fail status of the cable being tested. Fail results would require the installer to re-terminate both ends and re-test until it passes. Should re-termination fail to resolve the issue, then the installer must re-pull that run of cable.

END OF SECTION 27 10 00.1

SECTION 28 13 53.11
IP NETWORK COMPATIBLE INTERCOM (IX SYSTEM)

GENERAL

1.1 SECTION INCLUDES

- A. IP Video Intercom. (Aiphone IX Series s system)

1.2 RELATED SECTIONS

- A. Section 27 10 00.1 Ethernet Cabling

1.3 REFERENCES

- A. Standards Institute (ANSI/TIA/EIA) 568 - Commercial Building Telecommunications Cabling Standard.
- B. International Organization for Standards (ISO) 9001:2000 - Quality Management Systems - Requirements.

1.4 SYSTEM DESCRIPTION

- A. IP Network Compatible Video Intercom System: A network-based communication and security system featuring video entry security, internal communication, emergency stations, and paging. All units and app in the systems shall be able to unlock doors remotely on a network, view and assist onsite visitors from an offsite location, broadcast emergency announcements, and communicate using a PoE network.
 - 1. Power Source: Power over Ethernet (802.3af).
 - 2. Network Interface: 10 BASE-T / 100 BASE-TX Ethernet CAT 6a (RJ-45).
 - 3. Network Protocols: IPv4, IPv6, TCP, UDP, SIP, HTTP, HTTPS, MJPEG, RTSP, RTP, RTCP, IGMP, MLD, SMTP, DHCP, NTP, DNS.
 - 4. Bandwidth Usage:
 - a. G.711: 64Kbps x 2 per video call.
 - b. 64Kbps per monitor.
 - c. H.264: 24Kbps ~ 2,048Kbps.
 - 5. Communication: Hands-free (VOX), push-to-talk (simplex), or handset (full-duplex).
 - 6. Video Display: 7 inches color LCD.
 - 7. Camera: Type:
 - a. 1/4 inch (6 mm) color CMOS.
 - b. View Area: 2 feet 2 inches (660 mm) vertical x 3 feet 1 inch (940 mm) horizontal at 20 inches (508 mm).
 - c. Resolution: VGA or higher
 - 8. Video Stream: ONVIF Profile S.
 - 9. Door Release: Programmable Form C dry contact, 24V AC/ DC, 500mA (which requires 24V DC power supply).
 - a. District standard electric strike: HES model 9600 Series 24 V DC.
 - 10. Power Source for electric strike: Atop AD1048-24FS 48W/24DIN-Rail 24V DC.

11. Wire Type: CAT-6a. (District standard: Panduit)
12. Distance:
 - a. Base Bid to include up to 100 l. f. of cabling
 - b. Maximum allowable to any station to Network Node: not to exceed 330 feet (100 meters).

1.5 SUBMITTALS

- A. Submit under provisions of Section 01 30 00 - Administrative Requirements.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 1. Preparation instructions and recommendations.
 2. Storage and handling requirements and recommendations.
 3. Installation methods.
- C. Shop Drawings: Submit the following:
 1. Wiring Diagrams: Indicate wiring for each item of equipment and interconnections between items of equipment.
 2. Include manufacturer's names, model numbers, ratings, power requirements, equipment layout, device arrangement, complete wiring point-to-point diagrams, and conduit layouts.
- D. Installation and Operation Manuals:
 1. Submit manufacturer's installation and operation manual, including operation instructions and component wiring diagrams.
 2. Provide detailed information required for Owner to properly operate equipment.
- E. Warranty: Submit manufacturer's standard warranty.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: ISO 9001:2008 certified company.
- B. Installer Qualifications: Factory trained and experienced with system installations of scope and size required for the Project.
- C. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.
- D. Storage: Store materials in clean, dry area indoors in accordance with manufacturer's instructions.
- E. Handling: Protect materials during handling and installation to prevent damage.

1.7 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. IP Video Intercom System: IX Series Intercom System as manufactured by Aiphone Corporation. Web site:www.aiphone.com
- B. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00.1 – Request for Substitution.

2.2 SYSTEM DESIGN

- A. Master Station(s): Provide one master station at each campus.
 - 1. Aiphone Model IX-MV7-HW Provide one per campus at designated location.
- B. Audio Video Door Stations:
 - 1. Model IX-DA - Surface Mount: Provide one per campus at designated location.
or
 - 2. Model IX-DF - Flush Mount: Provide one per campus at designated location.
 - 3. Option: Model IX-DV – Surface Mount.
- C. Signage:
 - 1. At each Door Station/Wall Box Contractor shall provide weatherproof signage Signage: “ASSISTANCE” (English) and “ASISTENCIA” (Spanish).
- D. Functional Components: As indicated on the drawings or as required to complete system.
 - 1. Video Master Station Model IX-MV7-HW:
 - a. An IP addressable video master station with a 7 inch color LCD monitor. It can be wall or desk mounted (desk stand included. This station requires a 802.3af compliant Power-over-Ethernet network.
 - 2. Audio/Video Door Station: Model IX-DA, IX-DF, or IX-DV
 - a. Station connects to a PoE network using CAT-6a cable.
 - 3. Optional Components (Unit price items to be used at District option):
 - a. RY-IP44 IP Programmable Relay Adaptor:
 - b. 45 Degree Mullion Mounting Bracket Model KMB-45:
 - c. Stainless Steel Security Lock Box Model LB-SDVF: for IX-DF, IX-DF-HID, & IX-DF-RP10.
 - d. Stainless Steel Enclosure Model SBX-ISDVF:
 - 1) 18-Guage stainless steel enclosure designed for surface mounting the IX-DF door stations.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive integrated security and communication system.
- B. Notify District of conditions that would adversely affect installation or subsequent use.
- C. Do not begin installation until unacceptable conditions are corrected.

3.2 PREPARATION

- A. Verify the following compliance before starting installation.

1. The unit turns inoperative during power failure.
2. Keep the intercom wires at least 1 foot (30 cm) away from strong electrical wiring (AC 100-240 V) including, in particular, wiring for inverter electrical appliances. Noise and malfunction could result.
3. If a strong light shines on the main unit screen, the picture may turn white or only silhouettes will be visible.
4. Other manufacturer's devices (such as sensor, detectors, door releases) used with this system, comply with the manufacturer's installation requirements.
5. The LCD panel is manufactured with very high precision techniques, inevitably will have a very small portion of its picture elements always lit or not lit at all. This is not considered a unit malfunction. Please be aware of this in advance.

3.3 INSTALLATION

- A. Install integrated security and communication system in accordance with manufacturer's instructions at locations indicated on the Drawings.
- B. Mount equipment plumb, level, square, and secure. For video entrance stations and video door stations, comply with manufacturer's design requirements to provide optimum picture quality of station monitoring.

3.4 SET-UP AND ADJUSTING

- A. Adjust integrated security and communication system for proper operation in accordance with manufacturer's instructions.

3.5 DEMONSTRATION AND TRAINING

- A. Demonstration:
 1. Demonstrate that integrated security and communication system functions properly.
 2. Perform demonstration at final system inspection by qualified representative of manufacturer.
- B. Instruction and Training:
 1. Provide instruction and training of Owner's personnel as required for operation of integrated security and communication system.
 2. Provide hands-on demonstration of operation of system components and complete system, including user-level program changes and functions.
 3. Provide instruction and training by qualified representative of manufacturer.
 4. Provide DVD copy of video recorded training session(s)

3.6 PROTECTION

- A. Protect installed integrated security and communication system from damage during construction.

END OF SECTION

SECTION 283100

FIRE ALARM SYSTEM

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. The furnishing of all labor, equipment, materials and performance of all operations in connection with the Fire Alarm System. The work shall include all work associated with extension of existing Fire Alarm System to new detectors, addition of signaling devices and Voice Evacuation Fire Alarm Control Panel and Annunciator in the Modernized Administration Building.
- B. It is the intent of the Contract Documents to provide an installation complete in every respect. In the event that additional details or special construction is required for work indicated or specified in this section or work specified in other sections, it shall be the responsibility of the contractor to provide all material and equipment which is usually furnished with such systems in order to complete the installation, whether mentioned herein or not.

1.02 RELATED WORK

- A. Section 260100 - Basic Materials and Methods.
- B. Section 260533 - Conduit.
- C. Section 260526 - Grounding.

1.03 APPROVAL

- A. All fire alarm, signal and control equipment shall be approved by the District in addition to other required approvals.
- B. The following shall be provided by the Fire Alarm System Supplier:
 - 1. List of system components, equipment and devices, including manufacturers' model number(s) and California State Fire Marshal listing numbers.
 - 2. Copies of manufacturer's specification sheets for equipment and devices indicated.
 - 3. Voltage Drop Calculations--include the following information for the worst case:
 - a. Point-to-point or Ohms Law calculations.
 - b. Zone used in calculations.
 - c. Voltage drop percent [not to exceed manufacturers' requirements].

NOTE: If voltage drop exceeds 10 percent, indicate manufacturers' listed operating voltage range(s) for equipment and devices.

- 4. Battery type(s), amp hours and load calculations.

- C. The equipment and services described in this specification represent those supplied and supported by "Simplex", unless noted otherwise.

1.04 DESCRIPTION

- A. General: The system shall be a complete 24 VDC, closed circuit electrically supervised zone annunciated system. All fire system equipment shall be labeled with the same manufacturers name and logo to assure the integrity of the complete system. "Hybridized" systems (systems containing equipment from several different manufacturers) will not be accepted.

1.05 WARRANTY

- A. The Contractor shall warrant the completed fire alarm system wiring and equipment to be free from inherent mechanical and electrical defects for a period of one year from the date of the completed and certified test or from the date of first beneficial use.

1.06 QUALITY ASSURANCE

- A. Each and all items of the Fire Alarm System shall be listed as a product of a SINGLE fire alarm system manufacturer under the appropriate category by Underwriter's Laboratories, Inc. (UL), and shall bear the "UL" label. All control equipment is to be listed under UL category UOJZ as a single control unit. Partial listing shall NOT be acceptable. System shall be listed with California State Fire Marshal.

PART 2 - PRODUCTS

2.01 GENERAL

- A. All materials, equipment, accessories, devices and other facilities and appurtenances covered by these specifications or noted on the contract drawings and on the Contractor's approved shop drawings and installation specifications shall be new (manufactured within one year of installation), best suited for its intended use and shall conform to applicable and recognized standards for their use. All equipment shall be the standard cataloged project.
- B. Individual components and composite systems shall be designed for continuous operation without undue heating or change in rated values and shall be properly fused.

2.02 ACCEPTABLE MANUFACTURER

- A. Simplex.

2.03 CONTROL UNIT

- A. The control unit is an existing Simplex 4100U located in the Administration Building. Provide and interface new Simplex #4003EC with Voice EVAC System and Annunciator #4100-4610 and monitor modules for interfacing the two systems, additional zone cards, signal cards and batteries as necessary.

2.04 SMOKE AND HEAT DETECTORS

- A. Simplex. To match existing.

2.05 ALARM SPEAKER / STROBE

- A. Simplex. See drawings.

2.06 POWER EXTENDER

- A. Simplex 4009

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install wiring per point-to-point wiring diagram supplied by manufacturer. Number of wires as indicated on drawings are for general guideline only. Exact quantity of wires must be determined by manufacturer of equipment and included in bid. Provide spare wires as indicated on drawings.
- B. No wiring other than that directly associated with fire alarm detection, alarm or auxiliary functions shall be permitted in fire alarm conduits. Wiring splices are to be avoided to the extent possible, and if needed, they must be made only in junction boxes. Transposing or changing color coding of wires shall not be permitted. Wire nut-type connections are not acceptable. All conductors in conduit containing more than one wire shall be labeled on each end with "E-Z" markers or equivalent. Conductors in cabinets shall be carefully formed and harnessed so that each drops off directly opposite to its terminal. Cabinet terminals shall be numbered and coded. All controls, function switches, etc., shall be clearly labeled on all equipment panels.
- C. All wiring shall be checked and tested to ensure that there are no grounds, opens or shorts. The minimum allowable resistance between any two conductors or between conductors and ground is ten megohms as checked by a Megger after all conduit, conductors, detector bases, etc., have been installed; but before the detector devices are plugged into the bases or end-of-line devices installed.

3.02 FIELD QUALITY CONTROL

- A. Before the installation shall be considered completed and acceptable by the awarding authority, a test on the system shall be performed as follows: The Contractor's Job Foreman, in the presence of a representative of the manufacturer, a representative of the Owner, and the Fire Department shall operate every building fire alarm device to ensure proper operation, correct annunciation at each remote annunciator and control panel. One half of all tests shall be performed on battery standby power. The initiating circuit and the signaling circuits shall be opened in at least two locations per zone to check for the presence of correct supervisory circuitry. A test report shall be prepared.

END OF SECTION

SECTION 32 31 13

CHAIN-LINK FENCING

PART 1 – GENERAL

1.1 SUMMARY

- A. Fence framework, fabric, and accessories.
- B. Concrete anchorage for posts and center drop for gates.
- C. Manual gates and related hardware.

1.2 SUBMITTAL

- A. Submit product data and shop drawings for layout.

1.3 REQUIREMENTS

- A. Gates that are part of the accessible route shall meet the requirements of an accessible door in compliance with CBC 11B-404.
- B. The levers of lever actuated latches or locks for accessible gates shall be curved with a return to within $\frac{1}{2}$ " of the gate surface to prevent catching on the clothing or persons. CA Referenced Standards Code, T-24 Part 12, Sect. 12-10-202, Item (F).
- C. Swing doors and gate surfaces within 10" of the finish floor or ground shall have a smooth surface on the push side extending the full width of the door or gate. Parts creating horizontal or vertical joints in these surfaces shall be within $\frac{1}{16}$ " of the same plane as the other and be free of sharp or abrasive edges. Cavities created by added kick plates shall be capped. CBC Section 11B-404.2.10

PART 2 – PRODUCTS

2.1 MATERIALS:

- A. Framework: ASTM F1083; Schedule 40 steel pipe, standard weight, one piece without joints, finishes same as fabric.
- B. Acceptable Equivalent: ASTM F1043; Group 1A pipe with minimum yield strength of 30,000 pounds per square inch; SS40.
- C. Fabric: ASTM A392, Class 1, zinc coated wire fabric.

2.2 COMPONENTS:

- A. Line Posts: 2-3/8 inch NPS steel pipe.
- B. Corner and Terminal Posts: 2-7/8 inch NPS steel pipe.
- C. Gate Posts: 3 inch NPS steel pipe.
- D. Top and Brace Rail: 1-5/8 inch NPS, plain end, sleeve coupled steel pipe.
- E. Fabric: Climb resistant 1 inch diamond mesh steel wire, interwoven, 9 gage thick, top and bottom selvage knuckle end closed.
- F. Caps: Cast steel or malleable iron, galvanized; sized to post dimension, set screw retained.
- G. Fittings: Sleeves, bands, clips, rail ends, tension bars, fasteners and fittings: Steel.
- H. Tension Wire: 7 gage thick steel, single strand.
- I. Footings: Posts 48" x 12" with Concrete: 3000 PSI
- J. Swinging Gates: Constructed of tubular members welded at all corners in conformance with ASTM F900 and the following:
 - 1. Gate Posts: 3 inch NPS steel pipe for gates up to 6 foot for a single gate or a single leaf of a double gate. 4 inch NPS steel pipe for gates over 6 foot in width.
 - 2. Gate Frames: 1-1/4 inch NPS steel pipe, for welded fabrication with vertical intermediate brace at maximum 6 foot spacing and horizontal brace on all gates.
 - 3. Gate Fabric: To match adjacent fencing.
 - 4. Gate Hardware: panic hardware and use existing hardware where applicable.

2.3 FINISHES:

- A. Galvanized: ASTM F1043; 1.8 oz/sq ft coating for schedule 40 pipe. ASTM A90; 1.0 oz/sq ft coating for Class 1A pipe.
- B. Accessories: Same finish as framing.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Confirm area is clear of all obstructions and ready to receive new fence and gate
- B. Confirm all components are secured and properly attached as specified.

END OF SECTION

SECTION 323100

METAL FENCES AND GATES

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. The contractor shall provide all labor, materials and appurtenances necessary for installation of the commercial ornamental steel fence system defined herein as shown on the drawings.

1.02 SYSTEM DESCRIPTION

- A. The manufacturer shall supply a total commercial ornamental steel fence system and shall include all components (i.e., pickets, rails, posts, gates and hardware) required.

1.03 QUALITY ASSURANCE

- A. The contractor shall provide laborers and supervisors who are thoroughly familiar with the type of construction involved and materials and techniques specified.

1.04 REFERENCES

- A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
- B. ASTM B117 - Practice for Operating Salt-Spray (Fog) Apparatus.
- C. ASTM D714 - Test Method for Evaluating Degree of Blistering in Paint.
- D. ASTM D822 - Practice for Conducting Tests on Paint and Related Coatings and Materials using Filtered Open-Flame Carbon-Arc Light and Water Exposure Apparatus.
- E. ASTM D1654 - Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments.
- F. ASTM D2244 - Test Method for Calculation of Color Differences from Instrumentally Measured Color Coordinates.
- G. ASTM D2794 - Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).
- H. ASTM D3359 - Test Method for Measuring Adhesion by Tape Test.
- I. ASTM F2408 – Ornamental Fences Employing Galvanized Steel Tubular Pickets.

1.05 SUBMITTAL

- A. The manufacturer's submittal package shall be per Section 013000.
- B. Provide product literature and installation instructions.
- C. Provide shop drawing layout showing plan, elevation and details, including gates and operation.

1.06 PRODUCT HANDLING AND STORAGE

- A. Upon receipt at the job site, all materials shall be checked to ensure that no damages occurred during shipping or handling.

- B. Materials shall be stored in such a manner to ensure proper ventilation and drainage, and to protect against damage, weather, vandalism and theft.

1.07 PRODUCT WARRANTY

- A. All structural fence components (i.e. rails, pickets, and posts) shall be warranted within specified limitations, by the manufacturer for a period of 10 years from date of original purchase. Warranty shall cover any defects in material finish, including cracking, peeling, chipping, blistering or corroding.
- B. Reimbursement for labor necessary to restore or replace components that have been found to be defective under the terms of manufacturer's warranty shall be guaranteed for five (5) years from date of original purchase.

PART 2 – MATERIALS

2.01 MANUFACTURER

- A. The commercial ornamental steel fence system design is based upon Ameristar Aegis Plus, style in 8' panel lengths manufactured by Ameristar Fence Products, Inc. in Tulsa, Oklahoma,
- B. Or approved equal.

2.02 MATERIAL

- A. Steel material for fence framework (i.e. tubular pickets, rails and posts), when galvanized prior to forming, shall conform to the requirements of ASTM A924/A924M, with a minimum yield strength of 45,000 psi (310 MPa). The steel shall be hot-dip galvanized to meet the requirements of ASTM A653/A653M with a minimum zinc coating weight of 0.60 oz/ft² (276 g/m²), Coating Designation G-60.
- B. Material for fence pickets shall be 3/4" square x 17 Ga. tubing. The cross-sectional shape of the rails shall conform to the manufacturer's ForeRunner™ double-wall design with outside cross-section dimensions of 1.50" square and a minimum thickness of 14 Ga. Picket holes in the ForeRunner rail shall be spaced 4.70" o.c. Picket retaining rods shall be 0.125" diameter galvanized steel. High quality PVC grommets shall be supplied to seal all picket-to-rail intersections. Fence posts and gateposts shall meet the minimum size requirements per manufacturer.

2.03 FABRICATION

- A. Pickets, rails and posts shall be pre-cut to specified lengths. Rails shall be pre-punched to accept pickets.
- B. Grommets shall be inserted into the pre-punched holes in the rails and pickets shall be inserted through the grommets so that pre-drilled picket holes align with the internal upper raceway of the ForeRunner rails; use an alignment template. Retaining rods shall be

inserted into each rail so that they pass through the pre-drilled holes in each picket, thus completing the panel assembly.

- C. The manufactured galvanized framework shall be subjected to the PermaCoat® thermal stratification coating process (high-temperature, in-line, multi-stage pretreatment/wash, an electrostatic spray application of any epoxy base, and a separate electrostatic spray application of a polyester finish. The base coat shall be a thermosetting epoxy powder coating (gray in color) with a minimum thickness of 2 mils (0.0508mm). The topcoat shall be a “no-mar” TGIC polyester powder coat finish with a minimum thickness of 2 mils (0.0508mm). The color shall be determined and to match existing fence and gates.
- D. Completed panels shall be capable of supporting a 400 lb. load (applied at midspan) without permanent deformation. Panels without rings shall be biasable to a 12.5% change in grade
- E. Swing gates shall be fabricated using 1.5” x 14ga. Forerunner double channel rail, 1.75” sq. x 14ga. gate ends, and 3/4” sq. x 17ga. pickets. Gates that exceed 6’ in width will have a 1.5” sq. x 14ga. intermediate upright. All rail and upright intersections shall be joined by welding. All picket and rail intersections shall also be joined by welding.
- F. Pedestrian swing gates shall be self-closing, having a gate leaf no larger than 48” width. Integrated hinge-closer set (2 qty) shall be ADA compliant that shall include a variable speed and final snap adjustment with compact design (no greater than 5” x 6” footprint). Hinge-closer set (2 qty) shall be tested to a minimum of 500,000 cycles and capable of self-closing gates up to a maximum gate weight of 260 lbs. and maximum weight load capacity of 1,500 lbs. Hinge-closer device shall be externally mounted with tamper-resistant security fasteners, with full range of adjustability, horizontal (.5” - 1.375”) and vertical (0 - .5”). Maintenance free hinge-closer set shall be tested to operate in temperatures of negative 20 F to 200 F degrees, and swings to negative 2 degrees to ensure reliable final lock engagement.

PART 3 - EXECUTION

3.01 PREPARATION

- A. All new installation shall be laid out by the contractor in accordance with the construction plans.

3.02 FENCE INSTALLATION

- A. Fence post shall be spaced according to manufacturer’s recommendations, plus or minus ½”. For installations that must be raked to follow sloping grades, the post spacing dimension must be measured along the grade. Fence panels shall be attached to posts with brackets supplied by the manufacturer. Posts shall be set in concrete footers having a minimum depth of 36” (Note: In some cases, local restrictions of freezing weather conditions may require a greater depth)
- B. The “Concrete” sections of this specification shall govern material requirements for the concrete footer. Posts setting by other methods such as plated posts or grouted core-drilled

footers are permissible only if shown by engineering analysis to be sufficient in strength for the intended application.

3.03 FENCE INSTALLATION MAINTENANCE

- A. When cutting/drilling rails or posts adhere to the following steps to seal the exposed steel surfaces; 1) Remove all metal shavings from cut area. 2) Apply zinc-rich primer to thoroughly cover cut edge and/or drilled hole; let dry. 3) Apply 2 coats of custom finish paint matching fence color. Failure to seal exposed surfaces per steps 1-3 above will negate warranty. Ameristar spray cans or paint pens shall be used to prime and finish exposed surfaces; it is recommended that paint pens be used to prevent overspray. Use of non-Ameristar parts or components will negate the manufactures' warranty.

3.04 GATE INSTALLATION

- A. Gate posts shall be spaced according to the manufacturers' gate drawings, dependent on standard out-to-out gate leaf dimensions and gate hardware selected. Type and quantity of gate hinges shall be based on the application; weight, height, and number of gate cycles. The manufacturers' gate drawings shall identify the necessary gate hardware required for the application. Gate hardware shall be provided by the manufacture of the gate and shall be installed per manufacturer's recommendations.

3.05 CLEANING

- A. The contractor shall clean the jobsite of excess materials; post-hole excavations shall be scattered uniformly away from posts.

END OF SECTION

SECTION 328000

IRRIGATION

PART 1 - GENERAL

1.01 SCOPE

All work shall be performed by a contractor with a C-27 license or greater. The work required is indicated on the drawings and includes, but is not limited to new irrigation systems in medians and retrofitted irrigation systems on each side of roadway, automatic controller, remote control valves, quick coupler valves, water connections, and electric connections.

1.02 INSPECTIONS/TESTS

A. It is the landscape contractor's responsibility to contact the Owner's Representative, 48 hours prior to desired inspection of an item.

B. Prior to release of utilities or maintenance period commencement, the following inspections are required:

1. Construction of irrigation system in open trench condition (prior to backfill).
2. Pressure test 150 PSI for a three (3) hour continuous period.
3. An irrigation coverage test.
4. Planting, including street trees. Contact the Parks Planning and Landscape
5. Development Section, Engineering Division for species and locations.
6. Finish grade prior to seeding.
7. Compliance with approved landscape plans.
8. Any special Conditions of Approval attached to project.
9. Final Inspection.

C. The owner's representative and landscape contractor shall be present at this inspection.

1.03 MAINTENANCE GUIDELINES

A. Landscape shall be maintained in a neat, clean, weed-free and healthy condition. This shall include but not limited to:

1. Cultivation of planted beds at intervals not to exceed 10 days.
2. Regular mowing to maintain a lawn height not to exceed 2" (may vary per species).
3. Regular pruning of plants as necessary to control and direct growth.
4. Scheduled maintenance of irrigation controller to assure proper application rate of water necessary for proper plant growth. Drip irrigation may require specialized landscape maintenance care.
5. Immediate replacement of plant material as needed due to death, disease, or lack of growth.
6. Fertilization on a regular schedule as recommended by the manufacturer to provide proper plant growth.
7. Stakes, guys, and ties on trees shall be checked regularly for correct function. Ties are to be adjusted to avoid abrasions or girdling of trunks or branches.

8. Upon completion of the maintenance period, an inspection shall be made by the Owner's Representative. The landscape shall be maintained in accordance with these landscape maintenance standards. Maintenance bonding shall be released at the end of the appropriate period if the landscape is maintained according to plans and specifications.

9. The principal bond holder is responsible to contact the Owner/Owner's Representative and schedule the maintenance inspection.

1.04 TURNOVER IRRIGATION ITEMS

- A. Controller charts:
Provide one controller chart (of the maximum size the controller door will allow) for each automatic controller. The chart shall show the area covered by controller and be prepared from record drawings.
- B. Operation and maintenance manuals:
Two individually bound copies of operation and maintenance manuals shall be delivered.
- C. Supply as part of this contract the following items:
 - (a) Two keys for each automatic controller.
 - (b) One valve box cover wrench.

- D. Materials List:
 - (1) Complete material list shall be submitted to the on-site Construction Manager prior to performing any work. Catalog data and full descriptive literature must be submitted whenever the use of items different than those specified is requested.
 - (2) Material list shall be submitted using the following example:

Item	Description	Manufacturer	Model
1	Pressure Supply Lines	Lasco	Sched.40
2	Lawn Head	Rainbird	1806

- E. Record drawings for new systems: Contractor shall provide completed as-built drawings, which shall be Mylar copies of the project plans and shall conform to the following:
 - (1) Record accurately on one set of contract drawings all changes in the work constituting departures from the original contract drawings.
 - (2) The changes and dimensions shall be recorded in a legible and workmanlike manner to the satisfaction of the Inspectors. Prior to final inspection of work, submit record drawings to Inspectors for approval.
 - (3) Dimension from two permanent points of reference (walls, sidewalks, curbs, pavement, etc.). Data to be shown on record drawings shall be recorded day to day as the project is being installed. All lettering on drawings shall be a minimum of 1/8 inch in size.
 - (4) Show locations and depths of the following items for new systems:
 - (a) Point of connection for water and electrical
 - (b) Routing of sprinkler pressure lines (dimension maximum 100 feet along routing).
 - (c) Gate valves.
 - (d) Sprinkler control valves.
 - (e) Quick coupling valves.
 - (f) Routing of control wires.

- (g) Electrical service lines.
 - (h) Sprinkler heads.
 - (i) Lateral lines.
 - (j) Related equipment (as may be directed).
- (5) Maintain record drawings on site at all times.

1.05 GUARANTEE

- A. The entire sprinkler system, including all work done under this contract, shall be guaranteed by the Contractor against all defects, fault of material, and workmanship, for (1) one year from date of final inspection.
- B. The Contractor shall instruct the Owner's Representative in the operation and maintenance of the system and shall furnish a complete set of operating instructions.

PART 2 - MATERIALS

2.01 GENERAL

Materials and equipment installed or furnished that do not meet these standards will be rejected and shall be removed from the site at no expense to the District.

2.02 (NOT USED)

2.03 BRASS PIPE AND FITTINGS

- A. Brass pipe and fittings to be I.P.S. standard weight, 125 UBS, 85% red brass, and are to be used as standpipes on backflow preventor.
- B. Where galvanized risers and/or fittings are required, a dielectric union shall be installed at connection point of galvanized and bronze material.

2.04 PLASTIC PIPE AND FITTINGS

- A. All plastic pipe shall bear the following markings: manufacturer's name, nominal pipe size, schedule or class, type of material, pressure rating in PSI, NSF seal of approval, and the date of extrusion.
- B. Pressure supply lines 1 1/2 inches and smaller downstream of the backflow prevention unit shall be Schedule 40 PVC. Pressure supply lines 2" and larger shall be either Class 315 solvent weld PVC or Class 200 rubber gasket type PVC. Solvent weld and ring type pipe shall not be used together on the same pressure supply line.
- C. Non-pressure lines shall be Class 200 PVC.
- D. All fittings shall be standard weight Schedule 40 and shall be injection molded of an improved PVC fitting compound. Threaded plastic fittings shall be injection molded.
- E. All threaded nipples shall be standard weight Schedule 80 with molded threads unless otherwise specified.
- F. All solvent cementing of plastic pipe and fittings shall be a two-step process, using primer

and solvent cement applied per the manufacturer's recommendations. Cement shall be of a fluid consistency, not gel-like or ropy. Primer and solvent shall be applied to BOTH mating surfaces.

2.05 BACKFLOW PREVENTION UNITS

Backflow unit shall be as shown on the drawings.

2.06 VALVES

- A. Gate valves:
 - (1) Gate valves 2 inches or smaller shall have screwed joints and brass bodies.
 - (2) All gate valves shall have a minimum working pressure of not less than 150 PSI and shall conform to AWWA.
- B. Remote control valves:
Valves shall be as shown on the drawings. Connect the controller in the operating sequence indicated on the drawings.

2.07 VALVE BOXES

- A. Valve boxes shall be fabricated from a durable, weather resistant plastic material, resistant to sunlight and chemical action of soils.
- B. The valve box cover shall be secured with a hidden latch mechanism or bolts.
- C. The cover and box shall be capable of sustaining a load of 1,500 pounds.
- D. Valve box extensions shall be by the same manufacturer as the valve box.
- E. Gate valve boxes shall be round plastic boxes with bolt-down covers marked "GATE VALVE".
- F. Remote control valve boxes shall be rectangular plastic boxes with bolt-down covers marked with the valve identification number stenciled in 2-inch-high letters/numbers using epoxy resin base paint of a contrasting color.

2.08 AUTOMATIC CONTROLLER

Automatic controllers shall be as indicated on the drawings complete with hookup to electrical sources. All controllers shall be enclosed in a vandal-resistant, waterproof enclosure, LeMeur or approved equal, or as shown on the drawings. All wiring from electrical meter to pedestal mount controller to be underground and sleeved through concrete pads.

2.09 ELECTRICAL - PRIMARY

- A. All electrical equipment shall be NEMA Type 3, waterproofed for exterior installations.
- B. All electrical work shall conform to local codes and ordinances. Above ground wires shall be conduit enclosed.

2.10 WIRING - LOW VOLTAGE

- A. Remote control wire shall be direct-burial AWG-UF type, sized according to manufacturer's specifications. A continuous run of wire shall be used between the controller and each remote control valve. NO SPLICES shall be used.
- B. Connections shall be either epoxy-sealed packet-type or Scotch Lock connectors.
- C. Ground wires shall be white in color. Control wires shall be of same color for a given controller. Where more than one controller occupies a single trench, each controller shall have different color control wires.

2.11 SPRINKLER HEADS

Sprinkler heads shall be as indicated on the drawings. Anti-Drain valves (or equal) to be installed as required for elimination of low head drainage.

2.12 IRRIGATION SLEEVES

Irrigation sleeves shall be SCH 40 PVC. Size as required, electrical wiring and pipes to be sleeved separately. Sleeving required under all paved surfaces.

2.13 WATER SAVING SYSTEM

The water saving system shall be as indicated on the drawings. It shall consist of one main component: the rain collection unit.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION

- A. **Water Supply:**
Connections to proposed water meter (meter installation by others) shall be at the location shown on the drawings. Minor changes caused by actual site conditions shall be made at no additional cost to the District.
- B. **Layout:**
Layout irrigation systems and make minor adjustments required due to differences between site and drawings. Where piping is shown on drawings under paved areas, but running parallel and adjacent to planted areas, install the piping in the planted areas.
- C. **Diagrammatic Intent:**
The drawings are essentially diagrammatic. The size and location of equipment and fixtures are drawn to scale where possible. Provide offsets in piping and changes in equipment locations as necessary to conform with structures and to avoid obstructions or conflicts with other work.
- D. **Grades:**
Before starting work, carefully check all grades to determine that work may safely proceed, keeping within the specified material depths with respect to finish grade.

- E. Inspection:
 - (1) Prior to all work of this section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence without conflicts.
 - (2) Verify that the irrigation system may be installed in strict accordance with all pertinent codes and regulations, the original design, the referenced standards, and the various manufacturers' recommendations.
 - (3) Verify PSI prior to any work. Contact Landscape Architect if pressure varies from that indicated on plans.
- F. Discrepancies:

Do not proceed with installation in areas of discrepancy until all discrepancies have been resolved.
- G. Field Measurements:

Make all necessary measurements in the field to ensure precise fit of items in accordance with the original design.

3.02 TRENCHING

- A. Contractor shall notify UNDERGROUND SERVICE ALERT (800) 422-4133 at least two (2) working days before beginning to dig.
- B. Dig trenches and support pipe continuously on bottom of ditch. Lay pipe to an even grade. Trenching excavation shall follow layout indicated on drawings to the depths below finished grade and as noted.
- C. Tree roots shall be protected. Cut no roots over 1/2" diameter. Reroute pipe above or below all roots. Preservation of all roots to take precedence over pipe depth requirement. All trenching to maximize distance from existing mature trees. Hand digging is required where trenching might impact existing tree roots.
- D. Provide minimum cover of 30 inches over pressure supply lines under paved areas.
- E. Provide minimum cover of 18 inches over pressure supply lines 2 1/2 inches and smaller.
- F. Provide minimum cover of 18 inches over control wires.
- G. Provide minimum cover of 12 inches over non-pressure lines.

3.03 BACKFILLING

- A. Initial backfill on all lines shall be of fine granular material with no foreign matter larger than 1/2 inch in size.
- B. Backfill shall be tamped in 4-inch layers under the pipe and uniformly on both sides for the full width of the trench and the full length of the pipe. Materials shall be sufficiently damp to permit thorough compaction, free of voids. Backfill shall be compacted to dry density equal to adjacent undisturbed soil and shall conform to adjacent grades.
- C. Flooding in lieu of tamping is not allowed without specific prior approval.
- D. Under no circumstances shall truck wheels be used to compact soil.

- E. Provide sand backfill a minimum of 6 inches over and under all piping under paved areas.

3.04 PIPING

- A. Piping under existing concrete pavement must be installed in sleeves 2 1/2" x diameter. No hydraulic driving is permitted under asphaltic concrete pavement.
- B. Cutting or breaking of existing pavement is not permitted without written permission from the Owner.
- C. Install pipe with all marking up for visual inspection and verification.
- D. Remove all dented and damaged pipe sections.
- E. Contractor shall install concrete thrust blocking at all changes of direction and terminal points of pressure pipe.
- F. All lines shall have a minimum clearance of 4 inches from each other and 6 inches from lines of other trades.
- G. Parallel lines shall not be installed directly over one another.
- H. Make all joints in strict accordance with the manufacturer's recommended methods; allow solvent welds at least 15 minutes setup time before moving or handling and 24 hours curing time before filling.
- I. All threaded plastic-to-plastic connections shall be assembled using Teflon tape.
- J. For plastic-to-metal connections, use non-hardening pipe dope on all threaded plastic-to-metal connections, except where noted otherwise.
- K. Piping shall be snaked from side to side in trench bottom to allow for expansion and contraction.

3.05 ASSEMBLIES

- A. Install all assemblies specified herein according to the respective detail drawings or specifications, using best standard practice.
- B. Install backflow assemblies in shrub areas and/or adjacent to other hardscape items rather than turf areas, when possible, and at height required by local codes.
- C. Valves shall be installed in shrub areas whenever possible.
- D. Each valve box shall be installed on a foundation of pea gravel, backfill one cubic foot minimum. Valve boxes shall be installed with their tops one inch above the surface of surrounding finish grade in shrub area, and flush with turf areas.

3.06 CONTROLLER

- A. Controller shall be located behind shrubs and/or adjacent to other hardscape items. Maintenance access shall be provided.

- B. The irrigation system shall be programmed to operate during the periods of minimal use of the design area and at time of least evaporation and wind turbulence, generally 2:00 A.M. to 6:00 A.M.
- C. The controller shall be programmed so that each valve operates separately.

3.07 WIRING

- A. Wiring shall occupy the same trench and shall be installed along the same route as the pressure supply lines wherever possible.
- B. Where more than one wire is placed in a trench, the wiring shall be taped together at intervals on 12 feet.
- C. All connections shall be of an approved type and shall occur in a valve box. Provide an 18 inch service loop at each connection.
- D. An expansion loop of 12 inches shall be provided at each wire connection and/or directional turn, and one of 24 inches shall be provided at each remote control valve.
- E. A continuous run of wire shall be used between the controller and each remote control valve. Under no circumstances shall splices be used without prior approval.
- F. Wire running from controller to control valves shall be AWG-UF 600V, No. 14 minimum, solid core, single conductor copper wire, and style Br. (direct burial type).
- G. Spare control wires shall be run to valve box locations as shown on the plans. Provide an 18 inch expansion loop at valve box.

3.08 FLUSHING THE SYSTEM

- A. Prior to installation of sprinkler heads, the valves shall be opened and a full head of water used to flush out the lines and risers.
- B. Sprinkler heads shall be installed after flushing the system has been completed.

3.09 WATER SAVING SYSTEM

- A. The water saving system shall have one rain collection unit connected to the time clock.
- B. The system shall have one or more rain collection units per time clock and one rain collection unit per three designated valves, and will use irrigation wiring.
- C. The rain collection unit shall be wired to the existing solenoid wires, and allow switch of use of time clock wires from power of valve to part of water saving system.
- D. The rain collection unit shall not require any down time field maintenance.

3.10 SPRINKLER HEADS

- A. Sprinkler heads shall be installed as designated on the drawings.

- B. Spacing of heads shall not exceed maximum indicated on the drawings or in manufacturer's directions.
- C. Head height in relation to finish grades shall be as indicated on the drawings at the time of completion.

3.11 ADJUSTING THE SYSTEM

Contractor shall adjust valves, align sprinkler heads of each system to maximize coverage to 100% and minimize overspray prior to planting.

3.12 WIRE SLEEVING

Wire shall be sleeved separately under all hard surfaces at a minimum depth of 18".

3.13 IRRIGATION SLEEVING

- A. Provide minimum cover of eighteen (18) inches on irrigation sleeves to be provided under all paving.
- B. See 3.02 (TRENCHING) and 3.03 (BACKFILLING) for further information.

3.14 COMPLETION CLEANING

Upon completion of work, Contractor shall smooth all ground surfaces; remove excess materials, rubbish, debris, etc.; sweep adjacent streets, curbs, gutters, walkways, and trails; and remove construction equipment from the premises.

SECTION 329000

PLANTING

PART 1 – GENERAL

1.01 Scope of Work

All work shall be performed by a contractor with a C-27 license or greater. Work shall consist of furnishing all materials, services, and equipment necessary to completely install all landscape work as indicated on the drawings and herein specified.

1.02 Inspections and Tests

- A. Inspections shall be performed by a Owner's Representative at the following times. A 48-hour notice shall be given prior to anticipated inspections. Notify City or County of commencement of landscaping- give anticipated timeline from start to finish.

Inspections shall be as follows:

- 1) Upon completion of finished grade, soil preparation and final rake out.
 - 2) When trees and shrubs are spotted for planting, with the examples of planting holes for trees and shrubs.
 - 3) Final Inspection when planting and all other specified work has been completed.
- B. All landscaping, irrigation, and street trees shall be installed and maintained in accordance with Local Codes, Ordinances, and Standard Requirements.
 - C. All landscaping, irrigation, and street trees shall be installed and maintained in accordance with Local Codes, Ordinances, and Standard Requirements.

1.03 Guarantee

- A. All plant materials installed and workmanship performed under the contract shall be guaranteed against any and all poor, inadequate, or inferior materials, and/ or workmanship for a period of 365 days from the date of written final acceptance by an Owner's Representative.
- B. During the guarantee period, any material found to be dead, missing, or in poor condition shall be replaced by the Contractor within 10 days of written notification.
- C. Replacement shall be made in accordance with the original contract drawings and specifications.
- D. Material and labor involved in replacing plant material shall be provided by the Contractor at no additional cost.

1.04 Soils Test

Contractor shall obtain agronomic soils tests covering all planting areas after completion of finish grading and prior to start of soil preparation work. Tests shall be performed by an approved agronomic soils testing laboratory and shall include a fertility and suitability analysis with written recommendations for soil preparation and planting backfill mix. The soils report recommendations shall take precedence over minimum amendment and fertilizer application rates specified herein only when they exceed the specified minimums.

PART 2 – MATERIALS

2.01 Fertilizers, Organic Soil Amendments, and Inorganic Soil Amendments

- A. Fertilizers and soil amendments may include any or all of the specific materials specified herein and shall be applied at the rates indicated on the plans or in Part 2.06, Backfill Material, and Part 3.02, Soil Preparation, herein.
- B. Organic Soil Amendment: Shall be nitrogen fortified redwood or cedar wood shavings and shall contain a minimum of 1% available nitrogen. Material containing manure or pine is unacceptable.
- C. Inorganic Soil Amendment: Shall be agricultural grade iron sulfate.

2.02 Topsoil

All soil imported for backfill or as fill soil (if required) shall meet the following requirements: Backfill or fill soil shall be from a source outside the limits of the project, selected by the Contractor and in compliance with the requirements specified herein. The Contractor shall coordinate with the grading or general contractor in the case of fill soil and submit a written report of a testing agency, per 1.04 Soil Test, registered by the State prior to movement of soil. Soil shall have the same relative composition and structure, a friable sandy loam character, and be free of roots, clods, and stones larger than 1 inch in greatest dimension, pockets of coarse sand, noxious weeds, sticks, brush, and other litter. It shall not be infested with nematodes or other undesirable insects and plant disease organisms. Soil shall meet the following additional requirements:

- A. Gradation Limits. Sand=65%, Silt=25%, Clay=10% maximum. The sand, silt, and clay gradation limits shall be as defined in ASTM D422.
- B. Permeability Rate. Not less than 0.5 inches (13 mm) per hour nor more than 2 inches (51 mm) per hour when tested in accordance with ASTM D2434 or other approved methods.
- C. Agricultural Suitability. The topsoil shall be suitable to sustain the growth of plants specified.

2.03 Seed (if applicable, see legend)

All seed used for lawn and/or ground cover plantings shall be labeled and shall be furnished in sealed standard containers. Seed which has become wet, moldy, or otherwise damaged in transit or storage will not be accepted.

- A. Lawn: Seed mix shall be per plan.
Note: Thoroughly blend seed varieties prior to application.

2.04 Hydromulch Materials (if applicable, see legend)

Water: General precautions should be observed when drawing water from sources other than pressure main. Such water must be free of impurities.

Seed: Seed as specified in 2.03 above.

Mulch: Fiber shall be produced from cellulose such as wood pulp or similar organic material and shall be of such character that it will disperse into a uniform slurry when mixed with water. Materials which inhibit germination or growth shall not be present in the mixture.

Fertilizer: 'Gro-Power' organic fertilizer per 2.01-A, above, or equal.

Binding Agent: Dry powder organic concentrate, Ecology Controls M-Binder or equal.
Available from Robinson Fertilizer Co. (714) 538-3575.

2.05 Plants

All plants shall be true to name, and one of each bundle or lot shall be tagged with the name and size of plants in accordance with the standards of practice recommended by the American Association of Nurserymen, and be No. 1 grade, healthy, disease free, and have no physical damage.

Plant ground cover in areas shown on plans. Ground cover plants (rooted cuttings) shall have been grown in flats, and remain in those flats until transplanting.

All trees and shrubs supplied by Contractor shall be of the specified standard height and diameter set by the American Standard for Nursery Stock. The height of the trees shall be measured from the root crown to the last division of the terminal leader and the diameter shall be measured 6 inches above the crown roots. The trees shall stand erect without support. Root bound material is not acceptable. All plants of like species shall be of uniform height, spread, and form.

2.06 Backfill Material

- A. Topsoil used in the backfill material shall be a loamy, fertile, and friable soil and shall be free of weeds and seed. Topsoil shall conform to Section 2.02, Topsoil, of these specifications.
- B. Backfill material shall be prepared by blending the following materials and shall be used during planting as shown in the planting details:
 - 1) 80% approved topsoil
 - 2) 20% organic soil amendment, nitrogen stabilized (wood shavings)
 - 3) 15 pounds 'Gro-Power Plus' organic fertilizer per cubic yard
 - 4) 'Gro-Power' planting tablets per manufacturer's specifications
- C. 'Gro-Power' planting tablets per manufacturer's specifications

2.07 Headers, Stakes, and Ties

- A. Tree stakes shall be 2" diameter x 10 foot long straight grained treated lodgepole pine.
- B. Tree ties shall be "Cinch Ties" manufactured by V.I.T. Co., Cerritos, California. (714) 871-2309, or equal.
- C. Root barriers shall be manufactured by DeepRoot or equal, depth per plans.
- D. Arbor guards shall be '9" Barkguard Tree Shield', manufactured by Agri Supply, or equal.

PART 3 – EXECUTION

3.01 Landscape Grading

The Contractor shall bring all planting areas to finished grades, filling as needed or removing surplus dirt, removing rocks and debris over 1 inch in diameter, and floating to a smooth uniform grade. All areas shall slope to drain. Flow lines shall be established to existing road curbs and/or a sidewalk as shown on the plans and as directed. Final grade of all turf and ground cover areas shall be 1/2" below adjacent surfaces after establishment.

3.02 Soil Preparation

- A. All landscape mounding, rough grading, and finished grading shall be completed prior to beginning soil preparation.
- B. Soil preparation shall begin with rototilling of all planting areas under grades of 2:1 to a minimum depth of 8" prior to distributing soil amendments.
- C. The following soil amendments shall be added per 1,000 square feet to all planting areas under grades of 2:1:
3 cubic yards nitrogen stabilized organic amendment derived from redwood shavings, fir, or cedar shavings. 200 lbs. organic soil amendment: 'Gro-Power Plus' (5-3-1) organic fertilizer (to be incorporated to a minimum 9" depth following leaching).

3.03 Planting

- A. Planting is not recommended from December through February in all areas and also is not recommended from July through August. The Contractor assumes all responsibility for planting at these times.
- B. Trees and Shrubs:
Plant holes shall be dug to size as indicated in the detail drawings. Before trees are set in the holes, a water test should be made as follows: all plant holes shall be filled to the brim with water and allowed to drain before any planting is done. If water does not drain out of hole within 24 hours, conduct soil test.

Plants shall be planted at such a depth that the crown roots bear the same relative position to finish grade as they did to the soils where they were grown. When Maintenance Period ends and watering basin's earth berms are removed, under no circumstances shall dirt be leveled in a manner which buries crown roots.

Backfill after planting shall be compacted carefully into place without injuring the roots of the tree or breaking up the ball of earth surrounding the roots.
- C. Ground Cover:
Ground cover plants shall be planted in staggered rows, evenly spaced and at intervals called out on the drawings. Each plant shall be planted with its proportionate amount of the flat soil in a manner that will insure a minimum disturbance to the root systems. The cuttings shall be planted sufficiently deep to cover all roots. Root crown should bear the same relationship to soil as it did in the flat. Immediately sprinkle after each planting until entire area is soaked to the full depth of each hole.

D. Mulch: Ground Cover and Shrub Areas

Apply mulch in all ground cover and shrub areas after planting to 3 inch depth of medium bark chips or shavings of sufficient size not to be affected by wind.

3.04 Tree Staking

Stake trees as per planting details. No metal wire shall circle any part of any tree.

3.05 Weed Eradication

- A. Weed Eradication procedures prior to hydroseeding new areas and planting of ground cover areas infested with bermuda grass or other weed infestations:
- 1) Manually remove all existing vegetation completely (grub out roots) unless otherwise shown on the plans and legally dispose of it off-site.
 - 2) Fertilize all planting areas with urea 35-0-0 commercial fertilizer at the rate of .5 lbs. (1/2 lb.) per 1,000 square feet.
 - 3) Water all planting areas thoroughly to a minimum depth of 6" for a period of 2 consecutive weeks to germinate all residual weed seeds.
 - 4) Discontinue watering for 2 consecutive days, then apply a non-selective broad spectrum systemic herbicide per manufacturer's specifications. No water shall be applied for a minimum of 4 days following application of contact weed killer.
 - 5) Allow a sufficient period of time to insure that all weeds are dead and remove.
 - 6) Begin the hydroseeding operations or planting on all areas as specified herein.

All specified materials shall be delivered to the site in the supplier's original unopened containers bearing proper and accurate labeling.

3.06 Hydroseeding

A. Mixing of hydroseed:

Mixing shall be performed in a tank, with a built-in continuous agitation and recirculation system of sufficient operation capacity to produce a homogeneous slurry of fiber, M-binder, seed, fertilizer, and water in the designated unit proportions.

Fiber

Ecology M-Binder

Seed (see plant legend)

Water

'Gro-Power' organic fertilizer

With agitation system operation at part speed, water shall be added to the tank, good recirculation shall be established. Materials shall be added in such a manner that they are uniformly blended into the mixture in the following sequence.

When tank is 1/3 filled with water:

1. Add binding agent - 1/2 acre requirement
2. Add 3 - 50 lb. bales of fiber
3. Add seed- 1/2 acre requirement
4. Add 'Gro-Power' -1/2 acre requirement

Agitate mixture at full speed when the tank is half-filled with water.

Add remainder fiber requirement before tank is 3/4 full, and add remainder seed, M-binder, and 'Gro-Power' per amounts listed above. Slurry distribution should begin immediately.

Area to be hydroseeded shall be moistened to a depth of 6 inches just prior to application.

B. Application:

Hydroseed slurry shall be applied under high pressure evenly and result in a uniform coat on all areas to be treated. Care shall be exercised to assure that plants in place are not subjected to the direct force of an application.

Slurry shall be immediately removed from walks, pavement, structures, and ground cover areas that are inadvertently sprayed.

All bare spots shall be reseeded by the Contractor within 15 days. The Contractor will be responsible for all reseeded areas for as long after seeding as necessary until acceptable germination and establishment is realized.

3.07 Watering

- A. It shall be the Contractor's responsibility to maintain a balanced watering program to ensure proper growth until final acceptance of the work.
- B. Immediately after planting, apply water to each tree, shrub, or vine. Apply water in a moderate stream in the planting hole until the material about the roots is completely saturated from the bottom of the hole to the top of the ground.
- C. Irrigation:
 - 1) Contractor shall properly and completely maintain the irrigation system. A balanced water program shall be maintained to ensure proper growth until final acceptance of the work. Over watering is as unacceptable as under watering.
 - 2) All controllers are to have each station individually adjusted on a monthly basis. System shall be set considering the application rate each area is capable of receiving. The system shall operate on short intervals, with the cycle repeating at a later time to reduce runoff.
 - 3) Controller shall be programmed to operate during time of least evaporation and wind turbulence, generally 2 am to 10 am.

3.08 Maintenance

All areas landscaped by the Contractor under this contract shall be maintained by the Contractor for a period of not less than 90 days from the date of written acceptance for start of maintenance.

- A. Start of maintenance criteria:
 - 1) Maintenance period shall not start until all elements of the project are completed in accordance with the contract documents.

- 2) Power to remote controllers shall be established prior to the beginning of the maintenance period.
 - 3) Written acceptance by the Owner's Representative must be obtained prior to the beginning of the maintenance period.
- B. End of Maintenance:
- 1) On satisfactory completion of the 90 day (minimum) maintenance period, the Owner's Representative will inspect the project for final acceptance.
 - 2) Deficiencies noted during inspection shall extend the maintenance period until all are corrected.
 - 3) End of maintenance shall occur only on written acceptance by the Owner's Representative.
 - 4) Pre-emergent herbicide should be applied at end of maintenance period after hydroseed completes germination in all areas.
- C. During the maintenance period, provide all watering, weeding, fertilizing, cultivation and spraying necessary to keep the plants and turf in a healthy growing condition and to keep the planted areas neat, edged, and attractive. All trees and shrubs shall be pruned as necessary to encourage new growth and eliminate rank sucker growth. All pruning to be per NAA Standards. Old wilted flowers and dead foliage shall be immediately pinched or cut off. Shrubs shall not be sheared
- D. The Contractor shall retain a Certified Arborist to inspect conditions of mature trees impacted by roadway widening. Arborist shall make monthly report to City or County regarding condition of trees during maintenance period.
- E. After planting and during the maintenance period, in the event that trees exhibit iron chlorosis symptoms, apply FE 138 Geigy or equivalent at manufacturer's recommended rates.
- F. Should the appearance of any plant indicate weakness, that plant shall be replaced immediately with a new healthy plant. At the end of the maintenance period, all plant materials shall be in a healthy, growing condition and spaced as indicated on the plans.
- G. Lawns (if applicable) shall be mowed and clippings removed on a weekly basis. Cut lawns at least 2-1/2 inches during warm seasons and reduce to 2 inches during winter or cooler season. Avoid removing more than 1/3 of the leaf area of blade at any one time. Alternate mowing pattern to avoid rutting lawns.
- H. Trim lawn edges (if applicable) adjacent to walks, curbs, paved areas, buildings, shrub and tree areas every two weeks, or more often if needed to maintain a neat and well defined appearance.
- I. Damage to planting areas shall be repaired immediately and throughout the maintenance period.
- J. Remove watering basin's earth berms. Under no circumstances shall the soil be leveled in a manner that buries the plant's crown roots.
- K. Miscellaneous Maintenance Items:

- 1) Depressions caused by vehicles, bicycles, soil settling or foot traffic shall be filled and leveled. Replant damaged areas.
- 2) Exterminate gophers and moles, and repair damage as above.
- 3) The Contractor shall apply 'Gro-Power' organic fertilizer at a rate of 25 pounds per 1,000 square feet, for a minimum of 2 applications. The first application shall be between the 25th and 30th day of the maintenance period and the second application between the 75th and 80th day.
- 4) Debris and trash shall be removed from the site weekly at a minimum.
- 5) Further herbicide applications and hand weeding will be required if major weed infestation occurs, to be at the discretion of the Owner's Representative.

3.09 Disease and Pest Control

Throughout the maintenance period, all plants shall be maintained in a disease and pest free condition. A licensed pest control operator shall be retained by the Contractor to recommend and apply all pesticides, herbicides, and fungicides. All pesticides, herbicides, and fungicides must be reported to the Inspector, with documentation stating which pest and/or fungus was treated. Report quantity of materials used in gallons or ounces.

3.10 Clean Up

Upon completion of the work, the Contractor shall smooth all ground surfaces, remove excess materials, rubbish, debris, etc.; sweep adjacent streets, curbs, gutters, walkways, and trails, and remove construction equipment from the premises.

END OF SECTION